FISHING AT GWAIMASI:
THE INTERACTION OF SOCIAL AND ECOLOGICAL FACTORS IN INFLUENCING SUBSISTENCE BEHAVIOUR

by

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The research presented in this treatise is, to the best of my knowledge, original and my own work except as acknowledged in the text. The material has not been submitted, in whole or in part, for a degree at this or any other university

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ABSTRACT

Fishing at Gwaimasi:
the interaction of social and ecological factors
in influencing subsistence behaviour

This treatise describes fishing behaviour of people living at the village of Gwaimasi in the interior lowlands of Papua New Guinea. The concern is not with fishing as such but with the way in which social and ecological factors interact to influence behaviour. I argue that an adequate explanation for behaviour must incorporate both dimensions, and suggest a conceptual basis for achieving this. The study then illustrates how at least one aspect of social organization, the size of resource-sharing groups, could be incorporated within a frame of analysis - evolutionary ecology - that has typically focussed on the explanatory significance of ecological factors.

The primary thesis asserts that the probability of a particular pattern of behaviour being reproduced depends on both social and ecological factors. Variation in either domain can be expected to affect the kinds of behaviour observed, but the two domains do not affect behaviour in the same way. Ecological factors constrain production, the material outcome of action; social factors constrain consumption, the use that can be made of that outcome. The two domains are complementary, not contradictory, in their influence; in as much as production and consumption themselves are two facets of any action, ecology and society should be seen as mutually constitutive systems mediated by the actor.

Evolutionary ecologists have tended to analyse constraints on production, particularly extrinsic constraints on production, in explaining behavioural variability. While constraints on consumption are not ignored, they are usually discussed only in terms of the intrinsic requirements of the actor. I argue that consumption, like production, is subject to extrinsic constraints; the use that an individual can make of a particular outcome of action may depend on the actions of others. In particular, where a resource has declining marginal value, the amount that is likely to be received from others will limit the amount that an individual can usefully procure; as a corollary, the

expectation of having to distribute produce among others will increase the amount that can be usefully procured. In each case, the effect will depend on the size of the resource-sharing group.

These arguments are illustrated by analyses of the fishing behaviour of people at Gwaimasi over a period of 57 weeks. Early chapters set the scene for those analyses, introduce the actors and position fishing within their broader subsistence arrangements. The community was small and isolated, the people hunter-horticulturalists using about 50km^2 for subsistence. Skulls of nearly all fish caught within that area during the survey were purchased, and details recorded of fisher, technique, location and context of capture. In addition, records were kept of where individuals were based within the local area each day. Analyses of these data indicate that whether people chose to fish, as well as where and how they fished, depended on both the outcome that could be expected from the decision and the use that could be made of the outcome. Availability and accessibility of fish placed extrinsic constraints on production and, allowing for the relative time required to reach different fishing locations, people clearly preferred those streams and techniques that produced the largest hauls. But individual fishers differed in their intrinsic abilities to procure fish and in the use that they could make of fish. Differences in access to equipment, experience or information affected the viability and efficiency of fishing techniques. Differences in nutritional and social requirements affected the need for fish. Thus, men and women, people at different life-history stages, and those affiliated with different clan groups displayed rather different fishing behaviour, with the contingencies of heredity and experience adding a further layer of variation crosscutting these structural categories. Most importantly, the size of the resource-sharing group at the village, which changed as residents moved about and beyond the local subsistence zone, placed extrinsic constraints on consumption of fish. As the size of the group changed, and with it the amount of fish which could usefully be produced, fishing behaviour changed markedly.

The study demonstrates clearly that social factors, as well as ecological factors, can influence patterns of production; both domains must be considered in any adequate explanation of behaviour. It is also clear that the emphasis which evolutionary ecology has placed on production, and on factors affecting the material outcome of production as the basis of explanation, is not inherent in its methodology. I have demonstrated that that methodology is entirely appropriate to the study of social constraints on behaviour.

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ACKNOWLEDGEMENTS

The research presented in this treatise would not have been possible without the encouragement, advice and support of Peter Dwyer. The data analysed in the study were originally collected under his aegis, when I accompanied him to Gwaimasi in 1986-87.

The people of Gwaimasi and beyond, whose efforts provided the data, cared for us through our time in the field; their exhuberance, and often-amused tolerance of our struggles with language, custom and the art of staying upright in swamps, made it a memorable time. Tufa and Hegogwa, in particular, did their best to interpret for others our apparently puzzling interest in food scraps. Simo and Bowa, with a warmth of understanding that defied language barriers, guided us through much of the social life of the village.

Life in the field depends greatly on those out of it. The Institute of Papua New Guinea Studies negotiated permission for research both in 1986-87, when Peter Dwyer was affiliated with the Biology Department of the University of Papua New Guinea, and on a later trip in 1991, when both Peter and I were affiliated with the Papua New Guinea Museum and Art Gallery. I thank both the Government of Papua New Guinea, and the administration of the North Fly Region of Western Province, for their approval of the research. Dick Morton and Mark Busse greatly facilitated communication with all these institutions, and James Menzies organized accomodation in Port Moresby. John and Celia Fletcher, of Suabi, provided us with a line of communication while we were at Gwaimasi, organizing mail and supplementary supplies as we needed them. Vance and Patty Woodyard, of Dahamo, heard rumours of our need at one stage and, though we had not yet met, sent an unexpected but much appreciated food parcel. Jeffery Willmer visited Gwaimasi for a month, took many photographs that were better than our own, and provided essential supplies and support from Australia after he left. My father and mother, Matt and Jeanne Minnegal, my brother Joe and Leann Minnegal, and Su Solomon helped in different ways while we lived at Gwaimasi.

Back in Australia, Neil Gribble entered the fish data onto computer, and calculated the initial regressions which provided the basis for inferring fish weights. Dr P. Kailola, then of the Zoology Department, University of Adelaide, Dr G.R. Allen of the Western Australian Museum and R.J McKay of the Queensland Museum provided scientific identifications of Kubo fish taxa.

Harry Lourandos and Nancy Williams, my supervisors in the Department of Anthropology and Sociology, maintained confidence in my performance, despite their discomfort with the general frame in which I chose to operate. Others in the department, too, offered support, particularly Judy Bieg who, as always, saw the need for encouragement and assistance before it was requested and often facilitated communication with others. Writing a thesis can be an isolating business; I thank Bruno David and Lesley Jolly for making it a little less so.

And for Peter, my love.

A Note on Pronunciation

The people at Gwaimasi were Kubo, speaking a tonal and nasal language the subtleties of which were beyond my linguistic abilities. Kubo words and phrases used in this treatise are presented as approximations only.

a: as *a* in f*a*ther
e: as *e* in b*e*t
i: as *ee* in b*ee*
o: as *au* in c*au*ght
sometimes *oa* as in c*oa*t, especially when at the end of a word; where the *oa* sound was particularly strong and nasalized I have distinguished it as *ō*
u: as *oo* in sh*oo*t
sometimes *oo* as in b*oo*k
ai: as *eye*
au: as *ow* in c*ow*
ei: as *ay* in s*ay*

Nasalized vowels have been underlined.

PROLOGUE

The origin of the work reported here is to be found in Honours research that I undertook some years ago. That research concerned archaeological evidence for patterns of butchering and consumption of the large marine mammal *Dugong dugon* by people at Princess Charlotte Bay, on the east coast of Cape York Peninsula in Australia (Minnegal 1982, 1984a,b; Cribb & Minnegal 1989). The focus on butchering and consumption meant leaving to one side any questions to do with the people's decision to hunt dugong in the first place. Some observations, however, were hard to ignore.

Dugong are big. At 200-300 kg they were ten times the size of local macropods (wallabies and kangaroos), the largest of alternative prey items in the Princess Charlotte Bay area. While much effort may have been entailed in catching dugong - a canoe was needed, as well as the people to man it, and perhaps three or more days of searching - a lot of kangaroos would need to be caught in that time to produce the same amount of meat. It did not seem surprising, then, to find that dugong were a highly regarded resource for the people of Princess Charlotte Bay. It clearly made economic sense to pursue them.

And yet, on the west coast of Cape York Peninsula, people did not hunt dugong. Dugong were available in good numbers, the people had access to watercraft and suitable hunting technology, but these large and - in terms of amount of meat obtained for effort expended - highly profitable prey were ignored. To accept that these people, also, were economically efficient posed a problem. Either the returns from alternative foraging options were sufficiently great on the west coast that dugong-hunting was outranked, or the productivity of dugong hunting itself was less than along the east coast. The magnitude of the size-differential between dugong and local macropods made the former possibility unlikely. Equally, however, since availability and accessibility of dugong appeared to be similar at the two locations it was hard to see why productivity should have varied.

While contemplating this conundrum, another possibility occurred to me, one - stimulated perhaps by my analytical focus on distribution and consumption - that took me back to my starting point. Dugong ARE big. And north Queensland is hot; meat cannot be kept for more than two or three days before beginning to putrefy. With 100 kg to be consumed per day, it would take a lot of people to eat an entire dugong.

The implication is important. The value of obtaining a dugong - or a kangaroo - does not depend on the amount of meat that the animal comprises. It depends, rather, on the amount of the meat that can be used. The former is intrinsic. The latter is not; it may vary with, among other things, the size of the group that shares the catch. To a group of people that can eat only 30 kg in one day a dugong may not, in fact, be much more valuable than a kangaroo, particularly given the effort entailed in capture of the former. For such a group it actually might not make sense to spend time chasing dugong.

The productivity of dugong-hunting may indeed have been lower in the west, not because of any change in the availability or accessibility of dugong themselves, but because of the relative use that could be made of the meat. Differences in attitudes to dugong in the two areas could be traced, perhaps, to a simple difference in social organization - in, for example, the size of residence groups or sharing networks.

In fact, the west coast of Cape York Peninsula is not the same as the east; they are markedly different habitats. And there are other possible explanations - both cultural and ecological - for the fact that west coast people did not hunt dugong. Social organization will have been only one among many factors mediating resource-choice in the two areas.

But I continued to be intrigued by the realization that constraints on consumption, and not merely on production, might directly affect the appropriateness of procurement strategies. While ecological factors may determine the material outcome of subsistence behaviour, it is social factors that determine the use that can be made of that outcome. Variation in behaviour could arise from changes in either.

To explore these ideas I sought data that offered greater potential for analysis than the available or accessible Cape York Peninsula material. The effects on behaviour of variation in either ecological or social factors needed to be analysed by holding first one, and then the other, constant. I turned to smaller quarry - to fish rather than dugong - and to Papua New Guinea rather than Cape York Peninsula. The data obtained provide the subject matter for the work described in this treatise.

CHAPTER 1
INTRODUCTION

This treatise describes the fishing behaviour of people living at the village of Gwaimasi in the interior lowlands of Papua New Guinea, and analyses social and ecological factors underlying observed patterns. In doing so, it focuses on a minor component of the subsistence of a small group of people; only 25 people lived at Gwaimasi in 1986-87 when my data were collected, and fishing provided no more than one quarter of the meat they consumed. The limited scope is deliberate. My interest is not so much with fishing *per se* as with the ways in which ecological and social systems interact to influence patterns of subsistence behaviour. I wished to explore the possibility of incorporating aspects of social organization, in particular the size of resource-sharing groups, within a frame of analysis - evolutionary ecology - that has typically focussed on the explanatory significance of ecological factors. The study of fishing behaviour at Gwaimasi, precisely because it was limited in both scale and in importance of the activity within the overall subsistence system, seemed particularly suited to the task.

The first section of this chapter establishes my interpretation of the relationship between ecology and society, and positions this within earlier conceptualizations. The second section introduces evolutionary ecology as an approach to the understanding of behaviour; I focus particularly on the logic of the approach, showing how functional explanation need not imply unidirectional causality. These two sections are then drawn together to frame the thesis that informs this work. Ecological effects on behaviour have been extensively modelled in the past, so section three is primarily concerned with establishing ways to model the effect of variation in social relations.

Having established a conceptual and methodological frame, I turn to the subject matter of the study, fishing at Gwaimasi. The fourth section begins by discussing practical considerations that influenced this choice of subject, and the particular intentions of the study. Fishing has often been considered as quite different from other extractive activities. I go on to consider why this might be so, and address the implications for analysis of fishing at Gwaimasi. Though there have been many studies of fishing in small-scale communities, few match the ecological and social situation found at Gwaimasi.

Perhaps more importantly, none address the general issues that concern me in this work; they tend to ignore the interplay between ecological and social factors to focus on one or the other as causal.

Finally, I outline the organization of data and arguments to be presented in subsequent chapters.

1.1 CONCEPTUAL FRAME: ENVIRONMENT, ECOLOGY AND SOCIETY

> "If the environment of an animal includes its conspecifics, how - if at all - can we distinguish between its social relations and its ecological relations?" (Ingold 1986a:3-4).

An ecological system, according to classical definitions, comprises the inter-relationships between an organism and all the elements of its environment (Krebs 1972:3; Odum 1975:1-4; Smith 1986:3). A social system, on the other hand, comprises relationships between organisms of the same species. Since conspecifics can be considered part of the environment of any individual it might seem that social relations are simply a subset of a broader category of ecological relations.

But anthropologists do not use the terms in this way. They seem, rather, to contrast ecological and social relations as alternative bases for the explanation of human behaviour. At the least, these are seen as distinct contributors to the formulation of behaviour. Borgerhoff Mulder (1991:69), for example, stated that "the aim of modern human behavioural ecology is to determine how ecological *and social* factors affect behavioural variability within and between populations" [my emphasis]. I myself have argued that the connections between hunting and sago processing by Kubo of Papua New Guinea have "social as well as ecological dimensions" (Dwyer & Minnegal 1991a:210). In another analysis that focussed on gardening, I went further, to conclude that "the social and the ecological are undoubtedly synergistically related but, in the Kubo case, the former must take precedence in the explanation of local patterns of food production" (Dwyer & Minnegal 1992a:50). Similar statements are common, both in discussions of general (global) human behaviour (eg. Ellen 1982:Ch.11; Ingold 1991a; Janson 1992:126) and in analyses of specific (local) situations (eg. Evans-Pritchard 1940:94; Gell 1992:16;

Healey 1990:Ch.8; Morren 1986:158; Povinelli 1992:197). Most of these statements, however, including those with which I have been associated, fail to clearly establish the referents of the terms social and ecological, or the supposed relationship between them.

In some cases the boundary drawn between the social and the ecological appears simply to distinguish interactions with conspecifics from those with other elements, living and non-living, in the environment; the meaning of 'ecology' is thus narrowed from its original sweeping intent.[1] A distinction based simply on the identity of the interacting elements, however, while perhaps useful for organizing information, is arbitrary and contributes nothing, in itself, to explanation. If there is a relevant distinction to be drawn between the social and the ecological - and the persistence of the terms in the literature suggests that there is - then it must be in the nature of relationships.

My central concern in this work is with ways in which "ecological and social systems interact to influence patterns of subsistence behaviour" (p. 3). The existence of analytically distinct systems, and the assertion that they articulate, is the underlying conceptual framework of all that follows. It is essential, therefore, that I state what I mean by these terms, at least for the purposes of the work presented here, and locate my meanings within the often confusing and contradictory anthropological discourse in the area (eg. Bloch 1975; Ellen 1982; Faris 1975; Friedman 1974; Friedman & Rowland 1978; Godelier 1978; Harris 1968, 1979; Ingold 1986a,b, 1991a, 1992; Leacock & Lee 1982; Meillassoux 1972; Sahlins 1974, 1976a; Steward 1955). I do so in what follows, and return to the theme in the concluding chapter.

In the first instance, I regard the distinction between ecological and social relationships as mapping onto the classic, and perhaps less ambiguous, distinction between production and consumption. Thus, ecological relations determine the material outcome of any action; social relations determine the use that can be made of that outcome.[2] But this is a rather tight definition. The implications warrant some justification and elaboration.

The material outcome of any subsistence activity will depend on patterns in the

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[1] As Ellen (1982:90) noted, the word 'ecology' is often used in anthropology where 'natural environment' would be more appropriate.

[2] The following discussion relates specifically to subsistence activities. However, since all relationships entail exchange, the comments should be generally applicable.

distribution and abundance of resources within the environment, and on the means available to procure those resources. These comprise the generally recognised domain of ecological interaction. Conspecifics, too, may be considered resources - not as food, perhaps, but as potential mates, or allies - or may comprise the means of procuring resources, through their labour or through trade. To this extent intraspecific relations may be considered ecological.

The use that can be made of an outcome will depend on the availability of potential consumers, and on their need for the product; it is not intrinsic to the resource itself. Patterns of distribution and exchange comprise the generally recognised domain of social interaction. It is the potential for use, as mediated by social organization, that ultimately determines the value of procuring any resource. Intraspecific relations may be considered as social where their impress is on the use-value attached to procured resources.

Production and consumption are not independent processes. Any acquisition of resources - whether matter, energy or information - entails utilization of resources already to hand. Indeed, utilization itself cannot be defined except in terms of resources acquired as a result; an item is 'used to' achieve some end. Perhaps more confusingly, any transfer of goods between conspecifics comprises simultaneous acquisition by one and utilization by the other. Not surprisingly, then, the two have been often conflated. But, from the perspective of the actor, the processes are logically distinct.

The distinction, stated simply and, again, from the perspective of the individual, is temporal - not in the sense that production precedes consumption, but in the sense of transition and passage.[3] Production entails a movement of resources - matter, energy, information - towards the actor, while consumption entails a movement of resources away from the actor. Because production logically precedes consumption, there has been a tendency on the part of ecologists to accord it causal priority. This is unjustified. Clearly, constraints on outward movement, on consumption, could affect the flow of goods as effectively as any constraint on production.

Ecological and social relationships - affected by and, in turn, affecting patterns of

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[3] See Gell's (1992:Ch.16) discussion of the distinction in philosophy between A-series time (past/present/future) and B-series time (before/after). "The A-series incorporates the idea of transition or 'passage' - things being arranged in one way and then becoming arranged in some other way" (*ibid*:151).

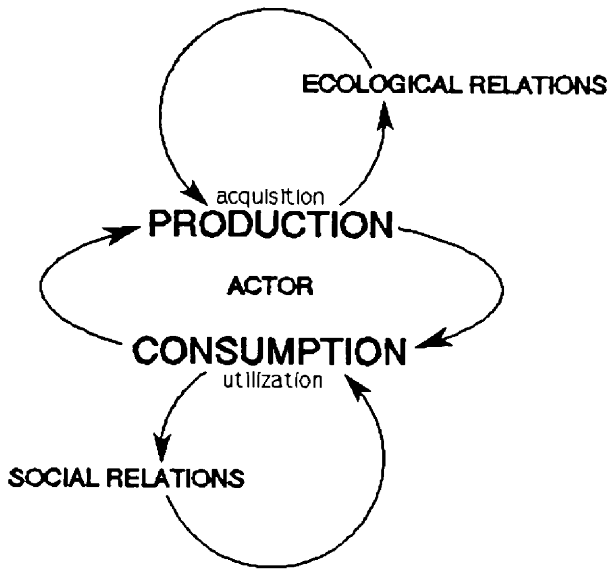

Figure 1 Inter-relationship of ecological and social systems, through patterns of production and consumption.

production and consumption respectively (Figure 1), must be seen as mutually constitutive systems, articulated through the person of the actor.

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Having separated ecology and society as distinct forms of relationship, I am left with the question of "how one might influence the other, and how we might measure and compare different entities or sets of relations" (Ellen 1991:150). It is an issue that Ellen saw as "the major problematic" of ecological anthropology (*ibid*) and one, he argued, that is rarely, and then inadequately, addressed. Clearly, it is to the relationship between production and consumption - between acquisition and utilization - that we must look if ecological and social relations are to be reintegrated in discussion of concrete examples.

It was the sense of purpose inherent in utilization that Ingold acknowledged when he argued that "the boundary between the social and the ecological corresponds to that between the intentional and the behavioural components of action, marking the point - in human life - where purpose takes over from, and proceeds to direct, the mechanism of nature" (1991a:285). Behaviour in the ecological domain, he argued, can be understood only in terms of the socially constituted purpose that motivates it. Thus "sharing does not come into play at the *end* of production, but rather constitutes the common purpose that people *bring into* the productive process itself" (*ibid*:283; italics in original). Social relations, in this view, determine "both the responsibilities taken into procurement activity and the manner of distribution of the products" (*ibid*). Thus Ingold envisaged the social and the ecological domains as coextensive, each interaction - interspecific as well as intraspecific - having both social and ecological aspects; the former he conceived of as action, the latter as reaction.

There is much that I like in Ingold's conceptualization, but his appeal to conscious intent is unnecessary.[4] To the extent that the intent is derived from pre-existing conditions, as Ingold asserted, it does not differ from unconscious teleonomic processes (Mayr 1988:Ch 3; see also discussion in Smith & Winterhalder 1992a:47ff); the purpose brought into production is programmed, as distinct from teleological or goal-directed purpose. I would argue that it is not socially constituted purpose that guides production but, rather, the socially constituted use-value of resources.

What Ingold appears to have overlooked, or put aside, is the requirement that the pre-existing conditions which determine use-value - social relationships and the associated patterns of distribution and consumption - must be themselves explained.[5]

The idea that value is socially constructed is not new. Ellen (1982:253), for example, following Sahlins (1974:150ff), argued that "values arise out of cultural arrangements internal to social organization and cannot emerge independently from objects". Resources, in themselves, have no value; what value there may be in their procurement is realized only in their consumption, their utilization.[6] Thus, I accept that the value of a subsistence decision cannot be reduced to the physical properties of the

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[4] That appeal reflects, perhaps, Ingold's deeper concern to identify the fundamental distinction between humans and other animals.

[5] Ingold is engaged in an exploration of these issues and, as he himself has noted, his published understanding changes through time (Ingold 1986a:13). This makes reference to, and criticism of, his ideas somewhat problematic. He presents a moving target. His recent writings (eg. Ingold 1992) do appear to recognize that value is "mutually constituted" by ecological and social relations. My concern, here, is with influential arguments presented in certain publications, not with an overall characterization of Ingold's thought.

[6] Value does not inhere in services any more than in objects. A service economy may be conceptualized as based on exchange of labour rather than of the products of labour (Collier & Rosaldo 1981; Merlan 1991; Sansom 1988). The value of the exchange, however, still resides in the use that can be made of the outcome, not in the labour or products themselves. Indeed, both may be read as resources.

product. Nor, however, is use-value purely symbolic, a culturally constructed concept of use arbitrarily assigned to a resource. It is to this view of value as semiotic transformation that ecologists from Steward onwards have responded when they decry the futility of "explaining culture in terms of culture" (Steward 1955:36; Harris 1968; Winterhalder & Smith 1992:20). They argue, as indeed do I, that value is constituted in action, not in thought.

But 'value' is a contentious term in anthropology. It has been dissected in many ways, and into many parts. Thus Sahlins (1974:218) wrote "food has too much social value - ultimately because it has too much use value - to have exchange value". Such statements defy translation. I define value only in terms of use; exchange of a resource itself implies use, for maintenance of social relations if nothing else.

The possibility of exchange may well increase the potential use-value of a resource. Exchange, however, will not necessarily remove all limits on the value of procuring the resource, and encourage unlimited production, as Sahlins (1974:84) suggested.[7] Indeed, exchange itself, I assert, can be understood only in terms of an asymmetry in the potential use-value of resources to the participants. Sahlins referred to this asymmetry when he argued that donors bring labour value to an exchange, while recipients assess use value (1974:307).[8]

Labour-value, in contrast to use-value, is an ecological construct; the labour required to produce a particular outcome will reflect the availability and accessibility of resources. It is best conceived, in my opinion, in terms of the potential use-value forgone - as an opportunity lost - by not using the labour in some other way.

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If ecological interactions and social interactions are to be incorporated within the one explanatory frame then it is essential that they be conceptualized in compatible terms. That has been the failure of much anthropological discussion and has been the aim of my

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[7] See p.27 for further discussion.

[8] Ellen (1982:254) asserted that social formations are systems in which "value is exchanged" as distinct from the material exchanges of ecological interaction. The reification of 'value' implicit in this statement can be understood only as a consequence of Ellen's focus on population-level phenomena; from the perspective of the individual, it is meaningless. Value is realized in the process of exchange - it is not transferred.

attempt at definition. The social cannot simply be derived from ecological relations, but the reverse is equally unsatisfactory. Appeals to conscious intent raise more questions than they answer; the intent itself must be explained. Appeals to symbolic and semiotic domains generate similar problems. These perspectives have their place but, like the materialist perspectives to which they are often opposed, their underlying conceptualizations are firmly grounded on one side of the ecology/society interface and cannot be easily extended to the other. My concern in this work is with the way ecology and society **interact** to influence behaviour, and the interpretations I have presented reflect this broader focus. My analysis is grounded in the opinion that, ultimately, use determines value and use offers the only pragmatic basis for representing social relations as distinct from, yet not independent of, ecological relations.

The focus throughout this brief account of the conceptual underpinnings of my research has been with individual actors - as producers and as consumers, as social beings engaged in ecological action. It is this focus that influences my choice of a methodological framework suited to the analysis of relations between the material outcome of activities and the value of that outcome to the actor. That framework is evolutionary ecology.

1.2 METHODOLOGICAL FRAME: EVOLUTIONARY ECOLOGY

The ideas that inform analysis in this thesis are developed within the frame of evolutionary ecology, though I will not - except in parts of this introductory chapter - use the explicit modelling approach advocated by many practitioners. Evolutionary ecology interprets variation in the form of living organisms - morphological, physiological and behavioural[9] - in terms of natural selection[10] operating within ecological contexts. In the

[9] Where the focus is on behaviour, as in the present work, the term 'behavioural ecology' is often used (eg. Krebs & Davies 1987, 1991). If the particular behaviours being examined entail interactions between conspecifics then studies may be characterised as 'socioecology' (eg. Standen & Foley 1989). I prefer to use the more general term, with its explicit acknowledgement of the evolutionary frame within which explanation is positioned.

[10] For many people, the term 'natural selection' has connotations of genetic determinism. This is not my intent here. Natural selection does not necessarily entail the

last decade or so, there has been increasing interest by some anthropologists in the potential of evolutionary ecology as an approach to understanding human behaviour (for reviews see Borgerhoff Mulder 1991; Cronk 1991; Smith 1992a,b; earlier reviews include Foley 1985; Martin 1983; Smith 1983; Winterhalder & Smith 1981). The theoretical and methodological assumptions that underlie use of the approach have been discussed in detail in several recent publications.[11] Here, I provide only a brief overview of the nature of explanation within evolutionary ecology, and a discussion of the implications for the way I approach explanation of fishing at Gwaimasi.

1.2.1 **Functional explanation**

Evolutionary ecology explains behaviour in terms of its consequences rather than in terms of its causes or motivations. As such, it falls within a long-established - and often criticised - tradition of functionalist explanation within anthropology (see reviews, and critiques, in Ellen 1982; Hardesty 1977; Jochim 1981; Orlove 1980; E.Smith 1981, 1991a). This mode of explanation begins with the recognition that the outcome of any action, through its consequences for the actor, may affect the probability of that action being repeated (for further discussion see Elster 1983:57ff; Smith & Winterhalder 1992a:42-3).

Any act, of course, may have wide-ranging consequences, and much of the past difficulty with functionalist explanation has concerned identification of relevant effects. For the most part, the problem reflects a failure to clearly specify a mechanism through

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existence of genes; it entails only the existence of replicators, variation in the form of those replicators, and a degree of error in replication itself, to allow generation of new variants (Dawkins 1982; Maynard Smith 1987; see 1.2.2). Genetic reproduction is but one of the systems that fulfil these requirements.

[11] See especially papers in Dupré (1987), Krebs & Davies (1991) and Smith & Winterhalder (1992b), and the book by Stephens & Krebs (1986). I find Beatty (1980) one of the simplest statements of the underlying logic, at least of optimality theory. The introductory chapters in Smith (1991a) and in Smith & Winterhalder (1992b) are expressly framed in relation to anthropological concerns, but also present perhaps the most careful and comprehensive discussion of the general concepts of evolutionary ecology. Their care may reflect the need to counter the discomfort felt by many anthropologists when encountering the language of evolution (a discomfort based in the past misuse of such language within anthropology to refer to developmental - not evolutionary - models of human history), by clearly laying out all implications.

which outcomes may influence future patterns of behaviour. With no prior understanding of process, researchers are left with little option; they must explain the repetition of behaviour in terms of effects maintaining conditions that produced the original behaviour. It is the lack of attention to process, rather than any intrinsic constraint of functionalist explanation, that has led to the justifiably criticised emphasis on *post hoc* homeostatic models in much ecological analysis.[12] As Elster (1983:21) noted, functional explanation is not complete in itself; it relies for its validation on an underlying causal explanation. It is in the provision of such a causal mechanism - in terms of natural selection - that evolutionary ecology differs from earlier approaches to functionalist explanation of human behaviour. That mechanism shifts the emphasis of investigation to the relative outcomes offered by alternative modes of behaviour, rather than the possible functions of a particular mode of behaviour (see discussions in Winterhalder 1981a:14-5; Winterhalder & Smith 1992:6-7).

1.2.2 **Selection**

The concept of natural selection, as it applies to behaviour, is based on three simple observations:

- individuals vary in their behaviour, as they do in morphology and physiology;
- patterns of behaviour can be transmitted from one individual to another, perhaps through genes but certainly through learning; and
- some patterns of behaviour are more likely to be transmitted, to be reproduced, than others.

Evolutionary ecologists go on to argue that the patterns of behaviour observed in any situation can be explained in terms of this differential reproduction. 'Natural selection' refers to the process by which those variants most likely to be reproduced in the given

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[12] Jochim's (1981:28ff) critique of the use of functionalist explanations in anthropology followed similar lines. He sought a mechanism in psychological processes of reinforcement - but failed to recognise that the logic of his explanations remained functionalist - ie., the outcome of behaviour determines the probability that it will recur. Operant conditioning, as described by Jochim, may provide a mechanism for the expression of conditional strategies and, recently, several evolutionary ecologists have expressed interest in the role of such mechanisms (eg. Krebs & Davies 1991:x; Crook 1989). Ultimately, however, it remains necessary to explain why a particular effect of behaviour is responded to as reinforcement or deterrent in the first place.

circumstances - those that are 'fittest', to use the technical term - increase their proportional representation through time, eventually replacing others.

I have not specified a mechanism by which behaviour is reproduced. (Nor, for that matter, did Darwin when he first outlined the idea of natural selection.) In fact, evolutionary ecologists usually do not concern themselves with this matter. They analyse behaviour *as though* it is transmitted by simple genetic processes, but are well aware that this is unlikely to be the case in even the simplest of behavioural systems. Certainly, the phenotypic traits (including behaviour) that form the focus of ecological analysis are not controlled by single genes; rather, their expression is the result of a complex interplay between environment and genes. Nevertheless, evolutionary ecology routinely models variation in such traits as though they are controlled by single genes. This 'phenotypic gambit' (Grafen 1991; see Lloyd 1977; Maynard Smith 1982; Smith & Winterhalder 1992a:33-4) is an analytical strategy, based on the assumption that selective forces will ultimately produce the same effect irrespective of the mechanisms of transmission operating.

Whether cultural transmission of behaviour - the propensity for which is presumably itself the result of genetic evolution - will result in deviation from optima favoured by genetic selection remains a moot point (see Boyd & Richerson 1985; Durham 1990, 1992; Goldschmidt 1993; Richerson & Boyd 1992; Smith 1991a:13-24). That such transmission (or adoption) is itself selective, however, seems clear. As Smith (1991a:23) notes, subsistence behaviour - the focus of this thesis - is most likely to be learned from parents or other close relatives. The assumption that selection of subsistence strategies will resemble that resulting from genetic inheritance is thus reasonable.

The use of a simplified genetic model leads to two significant methodological assumptions that characterize applications of evolutionary ecology.

(a) **Methodological individualism**. Selection acts at the level of the individual, not of the group or population. Patterns of action, therefore, must be understood in terms of their implications for the actor.[13] More specifically, differential reproduction

[13] More generally, 'methodological individualism' holds that the properties of groups (eg. populations, societies, economies) are the result of the actions of their individual members; consequently, they can best be analysed in terms of those actions (see discussions in Smith & Winterhalder 1992a; Smith 1991a). This assumption has provided

of behaviours must be explained in terms of their relative consequences for survival and reproduction of the actors.

(b) **Behavioural strategies**. Selection will ensure that, in all circumstances, actors are most likely to choose the behavioural option that best enhances reproduction. Consequently, behaviour can be modelled in the form of 'decision rules' or 'conditional strategies' (ie. "if the environment or payoff matrix looks like *x*, then do *y*"; Smith 1991a:10). Analyses assume that it is these strategies that are the subject of selection.

1.2.3 **Models**

The outcome of any behavioural strategy, however measured, depends on the context in which it is used. It is thus to context that evolutionary ecologists turn for explanations of variation in behaviour, both within and between populations. They seek to identify the proximate variables that influence the fitness value of one behavioural strategy relative to others.

Relationships between variables can be identified through a search for correlations, an inductive research strategy that makes no assumptions about process. Much ecological research in anthropology has relied on this approach and the use of *post hoc* explanations to accommodate observed relationships (see critiques in Ellen 1982; Jochim 1981; Smith 1991a). Evolutionary ecology, however, presupposes, in natural selection, an *a priori* mechanism underlying relationships. It then deduces the form that relationships could be expected to take given a postulated understanding of circumstances, and tests that understanding by comparison of predicted and observed patterns of variation. This hypothetico-deductive research strategy is seen, by most practitioners (eg. Krebs & Kacelnik 1991:106-7; Smith 1991a:8-10; Winterhalder & Smith 1992:11ff), as the great strength of evolutionary ecology. Certainly, it allows the identification of relationships that are not intuitively obvious, and that even may be counter-intuitive.

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the basis for much economic and social analysis (eg. Boone 1992; Hardin 1982; Heath 1976; Peoples 1982; Roemer 1982; Vayda 1986). Such analyses often further assume that actions are the result of rational choice by the actor, and must be understood in terms of the self-interests of the actor. These latter assumptions, however, are not necessarily entailed by methodological individualism.

The application of evolutionary ecology to interpretation of a given behavioural phenomenon entails identification of three kinds of variable[14]:

(a) **Strategy set** - the behavioural variable to be examined, and all the possible states that the variable could take. In the case of prey choice - one of the most common models used in evolutionary ecology, and of relevance to my concerns in this study - the strategy set comprises all the possible combinations of prey types that an individual might include in its diet. These possible strategies, then, provide the variation on which natural selection would act.

(b) **Currency** - a variable in the material outcome of behaviour that is used to calculate the relative success of a given strategy. Ultimately, the success of a strategy must be defined in terms of resultant changes in the relative frequency of that particular pattern of behaviour through time. Changes in frequency, however, can be measured only after the fact, and this raises major issues concerning the temporal scale of measurement. Evolutionary ecologists thus define factors that they consider affect propensity for differential reproduction of behaviour, and measure variation in these as an index of - a currency for - fitness. Many analyses concerning subsistence behaviour assume simply that, all else being equal, the relative fitness of a behavioural option - the relative probability that it will be reproduced - will be a function of the consequent time and energy available to invest in other fitness-enhancing activities; thus, energetic efficiency can be taken as a currency for fitness when comparing behavioural strategies (see discussions in Smith 1991a:45-52; Stephens & Krebs 1986:14-17; Winterhalder 1981a:20-22). This argument would hold whether the crucial activities are considered to be those affecting individual survival and reproduction or those of the culturally defined domains of political and economic competition.[15]

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[14] For other summaries of the components of models in evolutionary ecology, and more detailed discussion, see Krebs & Kacelnik (1991:108), Smith (1987a), Smith & Winterhalder (1992a:54ff) and Stephens & Krebs (1986:Ch.1).

[15] Some authors (eg. Betzig 1988; Boone 1992; Borgerhoff Mulder 1988) argue that political and economic interactions are ultimately reducible to the biological domain, as competition for the means to enhance reproductive success. They certainly provide substantive evidence that success in political, economic and reproductive domains is correlated.

(c) **Constraints** - the contextual variables that determine the outcome, and thus the relative fitness, of behavioural strategies. The constraints relevant to any analysis obviously depend on both the behavioural variable being examined and the currency being used to index fitness. The energetic efficiency that would result from choosing to pursue a particular type of prey, for example, would depend on the size and abundance of those items, and the average time entailed in their location and handling. Any variation in those factors would affect the relative efficiency of alternate strategies in predictable ways.

Models developed by evolutionary ecologists (often adapted from the optimality models and game-theory models of economic theorists), can be used to predict both the behaviour that would be expected given a certain set of constraints and the ways in which behaviour can be expected to change as constraints are altered. The identification of relevant constraints clearly is crucial to the explanation of variation in behaviour. But constraints may be of many forms. Constraints **extrinsic** to the actor, such as type and relative abundance of prey items available, are usually overtly incorporated within models. In addition, the actor may be subject to **intrinsic** constraints - set by biology or, in the case of humans, by technology - that affect performance; the potential rate of travel, or perhaps the ability to process information about resources, would fall into this category. Both types of constraint affect the material outcome of behavioural options, and it is the effects of variation in these that have formed the focus of most analyses. My concern in this thesis, however, is with another form of constraint - constraints not on the outcome of action but on the use that can be made of that outcome.

Stephens and Krebs (1986:10) subdivided intrinsic constraints into those affecting the abilities of the actor and those affecting the requirements of the actor.[16] I will go further, and argue that extrinsic constraints can be similarly divided. The extrinsic constraints usually recognised in models, and referred to above, are those that influence the outcome an actor can achieve; they affect 'ability'. But there are extrinsic constraints, too, on the requirements that an individual brings to any action. In particular, those requirements depend on the actions of others; resources received from others, for

[16] Stephens & Krebs wrote of 'tolerances' rather than 'requirements' when identifying their second category of intrinsic constraints. I have followed Smith & Winterhalder (1992a:56) in using the latter term.

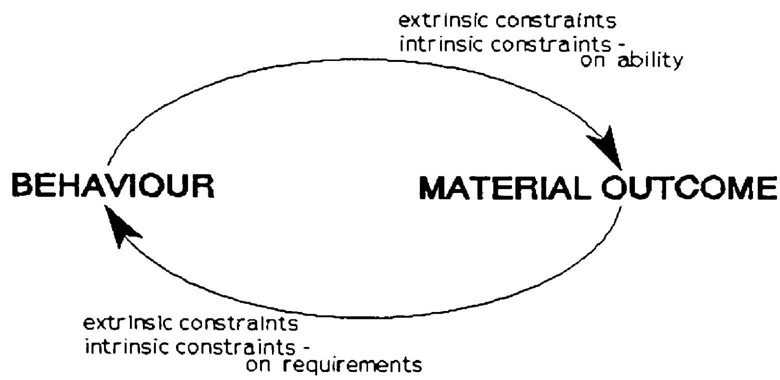

Figure 2 The locus of action for different categories of contextual variables affecting reproduction of behaviour.

example, would reduce the amount that could be usefully procured, while any part of one's catch taken by others would increase the amount that could be usefully procured.

Whereas constraints on ability affect the relationship between the form of behaviour and the currency used to index fitness, the requirements of the actor define the relationship between the currency itself and fitness.[17] In other words, the requirements of the actor mediate not the material outcome of behaviour but the implications of that outcome for reproduction of the behaviour (Figure 2). The distinction is important, and clearly relates to that drawn in Section 1.1 between the material outcome of action and the use that can be made of that outcome. I will return to this in the next section. First, however, I will briefly address some criticisms of evolutionary ecology as a method of inquiry.

1.2.4 **Criticisms**

The use of evolutionary ecology as an approach to the understanding of behaviour, particularly human behaviour, has not gone unchallenged. Indeed, there has been some

[17] This view seems to contrast with that of Stephens & Krebs (1986:9) who defined constraints simply as "all those factors that limit and define the relationship between the currency and the decisions variable(s)". The distinction I have identified is acknowledged in subsequent statements, however, as when they argue for "using energy maximization as the currency, and converting the consequences of each behaviour to probabilities of survival" (*ibid*:127). I am interested in factors that 'limit and define' the latter relationships.

quite vociferous criticism over the years from biologists as well as anthropologists (eg. Gould & Lewontin 1979; Gray 1987; Ingold 1990, 1991b; Keene 1983; Rose *et al.* 1984; Martin 1983; Pierce & Ollason 1987; Symons 1989). The various critiques have been addressed in detail by several authors (eg. Borgerhoff Mulder 1991; Dupré 1987; Krebs & Houston 1989; Smith 1987a; 1991a; Stephens & Krebs 1986; Winterhalder & Smith 1992) and, in general terms, I am aligned with these responses. A few points are worth mentioning here.

A common theme running through much criticism of evolutionary ecology is concern for the sociopolitical implications of interpreting behaviour in terms of fitness maximization (Lewontin *et al.* 1985; Maynard Smith 1985; Sahlins 1976b). Ideas are not developed in a social vacuum. The apparent emphasis on competition and individual self-interest within evolutionary ecology may be seen not only as deriving from current capitalist ideologies but as used to justify the racial, sexual and class inequities produced by that system. Such fears are difficult to allay. As Smith (1991a:37-39) noted, however, conservative political applications are neither necessary nor logical consequences of the assumptions of evolutionary ecology (see also Winterhalder & Smith 1992:18-20; Borgerhoff Mulder 1991:92-3); a concern with patterns of co-operation and with questions of collective action are as important as notions of competition in recent studies.

More specific criticisms tend to address the methodological assumptions that underlie models of behaviour. Evolutionary ecology is concerned only with the differential survival of form, not with its generation. Much of the criticism of evolutionary ecology within anthropology (and, for that matter within biology) can be traced to a confusion or conflation of these two levels of explanation. It is true that the optimization and game theory models of evolutionary ecology "differ drastically from actual decision-making procedures" (Jochim 1983:164). People do not usually act on the basis of calculated consequences for energetic efficiency (or, at a further remove, for survival and reproductive success). Their motives are generally far more particular, short-sighted, and constructed within a frame of culturally specific meanings. But the arguments of evolutionary ecology presuppose nothing of the process of decision-making. They presume simply that the **outcome** of behaviour, however motivated or generated, will affect the probability of its reproduction. Functional and causal accounts of behaviour[18] are complementary, not contradictory, ways of understanding decisions (Borgerhoff Mulder 1991; Krebs & Davies 1987:351-3; Winterhalder & Smith 1992); a complete explanation might entail understanding both the cultural meanings that motivate behaviour and the functional consequences of behaviour for reproduction of those meanings and thus of behaviour (cf. Bird-David 1992a; Smith 1987a; Therborn 1991). The exploration of intentionality is beyond the scope of evolutionary ecology, but this does not mean that evolutionary ecology itself is not a legitimate mode of enquiry.

There may well be an underlying rationality to behaviour, then, that is independent of the intentions of the actor or the ways that decisions are reached. But it is another matter to argue that the basis of that rationality will be found in the current context of action. As several critiques of evolutionary ecology have noted, this presupposes that the context is static, or at least changes more slowly than attributes evolve (Cody 1974; Maynard Smith 1978; Pierce & Ollason 1987; Pyke 1984). Natural selection is a process, not an event; it takes time. We could expect, then, a lag between any change in environment and corresponding shifts in the behaviour of organisms. In fact, where environments are highly changeable, selective forces acting on organisms may be too unstable for optimal strategies to ever emerge. Arguably, however, this would simply lead to selection for an ability to strategically adjust behaviour to rapidly changing conditions - perhaps through mechanisms such as learning, rationality, and cultural transmission (Smith & Winterhalder 1992a:53).

Even if organisms behave optimally in the given circumstances, it is questionable whether the models of evolutionary ecology could adequately represent the underlying rationality. Natural selection is but one of the evolutionary processes acting to shape behaviour, and it can act only on the variation that is encountered. It would be wrong, then, to assume that organisms could take any form specified by a model. Historical and developmental constraints on an actor may limit both the options available and the relative fitness value of those options (Gould & Lewontin 1979; Ingold 1990, 1991b). Critiques along these lines are aimed, in fact, at a naive 'panglossian' approach to modelling that

[18] Tinbergen (1963; see also Mayr [1988:27-8] for a slightly different categorization, and Winterhalder & Smith [1992:9-11] for a discussion of how the two schema are related) actually identified four distinct ways of approaching explanation of behaviour: in terms of function, causation, development and evolutionary history. All have held prominence at times within anthropology.

has long been superseded within evolutionary ecology. Practitioners are well aware that attributes of the actor, and not just of the environment, may constrain optimal solutions (see 1.2.3c). In fact, models may be used now to examine the implications of such intrinsic constraints (Smith 1991a:44).

To require that models explicitly incorporate the various historical and cultural factors that may be crucial for understanding a particular system, is to misunderstand the role of modelling. Formal models, as Smith (1991a:45) notes, "are not intended to describe reality fully but to isolate some of the variables that are presumed to be important, so that their importance can more easily be evaluated by theoretical and empirical means".

Nevertheless, it is true that extant applications of evolutionary ecology often overlook the crucial role of social constraints and interactions, and it is this failure that disturbs many anthropologists. There is a feeling that evolutionary ecology ignores "the social dialectic that exists between the needs of the individual and the needs of society" (Keene 1983:142).[19] This neglect, I suggest, can be traced to the general lack of attention paid to the role that constraints on requirements play in mediating patterns of optimal behaviour. People are social animals. The material needs of individuals, like their capabilities, are defined by the social context in which they exist. It should be possible to model the effects on optimal behaviour of variation in that social context.

1.3 THESIS

Drawing the various threads of the previous two sections together, my thesis can be summarized as follows:

The relative probability that particular patterns of behaviour will be reproduced depends on both social and ecological factors. Variation in either domain can be expected to affect the kinds of behaviour observed. But the two domains do not affect behaviour in

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[19] One response to this accusation has been the recent interest in investigation of collective action through the strategic models of game theory - models explicitly predicated on recognition that strategies optimal for one actor may not be feasible owing to the actions of others. In this view patterns of social behaviour are seen as an emergent consequence of interaction with others (eg. Boone 1992; Hawkes 1992).

the same way. Ecological constraints determine the material outcome of action; for analytical purposes, they can be considered to define the relationship between behavioural strategies and some measurable currency. Social constraints, on the other hand, affect the use that can be made of a particular outcome; they define the relationship between the measured currency and fitness, the probability that the behaviour will be reproduced. The two domains are complementary, not contradictory, in their influence. Patterns of behaviour, in this sense, are overdetermined[20]; each influential factor is itself both cause and effect. Neither ecological nor social factors can be considered the essential cause of behaviour, and either domain may be considered a legitimate entry point for analysis.

The role of ecological factors in influencing behaviour has been extensively modelled by evolutionary ecologists. The place of social factors within this methodological framework has been more problematic. Indeed, as will be discussed below, evolutionary ecologists have been more concerned with explaining patterns of social behaviour than with understanding the constraints that such patterns may place on the value of other actions. My primary concern is to establish the place of social relations in modelling the fitness consequences of behaviour.

1.3.1 The effect of social organization

> "If foragers can expect to exchange food with other individuals, their foraging strategies are likely to be sensitive to those expectations.... These considerations represent a largely unexplored area of foraging theory" (Kaplan & Hill 1992:194).

The particular analyses reported in this treatise concern patterns of fishing behaviour. Acquisition of resources, especially food, has been a primary topic of study for human behavioural ecologists, as for ecologists in general. This is, after all, the most obvious and tangible locus of interaction between people and the world that surrounds them; without food procured from that environment one cannot survive, much less reproduce. Models of optimal foraging behaviour were among the first to be developed by evolutionary ecologists and, until recently, have been the focus of most attention in

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[20] I use this term in the sense proposed by Resnick & Wolff (1987). For a brief introduction to the concept of overdetermination see the responses by Resnick & Wolff (1992) and by Graham (1992) to Peet's (1992) critique of anti-essentialist arguments.

anthropology. Over the years, the original models have been elaborated to deal with, among other things, diet breadth and choice of items, foraging space, foraging period and foraging group size (see reviews in Kamil *et al.* 1987; Stephens & Krebs 1986). There are specific versions for homogeneous and patchy environments, for central-place foragers and those who wander at random, for those sensitive to risk and those who have no need to worry about failure. All, however, start with the assumption that natural selection will favour efficient foragers, the usual measure of efficiency being the net rate at which energy is acquired during foraging. With all else held constant, it is argued, fitness will be a function of the time and energy available to invest in other fitness-enhancing activities.

In fact, of course, all else is not held constant. At the least, people need nutrients as well as energy for survival, and foraging decisions affect access to these as well as to energy and time. More complex modelling techniques (eg. linear programming, or the designation of indifference curves), which allow the effect of multiple variables to be considered in design problems, have been proposed to deal with such situations (eg. Belovsky 1987; Hill 1988; Stephens & Krebs 1986; Winterhalder 1983).[21] Nevertheless, energetic efficiency has proved a fairly robust currency for fitness.

My concern is not with the identification of particular currencies for fitness but with the shape of the functional relationship that is assumed to exist between the currency and fitness, and how it may be affected by constraints on requirements. Again, I return to the problem of the relationship between the material outcome of an action and the value of that outcome to the actor.

Initial models (eg. models of diet-breadth and prey-choice; MacArthur & Pianka 1966; Pulliam 1974; Schoener 1971) assumed simply that the relationship between currency and fitness was linear; the effect of any change in the amount of time and energy

[21] The increased realism of such complex models has its own cost (Levins 1966), a loss in the generality that was one of the great attractions of optimality theory. In addition, parameters of such models - eg. the shape of indifference curves - often cannot be derived from first principles, and must be induced from particular observations, with the associated problems of measurement and inference. Though there are methods available for testing confidence in assumed values (see Hill 1988), the move away from the deductive methodology that characterized initial developments within evolutionary ecology is seen by some as a major flaw (eg. Hawkes & O'Connell 1985; Smith 1991a:49-50).

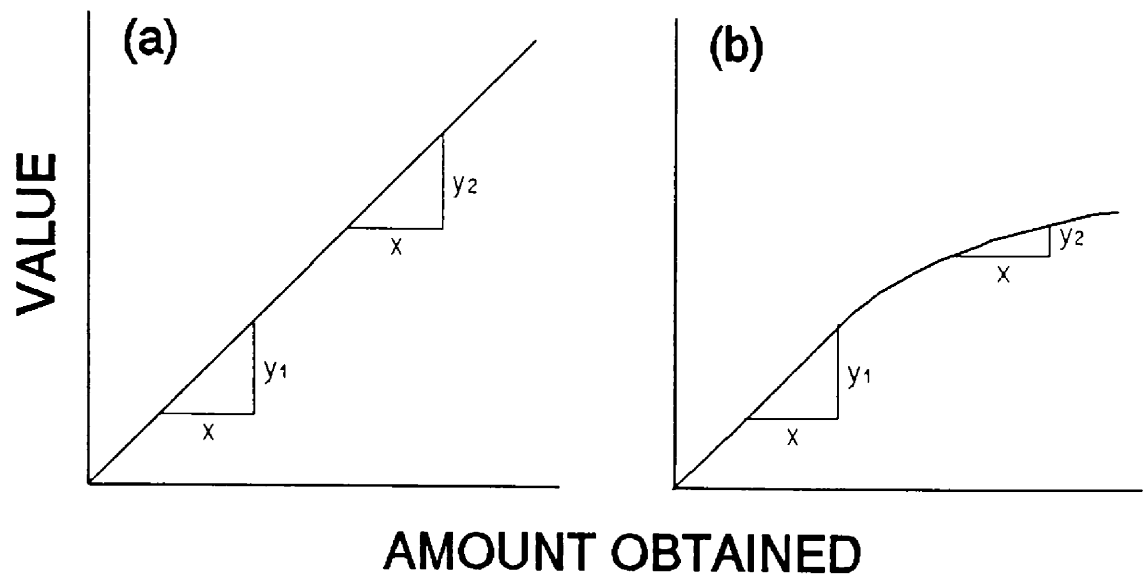

Figure 3 Gain curves showing relationships between the amount of a resource procured and the consequent benefit in terms of fitness: (*a*) linear relationship with value of product proportional only to amount - thus $y_1 = y_2$; (*b*) declining marginal value relationship, with initial units procured worth more than subsequent units - thus $y_1 > y_2$.

available to an individual was considered proportional only to the size of the change. Thus, a kilogram of meat would always provide the same benefit, irrespective of the context of capture, while two kilograms would be twice as valuable (see Figure 3*a*). The value of a foraging decision, then, was seen as being inherent in the physical properties of the product - in the case of food, its quantity and nutritional composition. Since size and nutritional composition of any category of prey could be regarded as given, any variation in the value of taking such items was assumed to arise in relation to the costs, rather than benefits, of procurement; a change in availability of items might affect search time, and thus the amount of energy foregone by not taking items of other types; a technical development might affect the accessibility of items, reducing both search time and handling time (for examples of analyses along these lines see O'Connell & Hawkes 1981; Winterhalder 1981b).

There is, however, no *a priori* basis for assuming a linear relationship between the material outcome of a foraging decision and the value of that outcome in terms of fitness. Several researchers have argued, to the contrary, that the value of procuring a resource depends not merely on its size but on the amount of that resource already available

(Blurton Jones 1984, 1987; Maynard Smith & Parker 1976). They suggest, for example, that the second kilogram of meat consumed at a sitting is likely to contribute less to nutritional status that the first. Where this is the case, food may be described as having a declining marginal value, in that the benefit to be gained from its procurement declines as the quantity already obtained increases (see Figure *3b*).[22,23]

Marginal value curves may take other forms (see Blurton Jones 1987; Boone 1992:320-2; Smith 1991b:234-6; Smith & Boyd 1990:169-73). Where an individual is close to starvation, for example, a small amount of food may make comparatively little difference to nutritional status; significant improvement would require a substantial meal. Marginal value of food thus would accelerate as the amount available increased, only to decline again as nutritional requirements were met. Economies of scale may induce a pattern of accelerating marginal value in monetary economies; the more wealth one has to invest the greater the proportional return. Non-material goods such as prestige or power, too, may display an accelerating pattern of marginal value. I am less interested, here, in the actual shape of curves than in establishing the fact that the benefit to be gained by procuring a resource does not simply depend on the physical attributes of the product. It may be affected by the state of the consumer.

The realization that state of the consumer might affect optimal foraging decisions is comparatively new in evolutionary ecology (see review in Krebs & Kacelnik 1991), and the implications are still being explored. First, while marginal use-value clearly is not determined by physical attributes such as size of resource packages, those physical attributes do influence the way that value is affected by changing requirements. As

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[22] Timescale is important here. Clearly, the amount of meat eaten the previous day will have less effect on the value of new acquisitions than that eaten the same day. The shape of the marginal value curve for food is determined by the rate at which nutrients are utilized. If rate of consumption can be reduced to match rate of utilization, through storage perhaps, then the marginal value curve - the relationship between material outcome of food-getting decisions and the value of that outcome - may well be linear.

[23] Models of patch leaving-time (Charnov 1976), and of central-place foraging (Orians & Pearson 1979), are also based on an assumption of diminishing returns through time. In these cases, however, the relationship is based on increasing costs through time as the forager depletes availability of resources or becomes less efficient as the amount carried increases. The models relate to constraints on production not consumption. I am interested, here, in the consequences of changing use-value of the product, rather than changing cost of its procurement.

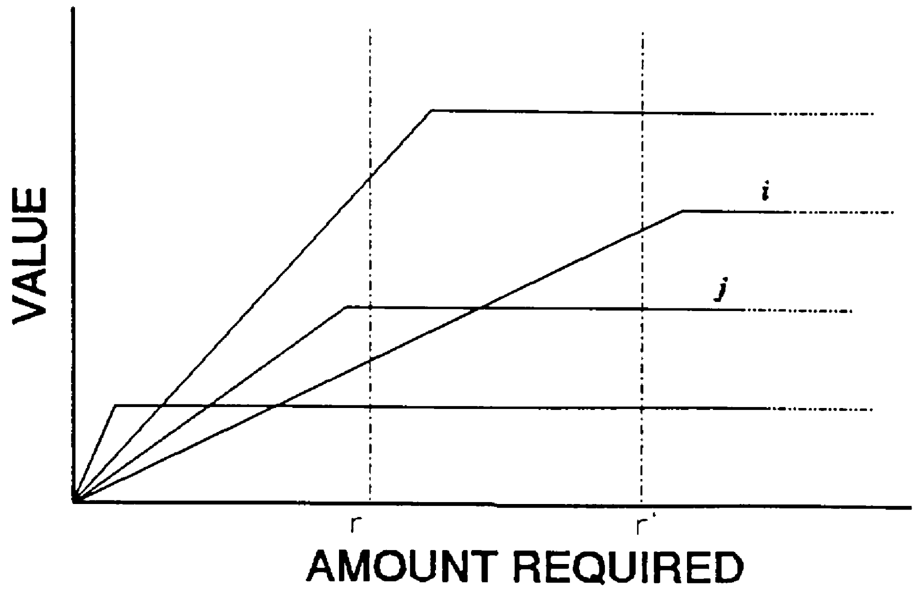

Figure 4 Effect of changing requirements on the relative value of different resource types. Resource *i* is potentially more valuable than resource *j* in this figure, but only if comparatively large quantities can be used. The two resources reverse their rankings as requirements decline (eg. from **r'** to **r**).

benefit to be gained from procurement of further food declines, relative costs become increasingly important in determining the potential value of foraging options. Figure 4 provides a simplified illustration (assuming that the relationship between material outcome and marginal value is linear but limited) of the implications of different needs for the way subsistence options are ranked. The potential value of procuring any resource will be limited by the average size of the items relative to the cost of procuring such items. But consumers are not necessarily able to make full use of an item; if only half the item can be used then the value of procuring it will be reduced accordingly. The point at which value begins to reduce with declining requirements will depend on the size of items; options that produce large packages of food may decline in value much sooner than others as needs reduce. (Costs of procurement presumably would be unaffected.) This differential effect means that rank of options, and not just absolute value, may be affected by changing requirements.

Clearly, individuals with different needs can be expected to make different subsistence decisions. And, as the needs of individuals change through their life history, patterns of behaviour may change as a result. In fact, the decisions made by any one individual can be expected to change through the course of a day in response to changing needs as it procures (or fails to procure) food. This could explain the fact that foragers display partial preferences for prey (sometimes taking items when encountered, but other times not) when early models predicted that a particular type of prey should either always be taken or always ignored. A person who has killed one pig may ignore signs of another, but stop to take a smaller item that would have been passed by earlier in the hunt. Alternatively, as time passes without success in pig hunting, an individual may turn to smaller but more predictable prey.[24]

Anthropologists, however, have been more interested in other implications of the fact that fitness value of a resource may depend on the state of the consumer. Where value does vary with state, asymmetries may arise in the value of a given resource; those who have consumed more may value the remaining portions of their produce less than would others. Such asymmetry, it has been argued, establishes the conditions for distribution of resources beyond the immediate kin of the producer through tit-for-tat reciprocity, trade or tolerated theft (see Hawkes 1992, 1993, Kaplan & Hill 1985 and Kaplan *et al.* 1990 for comprehensive discussion of these and other alternative hypotheses). People, after all, need more than food to operate successfully in their physical and social worlds. Individuals should be prepared to 'pay' for resources according to the potential benefits to be gained by their procurement. If one individual would gain more value from an item of food than would another, the former should be prepared to offer more to procure that item than the latter would lose by handing it over.

A producer, then, might increase the marginal value of produce by distributing it to others. He or she may forgo the limited increase in nutritional status that would result from personally consuming an item, in exchange for some other good that is of greater potential value - in the form of, perhaps, a share of food at a later time when the nutritional value of such food might be greater, or access to other resources or assistance of some kind[25], or simply avoidance of attack.

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[24] New techniques such as stochastic dynamic programming (Houston *et al.* 1988; Krebs & Kacelnik 1991:120ff; Mangel & Clark 1988; Stephens & Krebs 1986:Ch.7) are being developed to model cases of this sort, where the state of an organism both affects and is affected by behaviour.

[25] Some anthropologists have argued that 'generosity' in the sharing of food may be a means of obtaining prestige and associated power, and need have nothing to do with

The effect of sharing on value, however, depends on the use that the recipient can make of the resource. That, too, is presumably limited. Sharing or exchange, then, does not automatically remove limits on the value of resources (cf. Sahlins 1974:84; see p.9). But it does alter the shape of the marginal value curve. Figure 5 illustrates the effect of sharing on the relationship between amount of a resource procured and the benefit that the procurer can expect to obtain as a result. In effect, the use that can be made of a resource by sharing it depends on the cumulative marginal value of that resource to the potential consumers. That is, the value of procuring an amount '*a*' to be shared among two people would be twice that of the half-share each would receive; the same amount shared among four people would be worth four times the quarter each received. The value of procuring '*a*' would clearly be greater if shared among four individuals than only between two, but the value is not doubled and little further benefit would be gained by sharing more widely.

As Figure 5 shows, the larger the size of the resource-sharing group the closer the marginal value curve will approximate linearity. That is, the greater the number of consumers the more likely it is that all of an individual's produce could be fully used, and thus that value will be proportional simply to quantity obtained. But the gain curve can only approximate linearity. Even for large groups, theoretical limits to the value of produce exist.[26]

Once again, we see that the value of procuring a resource item is not determined

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manipulating access to other material resources including food (eg. Hill 1984; Kelly nd). If consequent prestige or power affect the probability that behaviour will be replicated, however, either through increased access to reproductive opportunities or simply as a result of providing a cultural role model, this can be seen as another example of 'trade' as the basis for sharing.

[26] Hawkes *et al.* (1985; see also Smith 1987b and Hawkes 1987) argued that Aché foragers behaved as though the use that they could make of resources was unlimited. Following the argument outlined above, this may simply mean that the resource-sharing groups were sufficiently large for the marginal value of hauls that could be produced in a day to approximate linearity. Individual needs, in fact, may well have been limited. The paper by Hawkes *et al.* focussed on analysis of time allocated to hunting, a risky activity that can produce large but unpredictable amounts of food. Such resources are precisely those for which marginal value could be increased through sharing, as the authors themselves have discussed elsewhere (eg. Hawkes 1990, 1991; Kaplan & Hill 1985). It would be interesting to see if allocation of time to procurement of reliable food items revealed evidence of limited value.

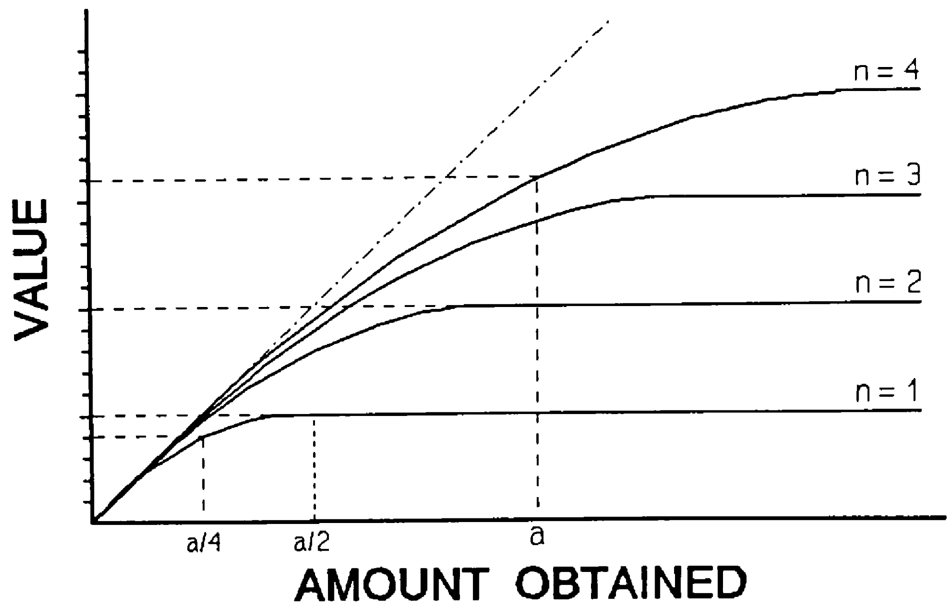

Figure 5 Effect of sharing on the relationship between the amount of a resource procured and the consequent benefit to the producer in terms of fitness. As number of consumers (n) increases, so does the amount of the resource that can usefully be procured. (See text for further discussion.)

simply by the physical properties of that resource. The way that value changes as the size of the resource-sharing group increases, however, does depend on those physical properties. One implication of the cumulative curves shown in Figure 5 is that large items can be beneficially shared much more widely than smaller items. An item half the size of '*a*' could be usefully shared between two consumers, but there would be little further benefit gained by sharing more widely; items of size '*a*', however, could be usefully shared among four individuals. But size of hauls is not the only important attribute. Asymmetry in the use that different individuals can make of a resource item, and thus the effect of sharing on marginal value of that item, will depend on asynchronous acquisition of such items (cf. Winterhalder 1986). The value of less predictable resources will thus be affected more by sharing. (Figure 5 is based on the assumption that potential recipients have no supplies of their own at the time of distribution.)

The fact that sharing will not affect the value of all resources in the same way could explain variation in patterns of sharing and resource exchange. People can be expected to arrange sharing networks in ways that maximize the marginal value of their material produce. Thus resources that are obtained in large packages, or unpredictably, are likely to be shared more widely than others (eg. Hames 1990; Kaplan & Hill 1992; Kaplan *et al.* 1990). More generally, people are likely to share produce more widely in patchy environments than in areas where resources are fine-grained (eg. E.Smith 1981, 1987b). This argument can be extended to explain variation in patterns of land tenure and usufruct; the value of defending exclusive use of a territory may depend, among other things, on fluctuations in the quantity of resources thus held (Smith 1991b; Smith & Boyd 1990).

But, here, I am more interested in the reciprocal argument. Variation in patterns of sharing and resource exchange could explain differences in the values accorded resources, and thus in decisions made regarding the procurement of those resources. As noted before, the effect on marginal value of variation in the number of consumers depends on physical attributes of the resources in question. Thus not only absolute value but also relative ranking of strategies will be affected by changes in size of the resource-sharing group. Decisions about production can be expected to change accordingly. Hawkes (1990, 1991, 1992; see also Dwyer & Minnegal 1993a), for example, argued that differences in the number of people to whom males and females distributed their produce might affect the types of resources taken.[27]

The shift in argument is significant. Most evolutionary ecologists have been concerned with the constraints that existing patterns of production place on optimal patterns of distribution and consumption. While production logically precedes consumption, however, the two form part of a single recursive process; as I argued before, there is no basis for assigning one causal priority (see 1.1). Production itself occurs within a historical social context. And, as Kaplan and Hill noted, "if foragers can expect to exchange food with other individuals, their foraging strategies are likely to be sensitive to those expectations" (1992:194). In other words, existing patterns of distribution and consumption may constrain the marginal value of resources, and thus constrain optimal patterns of production.

This conclusion is fundamental to my thesis. It implies that patterns of distribution

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[27] E.Smith (1981:46) also briefly acknowledged the possibility that patterns of resource use might reflect patterns of sharing, and not simply determine those patterns. In a rather different example (Smith 1985), he has modelled the implications of different sharing rules for optimal size of foraging groups.

and consumption - and the social organization that informs those patterns - can directly affect the appropriateness of procurement strategies. Consequently, change in social organization alone, without any variation in physical environment or technology, may be reflected in changes to patterns of production. I do not mean, by this, to dismiss the significance of ecological factors in constraining patterns of production - and hence patterns of consumption. Subsistence behaviour must be understood in terms of the interaction between social and ecological relationships. Most studies, however, do not progress beyond a consideration of the ecological constraints on behaviour. My intention is to demonstrate the potential to extend such studies by incorporating the effects of social constraints.

1.4 THE STUDY

The previous section established a general model of the respective roles played by ecological and social factors in influencing the probability that different patterns of behaviour will be reproduced. I will now go on to examine the ways in which patterns of behaviour of a particular group of people varied with change in ecological and social context. In this section I briefly outline the practical considerations that guided choice of a subject for analysis, and the particular intentions of the study. I then examine some implications of the choice of subject matter for analysis.

1.4.1 Fishing at Gwaimasi

The study focuses on the fishing behaviour of people living at the village of Gwaimasi in the interior lowlands of Papua New Guinea in 1986-87. In particular, I examine patterns in where and how people chose to fish, and what species they targeted, as ecological and social factors changed. My aim is not to provide a comprehensive explanation of fishing behaviour in the area but to illustrate the effect of different kinds of variables on that behaviour.

By restricting analysis to a single location and social group, I minimize extraneous variation that might complicate interpretations; it becomes possible to hold first social and then ecological domains constant, while I explore the effects on behaviour of variation in the other. By focussing on a single subsistence activity, I simplify definition of a suitable currency for analysis; fish do not differ greatly in their nutrient composition, so the material outcomes to be expected from alternative fishing options can be compared simply in terms of weight.

Fishing at Gwaimasi offered several practical advantages as a subject for analysis of the impact of both ecological and social variation. First, Gwaimasi provided a clearly delimited population, small enough to allow detailed recording of subsistence activities for all individuals over a year as well as the changing composition of groups from day to day through that time. Second, while I expect both social and ecological factors to influence all subsistence behaviour, the effect of the former is likely to be most visible in activities that are not themselves tightly constrained by ecological considerations. Because people at Gwaimasi obtained the bulk of both energy and protein from sources other than fish, fishing is unlikely to have played a dominant role in determining the architecture of the local subsistence system. It was, in fact, the limited scope of the study that made it suitable for investigating the interactions that interest me.

Social and ecological systems are multidimensional. In this research I have restricted analysis to a few of those dimensions that I considered likely to be significant in the case being examined. Variation in the availability and accessibility of resources should affect the outcome of procurement activities, while the size of the resource-sharing group should affect the benefit that any actor can expect to gain by procuring resources. These two domains will be mediated, of course, by the attributes of the particular actor, both physically and socially defined.

I am interested, here, in consequences of behaviour and their implications for reproduction of that behaviour; I am not concerned with the proximate causes of behaviour. Thus I do not address the ways in which fishing decisions were made at Gwaimasi or the perceptions and conceptualisations of fish and of fishing that may have guided those decisions. These issues fall within the domain of cultural explanation, with its focus on intentionality. While they are legitimate and important questions they are, as I have noted before (1.2.4), beyond the scope of the methodological frame (ie. evolutionary ecology) adopted in this work.

Again, my emphasis on differential reproduction of behaviour, not its generation, means that I am seeking statistical patterns of action, not deterministic explanations for action. A change in context, whether ecological or social, may change the probability that particular forms of behaviour will occur; it does not dictate what any individual will actually do.

To avoid possible confusion, I will re-emphasise some of these distinctions. Where more than two options exist for action, and one is taken, I consider a decision to have been made. When I say that people at Gwaimasi preferred a particular option, I mean simply that they chose that option more often than alternatives. In other words, they were more likely to choose that option. This statement presupposes nothing of the process of decision-making. I am interested in identifying contextual variables that affect the probability that a particular option will be chosen. The relative amount of fish that a person could expect to obtain may affect the probability that one option would be preferred to others. But this does not presuppose that the fisher actually expects a particular outcome, or consciously weighs up the potential catch before making a choice. Such factors may well be encoded within cultural constructions of fishing behaviour that make no reference to quantities. Investigation of the ways in which decisions were actually made, while important, is beyond the scope of evolutionary ecology, and thus of this study.

1.4.2 **Fishing as a subject for research**

The decision to focus on fishing rather than some other aspect of subsistence behaviour at Gwaimasi was at least partly a practical response to the requirements of statistical analysis; the number of successful fishing events during my survey, and the number of individual fish caught, were far greater than numbers for procurement of other vertebrate animals[28], or of gardens initiated or sago palms processed. But there were other aspects of fishing, as distinct from hunting of terrestrial game, that made it particularly appropriate for the analyses that I had in mind. People did not usually enter the aquatic domain where fish were found other than in pursuit of those fish. Fishing episodes thus tended to be fairly distinct, whereas people might be alert for signs of terrestrial game in the course of other activities. In addition, the river and streams where

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[28] Procurement of invertebrate animals, such as crustacea or insect larvae, proved impossible to monitor with the consistency required for quantitative analysis (see 4.1.1).

fish were found in the Gwaimasi area comprised several geographically distinct patches, the productivity of which could be directly compared. Finally, while fish were small compared to the major terrestrial prey species at Gwaimasi (pigs and cassowaries), it was possible to catch several fish during any fishing episode. People thus had far more control over the size of hauls produced by fishing than they had over the size of hauls produced by hunting. Fishing offered the potential for more subtle manipulations of outcome in response to changes in the amounts of fish that could be used.

Interestingly, the very attributes of fish and of fishing that made the activity most appropriate for my research may also have been responsible for one of the major difficulties I encountered in this research - a lack of relevant comparative literature. Available studies of fishing behaviour tend to deal with communities where fishing comprises the dominant subsistence activity; where fish are of less obvious economic significance, as at Gwaimasi, their procurement is accorded little attention by anthropologists.

Fishing generally has received less attention than hunting in the analysis of subsistence economies (Gragson 1991, 1992; Hames 1989; Pàlsson 1991).[29] This neglect cannot simply be attributed to fishing being of lesser economic significance; it frequently is not. As Kent (1989:5,9) noted, however, even where fishing is the dominant source of protein for a community, hunting - and the meat procured thereby - is commonly accorded greater value by local people. Anthropologists, it seems, have adopted that bias. But why the original difference in status? Fishing is not necessarily less dangerous than hunting. Nor is it always more reliable. The flexibility of fishing returns, however, and the fact that hauls usually comprise a number of comparatively small items, have important implications for patterns of sharing. Such hauls, as I noted above, are easily tailored to requirements. They are also simply divisible. Where hunting of large game is a viable alternative, then, fishing activity may be more likely to reflect patterns of social organization than to establish or facilitate manipulation of those patterns.

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[29] In this context I use the term 'hunting' as the authors referred to seem to intend, to refer to procurement of terrestrial meat as distinct from aquatic meat. A more useful categorization for the understanding of subsistence decisions, and one that Gragson (1992:428) hints at, would distinguish strategies of procurement irrespective of target. Fishing, then, might be a subset of hunting. That is the approach taken elsewhere in this work (see 5.2.3).

It is not surprising, therefore, to discover that most research into fishing behaviour has focussed on coastal fisheries (eg. Begossi 1993; Chapman 1987; Cordell 1989; Johannes 1981; McCay 1978; Nietschmann 1973; Ohtsuka 1977; Smith 1977; Smith & Hanna 1993), where alternatives are limited. In fact, Acheson's (1981) major review entitled "Anthropology of fishing" treated the topic as virtually synonymous with 'maritime anthropology', a view that still seems to inform more recent work (eg. papers in Harris & Vanderpool 1992). In coastal and lacustrine contexts the world is clearly and sharply divisible into aquatic and terrestrial domains, and this division has provided a primary metaphor for much analysis of social, as well as ecological, interpretation.[30] Gwaimasi, in contrast, lay far inland; fish were obtained from numerous small and larger streams that finely dissected the landscape. The aquatic and terrestrial domains of activity in the Gwaimasi area were intricately interwoven, and the contexts and styles of fishing reflected this.

There have been several studies of inland riverine fisheries. Many, however, because of the size of the rivers concerned, still may more correctly be seen as situated in a binary world of land and water (eg. Goldman 1963; Harms 1987; N.Smith 1981; Welcomme 1985:Ch.7). Other inland groups, while using artisanal techniques, were engaged in commercial fishing for a market much wider than the producing community (eg. Harms 1987; Ichikawa 1985). Only a few studies address patterns of subsistence fishing in inland contexts. Most are from South America (eg. Beckerman 1983a, 1991; Chernela 1985, 1987; Gragson 1991, 1992; Stocks 1983), a few from elsewhere (eg. Kuchikura 1988; Pagezy 1988; Watson 1982). While there are some brief, often anecdotal, descriptions of fishing by inland groups in Papua New Guinea (eg. Dornstreich 1973; Ernst 1984; Hyndman 1979; Kelly 1977; Townsend 1969), I know of no detailed analyses of an inland fishery from that area.

The description of fishing behaviour at Gwaimasi should thus be of interest in its own right. But my primary interest remains theoretical. Here, too, the existing literature on fishing behaviour is of limited comparative value. Many of the studies referred to above make use of evolutionary ecology to explain fishing behaviour. At the most general

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[30] See Davis & Nadel-Klein (1992) for a critique of the tendency among maritime anthropologists to map the dichotomy between land and sea onto a dichotomization of gender.

level, these address the relative values of, and the relationship between, fishing and hunting (Beckerman 1983a; Gragson 1991, 1992, in press; Kuchikura 1988). More specific studies deal with such questions as choice of fishing strategies and techniques (Gragson 1991; Ichikawa 1985), choice of fishing locations and the effect of previous activities on such choices (Bennett 1991; Stocks 1983) or the duration of fishing expeditions (Beckerman 1983a). Whatever the particular focus of study, however, the emphasis is on the explanatory role of ecological variables, on the relative costs and benefits of production.

The social organization of fishing does attract some attention in the literature, with particular focus on the size of fishing parties (eg. Beckerman 1983b, 1991), or the division of fishing labour by gender or along other lines (eg. Chapman 1987; Stearman 1989a,b). Again, however, these studies are predicated on the usual line of causality; there is an implicit assumption that the social is to be explained in terms of the ecological. Even studies expressly concerned with the social integration of fishing beyond a local community (eg. Chernela 1985) tend ultimately to explain such integration in terms of patterns of resource availability within the region. An occasional paper does mention the possibility that social organization of consumption might directly affect fishing behaviour, rather than being merely a reflection of the ecological constraints on fishing behaviour (eg. Stocks 1983), but provides no quantitative analysis.

Existing studies, then, offer little comparative information relevant to my interest in exploring the ways that social and ecological factors interact to influence fishing behaviour. Those studies may still be of relevance to a general understanding of the ecology of fishing but, in most cases, environmental and technological contexts were too different to allow direct comparison with the situation at Gwaimasi.

Information about inland fisheries in Papua New Guinea could be more useful as a basis for comparison with Gwaimasi but, as noted before, is very limited (Haines 1982). Again, the more detailed reports concern coastal, lacustrine, estuarine or large riverine fisheries (eg. Eley 1988; Haines 1979a,b; Johannes 1982; Johannes & MacFarlane 1991; Liem & Haines 1977; Maunsell *et al.* 1982; Quinn 1983), and focus almost exclusively on ecological considerations. Many of these studies were motivated by an interest in the potential for commercial harvesting or the possible consequences of development. The data collected and subsequent analyses reflect that interest and are of limited use for understanding constraints on subsistence fishing.

Reports of fishing in smaller rivers and streams of Papua New Guinea, as at Gwaimasi, are largely anecdotal; most comprise brief and general statements within ethnographies dealing with quite different concerns. Several of these descriptions come from ethnographies of people culturally related to those living at Gwaimasi (eg. Beek 1987:91-93; Ernst 1984:106-10; Kelly 1977:38-40) or at least living in similar areas nearby (eg. Dornstreich 1973:255-64; Hyndman 1979:227-30; Townsend 1969:48-9), but they provide few quantitative details and tend to be selective in their observations. In particular, there is a disproportionate emphasis on the use of poison for fishing (an emphasis that reflects the social, but not necessarily nutritional, importance of this technique; see 5.2.3), and on differences in the fishing activities of women and men. Despite this overt concern with social aspects of fishing, however, the interpretative emphasis is again on ecological rationalization. Patterns are explained, if at all, in terms of constraints on the material outcome of production; there is no consideration of the effects of consumption on creation of use-value. Again, I can make little use of this comparative literature in the study that follows.

1.5 OUTLINE

In this chapter I have introduced the basic concerns that stimulated my study of fishing behaviour at Gwaimasi, and the conceptual and methodological assumptions that framed the research. It is time to turn to more substantive matters.

The next two chapters introduce the context within which fishing at Gwaimasi occurred. Chapter 2 describes the geographical setting of the village, and the social setting of the people who lived there. Together, these comprise the landscape within which individuals made their fishing decisions. Fishing, however, was only one of many subsistence activities engaged in by people at Gwaimasi. Chapter 3 briefly describes the subsistence economy of Gwaimasi in 1986-87, and the place of fishing within that economy.

Chapter 4 introduces the data to be used in the rest of the thesis. Those data concern, on the one hand, fishing behaviour and, on the other, changing composition of social and residential groups within the local subsistence zone. In each case, methods of data collection are described and the kinds of data produced are summarized. Problems inherent in the procedures used, and the implications these have for analysis and interpretation are discussed.

Chapter 5 presents the first substantive analysis of fishing in the Gwaimasi area, summarizing overall production of fish during the survey. The returns achieved at Gwaimasi resulted from people taking a wide variety of fish species, from many different streams and by several techniques. In this chapter I outline those parameters of decision-making and provide a brief overview of where and how people at Gwaimasi fished.

Before proceeding to more detailed analyses, I digress to a narrative account of all fishing by two residents of Gwaimasi during the survey. This brief interlude serves both to illustrate issues to be addressed in later chapters and to remind the reader of limitations inherent in quantitative analysis.

The next three chapters then explore the ways in which attributes of fish, of the fishers, and of the consumer groups which those fishers supplied, influenced the decisions responsible for results summarized in Chapter 5.

Chapter 6 begins the explanation of fishing behaviour by looking at effects of variation in the physical environment, and thus in the material outcome to be expected, on fishing decisions. This, as argued earlier, is not the only legitimate entry point to analysis of subsistence behaviour. It is, however, where most studies begin - and where many end. Inasmuch as my aim is not to reject previous approaches but to show the potential of going beyond them, it seems appropriate to begin at the same place. The chapter describes spatial and temporal patterns in the availability and accessibility of fish within the Gwaimasi area, and identifies correlates in how, when and where people chose to fish.

Chapter 7 shifts the emphasis from attributes of fish to attributes of fishers as determinants of fishing behaviour. Individuals at Gwaimasi differed both in their ability to procure fish and in the benefits to be gained by doing so. This chapter describes general constraints on access to fish, constraints associated with socially mediated (but nonetheless biologically based) categories such as gender, age, marital and reproductive status, and constraints associated with individual skills and capabilities, and discusses the impact of each on fishing decisions.

There is, implicit in some of the discussion of Chapter 7, a recognition that people may have different uses for fish, and that the relative utility of fishing options may vary as a result. Chapter 8 explicitly addresses this issue, shifting attention from production to the organization of consumption and implications for the value of produce. The chapter identifies the resource-sharing group at Gwaimasi, describes variation in the number of consumers comprising that group, and explores correlations between this variation and patterns of fishing behaviour.

Chapter 9 draws together the threads of the analysis of fishing behaviour at Gwaimasi developed in previous chapters. Clearly, the decisions which people at Gwaimasi made concerning where and how to fish, and what to target, could be modelled in terms of costs and benefits associated with the different options available. But neither the costs nor the benefits of available fishing options were intrinsic to the environmental context of fishing. Social factors interacted with ecological factors to influence the decisions that people made. These results provide a context in which to return to some of the broader themes raised in this introductory chapter.

CHAPTER 2
GWAIMASI

From August 25, 1986 to November 16, 1987 I lived, with Peter Dwyer[1], at Gwaimasi, a village in the southern lowlands of Papua New Guinea. The data to be analysed in the chapters that follow were collected at that village during that time. These data concern fishing behaviour, but it is one of the major contentions of my thesis that behaviour must be understood in terms of the context - both ecological and social - in which it occurs. This chapter, then, provides a basic introduction to the physical and social environments of people who lived at Gwaimasi.

The first section describes the geographical location of Gwaimasi, delineates the bounds of the local subsistence area and describes salient features of the landscape, climate and vegetation. It then turns to the physical organization of people within that landscape. The focus gradually widens, from the layout of the village itself, to the distribution of associated bush houses within the local subsistence zone, and then to the relative location of other communities and services that impinge on Gwaimasi. Finally, I discuss the history and impact on Gwaimasi of contact with the wider world, through Australian and National administrations, missions and mining.

In the second section I turn to the social landscape within which people at Gwaimasi operate. I begin by indicating the location of Gwaimasi relative to the distribution of linguistic and cultural groups in the general region. By identifying the cultural affiliations of people living at Gwaimasi I provide a basis for interpreting the organization of the community itself and of ties with the wider society. The individuals who comprised the community of Gwaimasi are introduced, and then different levels of integration discussed. Again, the focus gradually widens, from households, through family clusters and clan groups, to the village as an economic and political unit in its own right. Finally, I discuss the nature and basis of interactions with neighbouring

[1] Peter Dwyer, of the Zoology Department, University of Queensland, was affiliated with the Biology Department, University of Papua New Guinea, for the purpose of researching aspects of the ecology of people living at Gwaimasi.

communities and with those further afield.

The last section of the chapter briefly outlines the ways in which patterns identified within social and geographical domains map on to each other. This sets the scene for the description of general subsistence behaviour that follows in the next chapter.

2.1 GEOGRAPHICAL CONTEXT

2.1.1 Location

The village that became known as Gwaimasi[2] (Figure 6; 5°54'S 142°6'E) was built on the west bank of the Strickland River, some 50 km northwest of the government station Nomad, in the Western Province of Papua New Guinea. Though more than 300 km from the coast - nearer 800 km by river - Gwaimasi was only 100m above sea level[3]; it lay near the northern edge of the vast Strickland-Fly basin, where the river emerges from the central ranges. The land in the immediate vicinity of the village, and stretching away to south and west, was low, flat and poorly drained, but only a few kilometres to the north, and east across the river, lay the foothills of the Blucher and Muller ranges, rising rapidly to an altitude of several hundred metres.

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[2] Gwaimasi was the name of a waterfall (= *si*) beside which the new longhouse was built. Although the referent of this name gradually extended to include and eventually denote the village some people, particularly males living at a distance, preferred to use the name Komagato for the village. The 1:100,000 topographic map for this area lists Komagato as the name for a community that lived immediately south of Gwaimasi in the early 1970's, and government officers prefer to perpetuate such names. In fact, the earlier community was called Gwisi, a reference to the fact that it was built beside a fall on the stream Gwi. The name Komagato is now used by locals to refer to a location a couple of kilometres north of the village, but that location, and the name itself, has spiritual connotations that I did not adequately penetrate. It may once have been used in connection with the beach near Gwaimasi where, we were told, a group of white hunters in the early 1970's processed large numbers of crocodile (= *koma*) carcasses. This episode may have had a significant effect on local spiritual beliefs and practices (Dwyer & Minnegal 1988).

[3] The 1:100,000 topographic map covering the area where Gwaimasi was located (Karoma) shows the altitude as 80m ASL. The map covering the area just to the south (Nomad) shows the same contour as 160m ASL. I have decided to use 100m ASL as a compromise.

The people who lived at Gwaimasi used an area of approximately 50 km^2, roughly centred on the village, for subsistence purposes. That local subsistence zone (Figure 7) incorporated land on both sides of the Strickland, and included both plain and foothill zones. Its bounds were roughly marked by streams: Auti to the south and east, Dege and Koto to the west, and Soiyu, a tributary of the Murray River, to the north. The analyses in this and following chapters refer only to activities within this particular area.

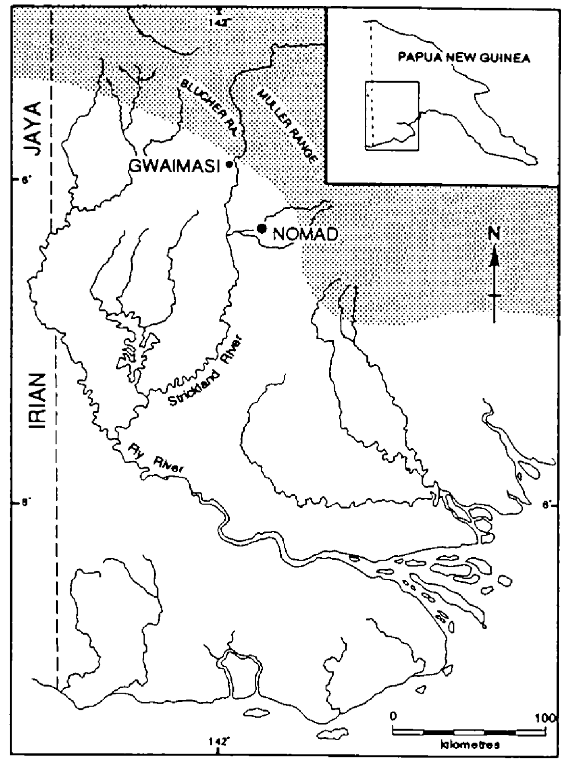

Figure 6 Location of Gwaimasi. Shading indicates land > 200m ASL.

2.1.2 Landscape

The physical world of Gwaimasi was dominated by the distinction between plain and foothills - *u sa* and *bi sa* respectively, in local terminology - and by the streams which drain both, all of which are linked by the broad sweep of the Strickland River.

(a) *U sa* - the flat country

Near Gwaimasi the Strickland River emerges from the mountains into a broad alluvial landscape, a landscape for which the river itself is largely responsible.

The *u sa* comprises a composite levee plain with associated backswamps.[4] The Strickland River is now incised well below the original alluvial plain, but it remains flanked by levee banks built up in the past (RMU No. 113). These form a narrow strip of slightly higher land along the channel, sloping gently away from the stream, and it was on this higher ground that the village was built.

[4] This and subsequent descriptions draw on details provided in the Papua New Guinea Inventory of Natural Resources, Population Distribution and Land Use. The relevant Resource Mapping Units (RMU) within that database are indicated in the text. See Bellamy (1986) for further information and definition of terms.

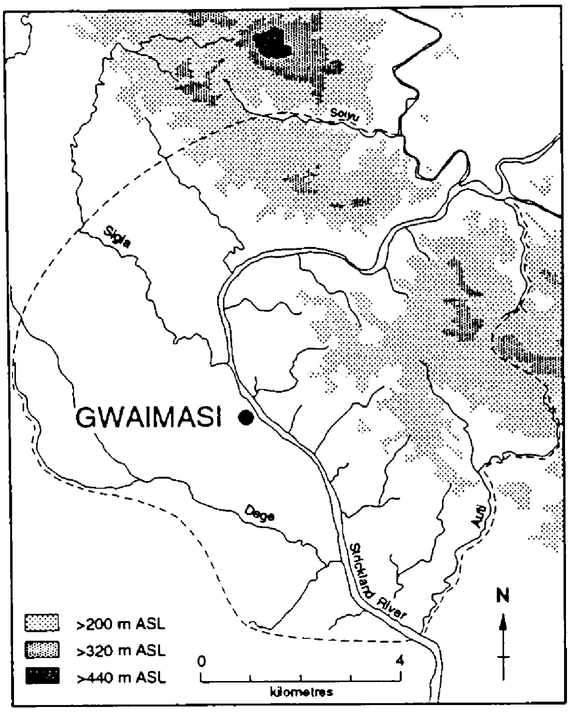

Figure 7 Bounds of the area used for subsistence by residents of Gwaimasi.

The levee banks are generally better drained than the plains that lie behind them. In fact, although now dissected by a number of small streams, the levee banks in this area still, to some extent, impede free drainage of water from the plains. This, together with the generally low relief (< 10 m with slopes < 2°; the plain here does not display the intricately dissected surface found further south), has led to development of extensive swamps, particularly west of the Strickland River. These backswamps - *igie sa* - are interrupted by occasional rises, and by local levees along some of the larger drainage channels, but are generally subject to more or less permanent inundation, with the water table at, or above, ground level (RMU No. 114).

East of the Strickland River the swamps are less extensive, but broad, swampy drainage depressions are still common among the gentle undulations of the relict alluvial plain (RMU No.112).

The muddy substrate and rich leaf litter of the swamps make the numerous streams that drain them attractive and productive habitats for fish. Those streams usually run clear and slow, winding through the flat terrain, but heavy rain can rapidly turn them into murky torrents. Because of the reservoir effect of the swamps themselves it can then take days for the water to clear.

(b) ***Bi sa* - the foothills**

The hills north and east of Gwaimasi village form a marked contrast to the plain. Weathering of tilted beds of coarse-grained sedimentary rock has left a series of homoclinal ridges running roughly northwest to southeast (RMU Nos 93-94). Relief is still relatively low (30-100 m), but slope now ranges from 10°-30°. While drainage is not impeded in the hills, as it is on the plain, soils are often shallow and stony. Limestone outcrops appear in places. North of the *bi sa* lies the *kegu sa*, which comprises rugged polygonal karst formations with nearly vertical, razorblade-like ridges. People spoke of these areas with awe (for a description of travel through this country see Hides 1939), and rarely, if ever, ventured there.

The Strickland River, already a long way from its source in the highlands, cuts a deep gash through the mountains north of Gwaimasi, dividing them into the western Blucher and eastern Muller Ranges. Its path, however, does not mark any major underlying structural boundary; the foothills to either side are very similar.

Foothill streams are generally shallower and more rapid-flowing than those which drain the swamp, and the water is crystal clear. They also have wider, stony beds, and are generally less productive habitats for fish. Though these streams, too, can flood rapidly after rain they tend to return to normal levels within a few hours.

2.1.3 **Climate and vegetation**

The climate around Gwaimasi is decidedly tropical - hot and humid, with little marked seasonality. Maximum and minimum temperatures, and rainfall, were recorded daily throughout the fieldwork. Monthly mean temperatures at Gwaimasi, for twelve months from October 1986, ranged from 25.8° to 28.4°C, with extreme temperatures for the year of 21.5° and 35.5°C (Figure 8a). Rainfall totalled 5871 mm in the same 12 months (Figure 8b). September to December 1986, and May, July and October 1987, were the driest months, but even these received more than 300 mm of rain each. The higher rainfall, and decreased variation in rainfall, at Gwaimasi relative to Nomad (cf. Shaw 1990:40) is probably attributable to Gwaimasi's proximity to the mountains.

As might be expected, given the climate, the region is heavily forested. Structure and composition of forest, however, varies with soil type and drainage, from medium-crowned lowland hill forest in the foothills, through more open forest on the levees, to mixed swamp forest, with extensive stands of sago palms and stilt pandanus, in the backswamps.

Human activity has also played a role in determining vegetation patterns. Patches of regrowth and secondary forest are concentrated along the levees, and on occasional

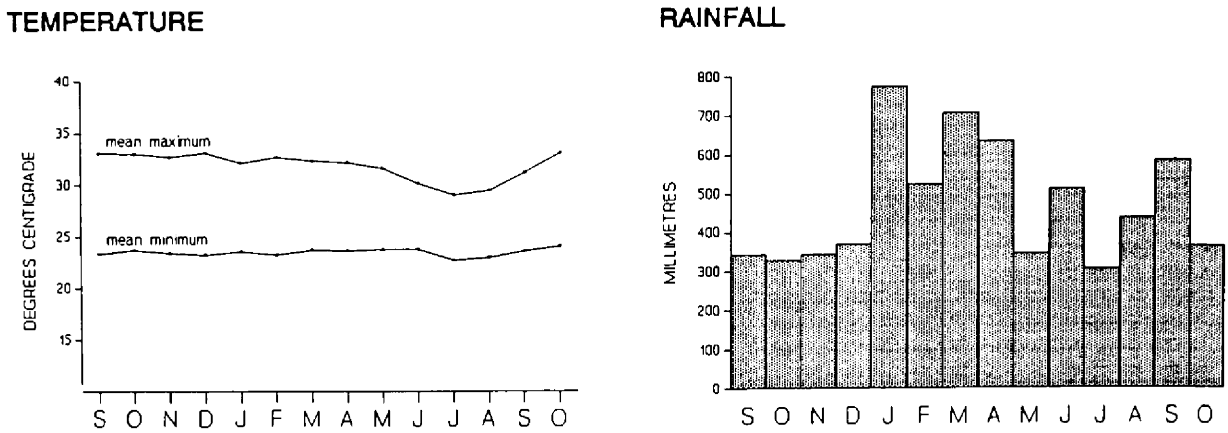

Figure 8 Temperature and rainfall at Gwaimasi, September 1986 to October 1987. (Months are coded by their initial letters.)

small rises within the swamps, where better drainage has facilitated gardening. These patches tend to be small; judging from aerial photos, maps and personal observations less than 50 ha of the 50 km^2 centred on Gwaimasi had been gardened in the 15 years to 1988. (This does, however, represent a significant proportion of suitable gardening land.) In addition, people have greatly affected the distribution of several tree species within the forest, by practices as simple as occasional planting of seeds in favoured location (eg. Okari nuts; *Terminalia kaernbachii*) or differential preservation of seedlings in clearings (eg. Tulip; *Gnetum gnemon*). In fact, the composition of the plant community on levee banks in particular was probably largely an artefact of human activity.[5] Even the untouched patches could validly be seen as artefacts, since their preservation related solely to their definition as *toi sa*, 'forbidden places' where the spirits of the dead dwell.

2.1.4 **The village**

Gwaimasi was built on a relict levee bank. This levee, as noted above, originally formed a narrow strip of slightly higher ground along the west bank of the Strickland, that sloped gently away from the river. It has since been dissected by several small streams. Two of these, Gwo and Gwi, have cut through immediately north and south of the village

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[5] Sago palms could also be planted in, or transplanted to, areas close to suitable village and garden sites, but this was done only occasionally; the great majority of palms near Gwaimasi were self-propagated. Rhoads (1982), however, has argued that even wild sago palms in New Guinea owe their current distribution almost entirely to past human management practices.

site, leaving the impression that the village was built on a ridge running back from the river.

The peoples who live in this area, like many others of the southern highland fringes and adjacent lowlands (see Beek 1987; Kelly 1977; Knauft 1985a; Schieffelin 1976; Shaw 1990; Weiner 1988a,b), construct large communal longhouses. Traditionally, settlements were moved, and new longhouses constructed, every three to four years as suitable gardening land and sago resources near the original site were depleted. Small villages, like that at Gwaimasi, still followed this pattern of movement in the 1980s.

The longhouse at Gwaimasi, small but of traditional design[6], was built in February-March 1986 at the eastern edge of the ridge, where the levee dropped steeply away to the river. Consequently, while the entrance and communal hearth section of the house were at ground level the back verandah was about 5 m above the ground. In the past, such a location would have provided some protection from attack; the building could be approached with ease only from one direction. The position ensured that the house caught whatever breezes might be passing, while the back verandah provided an excellent view of activities on the river and a ready garbage disposal point. Domestic pigs were often tethered below the raised section of the house, and rapidly disposed of any organic scraps.

Such longhouses were not designed primarily as residences. Rather, they were meeting-houses, places where the community and their guests could congregate for special occasions - seances, curing dances, death feasts, anything that necessitated community action or facilitated community identity. While a few people might have based themselves at the longhouse other families spent much of their time at smaller houses scattered through the bush.[7]

With government pressure to live in more central locations, and possibly with increased reliance on banana gardening making such aggregation more feasible (Dwyer &

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[6] See Knauft (1985a:22) and Shaw (1990:35-38) for descriptions of longhouse design. Though they refer to Gebusi and Samo people respectively, the basic design of the longhouse at Gwaimasi was similar.

[7] In this thesis I use the term 'bush' in the Australian sense, to contrast with 'town' or 'settlement' as a scene for human activity rather than in reference to any particular type of vegetation. At Gwaimasi, 'the bush' comprised areas of garden, forest and swamp.

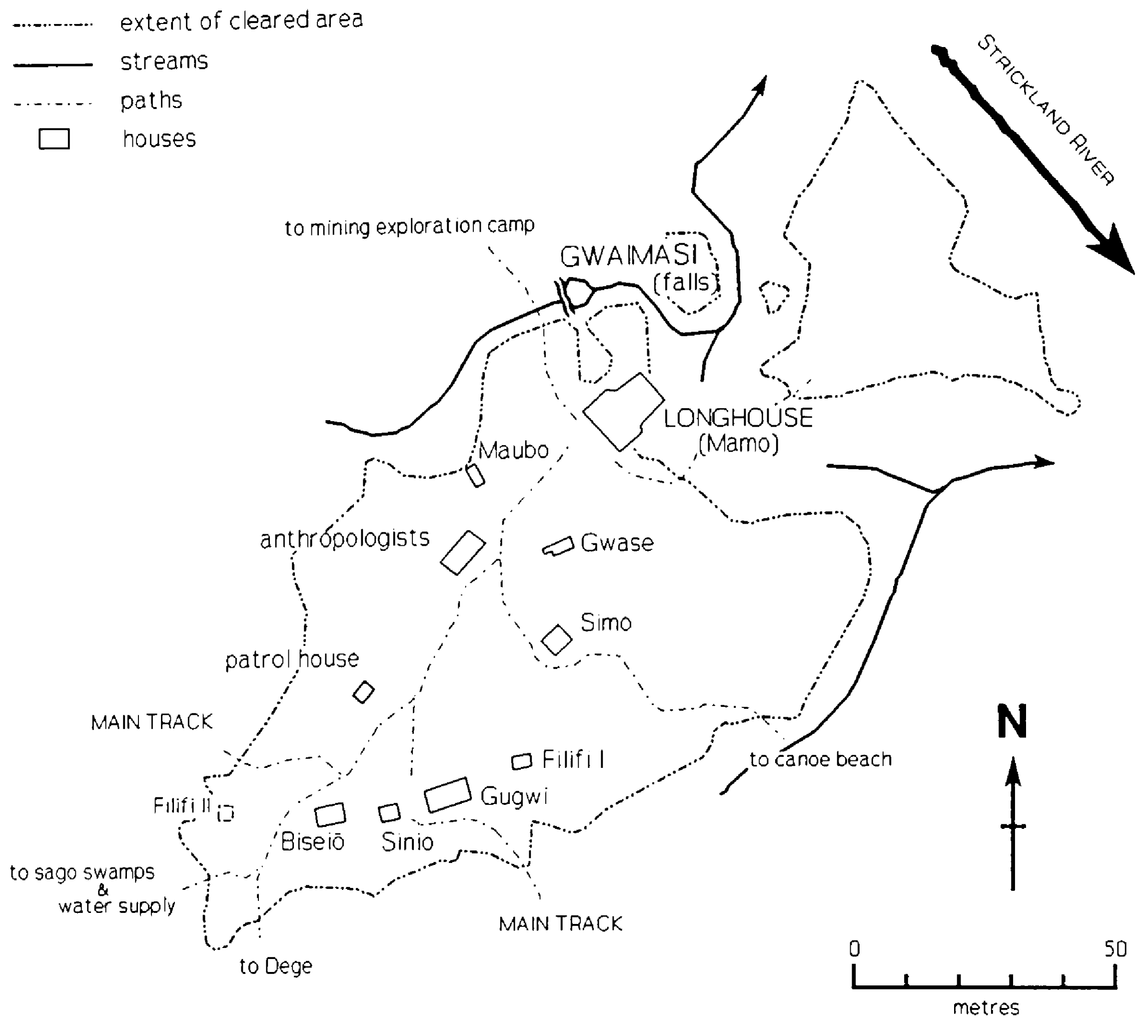

Figure 9 Map of Gwaimasi village in October 1987. One house (dotted outline) was begun in late October.

Minnegal 1991a, 1992a), the residents of Gwaimasi spent less time at dispersed bush houses than they would have in the past. Apparently, however, they disliked the loss of privacy that longhouse living entailed (cf. Beek 1987:15; Wagner 1967:19) for, even before the longhouse was completed in March 1986, people began building private family houses nearby; by the end of 1987 only one family was still living in the longhouse. These smaller family houses were extremely variable in both size and design; usually they were fully walled, for privacy and security, but lacked anything like the internal partitions of longhouses or traditional bush houses. They were strung out in an arc along the top of the ridge running back from the longhouse. Figure 9 shows a plan of the village as it was in October 1987.[8] Times of initiation and completion of houses varied greatly (the last of the primary houses was not completed till October 1987, and another house was actually started in late October), so no map can present a definitive picture of village layout, but the basic structure remained the same throughout our stay.

2.1.5 **The bush**[9]

While Gwaimasi residents may have spent more time at the village in 1986-87 than they would have in the past they had not abandoned the use of bush houses. During the survey residents stayed at bush houses, or camped in temporary shelters in the bush, on 25% of nights that they were in the local area (1999 of 8015 nights). Most families, or in some cases two closely related families, maintained at least one substantial house an hour or more by foot or canoe from the village. Such houses were used as a base for processing sago or hunting, or simply as a retreat from the tensions that may arise in small communities (Dwyer & Minnegal 1992a; see also Beek 1987:15-16; Knauft 1985a; Sørum 1982:43).[10]

Figure 10 shows the distribution of all local bush houses used in the 14 months from September 1986. Those houses were not all in use, or available for use, at the same time; several were abandoned, and others constructed, during the documented period. Table 1 gives details of these changes, as well as details of 'ownership' for each house - who built it and who primarily used it.

Major bush houses, with the possible exception of Duwa, were all located on the plain, usually close to substantial stands of sago palms; smaller houses were sometimes built within gardens. In the foothills people usually built temporary shelters of palm fronds, taking no more than an hour or so to construct but with a very limited life, rather than houses. Visits to the foothills tended to be short, rarely more than a few days, and for purposes such as hunting or collecting that required covering wide areas. For such

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[8] See Negerevich (1991) for comparative details of village arrangements elsewhere in Kubo territory and in neighbouring areas.

[9] See footnote 7.

[10] Similar 'withdrawal' tendencies have been reported elsewhere in the Papua New Guinea Highlands fringe (eg. Townsend 1969:158; Dornstreich 1973:29).

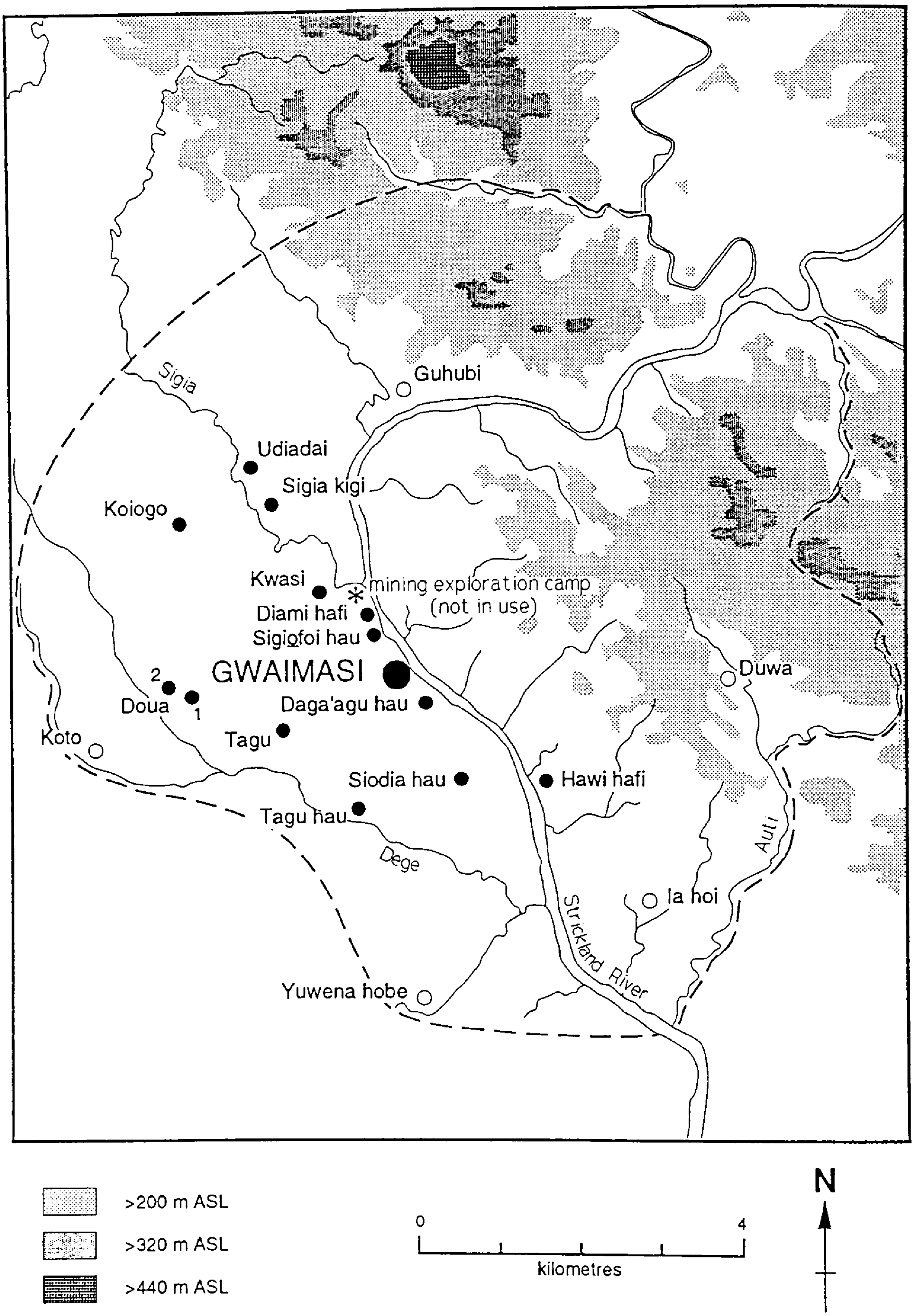
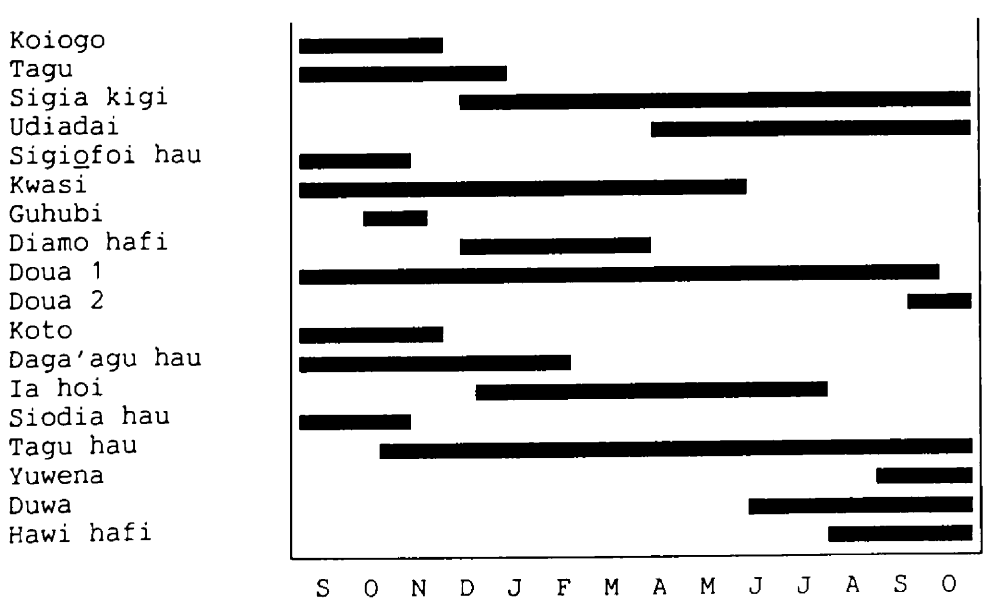


Figure 10 Bush houses used by residents of Gwaimasi between September 1986 and October 1987. Open circles indicate houses not actually visited, with approximate locations identified from satellite photographs.

Table 1 Bush houses used by residents of Gwaimasi between September 1986 and October 1987.

HOUSE	PRIMARY OCCUPANTS:
Koiogo	Mamo household
Tagu	Mamo household
Sigia Kigi	Anthropologists, Mamo family
Udiadia	Mamo household and Gogo family cluster
Sigiofoi hau	Gogo family cluster
Kwasi	Gogo family cluster and Mamo household
Guhubi	Gogo family cluster and associated visitors
Diamo hafi	Gogo family cluster
Doua 1	Gogo family cluster
Doua 2	Gogo family cluster
Koto	Gogo family cluster and Gugwi household
Daga'agu hau	Gugwi and Sinio households
Ia hoi	Gugwi household
Siodia hau	Biseiō and Sinio households
Tagu hau	Biseiō, Sinio and Gugwi households
Yuwena	Biseiō household
Duwa	Simo household
Hawi hafi	Simo and Biseiō households



Solid blocks indicate period of use

trips investment in a house could well have been unwarranted, the rough lean-tos being quite adequate and allowing greater flexibility of movement. (During our stay people intending a trip to the foothills often requested a loan of our tarpaulin.)

2.1.6 The wider scene

Gwaimasi was, even by Papua New Guinea standards, rather isolated (Figure 11). The general area was sparsely populated. Twenty-five people lived at Gwaimasi in 1986-87 (the monthly average; see 2.2.2). Other villages of similar size lay three hours' walk to the west (Nanega), six hours' walk to the southeast, across the river (Gugwuasu) and a full day's walk to the north (Wagohai). Small hamlets, of one or two houses and occupied regularly by perhaps a couple of families, lay somewhat closer - at Tiakigi, at Sosoibi until mid 1987, and at Diwosuhau from early 1987 - but these are best regarded as outliers, the first two of Gugwuasu and the last of Nanega. (Such outliers, however, could form the core of a future community; Diwosuhau was growing, and a longhouse was being built there as we left.)

The nearest large communities lay two days' walk from Gwaimasi, at Suabi to the southeast, and at Dahamo to the northwest. At both these places 100-150 people had congregated around a mission-built airstrip. Those strips, first opened in 1984 and 1987 respectively, provided the nearest sources of western medicine for residents of Gwaimasi - small aid posts staffed by a government paramedic and supported by European missionaries. There was also some talk of establishing a government school at Suabi, but this had not happened by the end of 1987. At Suabi, and probably also Dahamo, there was a small trade store which stocked a very limited variety of clothes, cooking utensils and tools, including fishing lines, fish spears and goggles that will feature in later chapters. It also stocked a few consumables - foods such as tinned fish and rice, soap, matches and kerosene.

Nomad, the nearest government station, was another two days' walk south of Suabi. Here were to be found the nearest schools (government and mission) and hospital, and the nearest police officers. In 1986 there were no roads connecting any of these

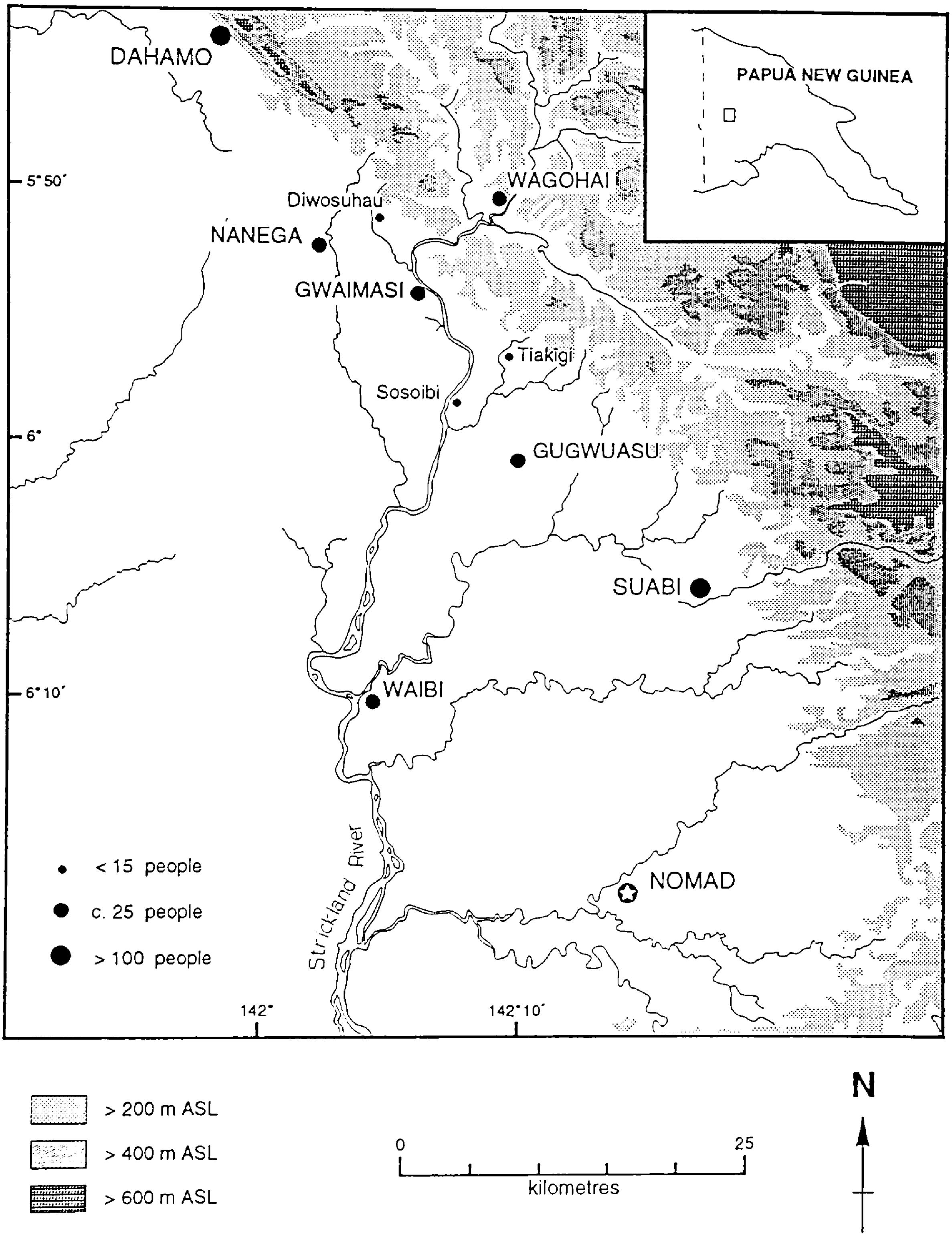


Figure 11 Communities neighbouring Gwaimasi.

communities; beyond the airstrips all travel was by foot or canoe.[11] Gwaimasi residents rarely travelled as far as Nomad, and had very little contact with the government representatives there, but this did not stop Nomad, and the wider world it represented, having great significance in the minds of people at Gwaimasi.[12]

2.1.7 Contact history

Gwaimasi was located within one of the last area of Papua New Guinea to be reached by regular Australian Government patrols. There had been intermittent contact between Europeans and local people from as early as 1885, but until the 1960s all had been from rapid transits along the Strickland River by people who were more interested in passing through the area than they were in the area itself. Though interest has increased since then, contact remains limited. The history of contacts can be considered in terms of three components: government-sponsored exploration and patrols; mission activity; and mining exploration.

(a) Government

In 1885 the Royal Geographical Society of Australasia, with support from the governments of Australia, funded its first expedition. The intention was to reach into the central ranges of New Guinea and, after initial plans were thwarted by weather, the Strickland River was chosen as the route. The primary aim failed; the expedition turned back some 10 km north of Gwaimasi. By then, however, the explorers had frightened several locals, and left a number of steel axes in exchange for items taken from unattended longhouses (Bauerlen 1886; Everill 1888; Froggatt 1936). More than 40 years later, in 1927, the Patrol Officers Karius and Champion, while attempting to cross New

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[11] In 1986 the only functional road connected Nomad with the Bedamuni community of Mogulu to the east. In 1987, however, construction began on a road from the Fly River opposite the port of Kiunga to the Strickland River, with the intention of connecting to Nomad. This road was to provide access for resettlement of refugees from Irian Jaya, and was to be funded by cash from mining companies (Sands nd). By 1990 it had reached to within 20 km of the Strickland River, but no attempt to bridge that river, or the Fly River, had begun.

[12] This significance was expressed in the concept *mosebi* (= Moresby), a centre of power. People expressed regret that *mosebi* was built at Nomad rather than in their own territory.

Guinea from the Fly River in the south to the Sepik River in the north, were forced east and south to eventually meet the Strickland River and rafted down it, past Gwaimasi, from its junction with the Murray River (Champion 1932). Patrol Officers also accompanied some early oil-exploration trips through this country. It was not till the late 1950s, however, that the Australian government paid serious attention to the area.

A government station was established at Nomad in 1962, but the attention of its officers was primarily focussed on Bedamuni (Biami) people, who lived to the east at the edge of the Great Papuan Plateau and had established a reputation for aggressiveness and violent raids on their neighbours; the more 'tractable' people of the Strickland Plain were very much a subsidiary concern. A patrol from this station first contacted people near Gwaimasi in 1968 (Johnson 1968).[13] Annual patrols followed for about a decade but gradually decreased in frequency after Papua New Guinea obtained its independence. By 1986 routine patrols had ceased. Police stationed at Nomad now expected that participants in serious disputes would themselves report to Nomad where the matter could be resolved. Medical services, too, are no longer brought to isolated villages. The people are enfranchised, and in July 1987 several travelled to Dahamo to vote in the National elections, but no government officer came nearer Gwaimasi than Dahamo or Suabi in 1986-87. (One election candidate did visit Nanega, but was unwilling to travel further.)[14]

The government nevertheless continued to exert considerable influence on the people at Gwaimasi and neighbouring communities. Raiding had effectively been eliminated, with people taking major disputes to Nomad for judgement (though sorcerers

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[13] The people had apparently avoided an earlier patrol in 1963-64. Gwaimasi residents also told us of a large camp that had been built at a site four kilometres south of the village approximately 25 years earlier. It had remained for some time, but the people were frightened and went to the mountains to hide. This may have been the camp built as a base for construction of Nomad (Shaw 1990:5). People also remembered a party of soldiers, possibly the Pacific Island Regiment which was in the area in 1967 (Johnson 1968). The young men had been excited, but were prevented from following by their elders. Army can-openers obtained at this time were still used for shaping arrowheads in 1987.

[14] Gwaimasi residents were culturally tied to people east of the Strickland River (see 2.2) but lived west of the river. Resultant ambiguity as to which station, Nomad or Kiunga, was administratively responsible for them may have contributed to the apparent neglect (Dwyer *et al.* 1993).

may still have been killed on occasion). By the 1980s, people spent more time at central village sites, although those villages were still moved more frequently than the government preferred. The ground within village sites was scraped clean, in accordance with government decrees, and pit latrines constructed. Platform burial had been discontinued, and women took their infants to Dahamo for immunisations.

The Australian Administration rapidly concluded that there was little potential for economic development in the Nomad area given its poor soil, low population density and relative isolation from other parts of the country. Agricultural Officers did try to introduce cash crops, particularly chillies, to the Bedamuni and Samo near Nomad in the 1970s, but the project foundered on problems of transport and absence of places where money earned could be spent (Shaw 1990:180). These difficulties, however, did not discourage people from attempting to establish a crop of chillies at Gwaimasi in 1987; the crop failed.

(b) **Missions**

Missionaries rapidly followed the government into this area, and have been generally more effective than the government in providing health and education services. By 1963 missionaries of the Unevangelized Fields Mission (UFM) were building their own airstrip near Nomad, and sending indigenous pastors from the lower Fly into the surrounding area (Shaw 1990:6). In the early 1970s, this group changed its name to Asia Pacific Christian Mission (APCM) and set up its indigenous pastors as the independent Evangelical Church of Papua (ECP; Schieffelin 1978); by 1986 the latter had become the Evangelical Church of Papua New Guinea (ECPNG). In 1982 an APCM missionary, John Fletcher, began constructing an airstrip north of the Cecilia River where Suabi now lies. That strip was completed in 1984 by an oil-exploration company, but since then has reverted to mission control. The missionaries arranged the appointment of an Aid Post Orderly, and in 1987 were trying to organize a government-sponsored school and teacher. Seventh Day Adventists (SDA) arrived at Nomad in 1971, but had little initial success (Shaw 1990:6). In 1985, however, they moved into Suabi using local pastors, and by 1987 approximately half the people of that community had affiliated with them.

An ECP pastor from Awin had moved into the area near Gwaimasi sometime around 1976, and attracted many of the local people to live with him at a place called Sesanabi. He died about 1984, leaving the people without a pastor again, but most residents of Gwaimasi still declared themselves to be *isipi* (ECP).[15]

Affiliation with ECP had had little impact on behaviour of people at Gwaimasi by 1986-87 and added to, rather than replaced or diminished, customary beliefs. Unlike SDA, who follow the proscriptions of Leviticus with some Papua New Guinean twists to accommodate marsupials[16], ECP proscribes only smoking. Smoking, however, is socially significant in this region, and the proscription was generally ignored. The world of the spirits remained very real at Gwaimasi, and seances and curing dances were a regular part of life (eg. Dwyer & Minnegal 1988). The new spirits, *godi* (God) and *yeisu* (Jesus), had certainly been added to the pantheon, and were often placated before eating or appealed to in case of illness, but restrictions on behaviour associated with bush spirits or spirits of the dead had not been modified as a result.

(c) **Mining**

The search for mineral wealth has motivated European visitors to this area from the earliest years of contact. One of the goals of the Royal Australasian Geographical Society expedition in 1885 was to examine the geology of the region with a view to future mining possibilities. In 1937 Jack Hides led a private expedition up the Strickland River into the mountains looking for gold (Hides 1939; he reported speaking to people in what I infer to be the approximate vicinity of Gwaimasi, and trading steel axes for food). Next the focus turned to oil, with the Australian Petroleum Company (APC) sending parties of geologists through the region in 1948 and 1954 (Clancy 1962). According to patrol reports at least one man from the Gwaimasi area traded with the 1948 expedition (Patterson 1969), but it was not till 1971 that APC made a real impact on the area. Gwaimasi residents remembered *eibisisi* (APC) setting up a camp and helipad at a place called Egogowahe (*ego* = aeroplane or helicopter) some two kilometres south of the village site, and employing locals to cut a long shotline through the swamp to the southwest.

The search for oil and gold continues to the present time, and continues to offer

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[15] One *esadiei* (SDA) woman married into the community in 1987. Through a period of months she gradually abandoned the food restrictions that SDA impose, but I do not know whether she expressly changed her affiliation.

[16] Bandicoots and possums, etc., with their syndactylous feet, are interpreted by SDA as having cloven hooves.

sporadic employment to locals - virtually the only source of money available to them (apart from the occasional anthropologist; see 4.1). It is likely to have an increasing effect on the area in the next few years. Several Gwaimasi men had travelled to Duha, in the mountains north of Suabi, in 1984 to work as labourers for Gulf Oil on an exploratory drilling rig. In late 1985 a team of geologists employed by Esso Papua New Guinea set up a camp and helipad at the mouth of the stream Sigia (see Figure 7; this was the heart of the local *toi sa*, the 'forbidden place' where the spirits of the dead dwell) and began searching for alluvial gold. They employed most of the local males to cut shotlines, and to build and maintain the camp, but left again within a couple of months. In February 1987 two men returned and employed people to repair the camp site, but plans to resume surveying were postponed when Esso sold its exploration rights to City Resources and the men left after a week. At each departure local people were appointed to act as caretakers of the camp, and the conviction that *kampani* (company) would one day return had much to do with the establishment of a village at Gwaimasi in 1986.

2.2 SOCIAL CONTEXT

2.2.1 **Location**

Gwaimasi was at the western edge of Kubo territory (Figure 12). The Kubo are a culturally and linguistically distinct group of about 500 people[17] who live on the northern fringe of the East Strickland plain and in the foothills south of the Osio (Carrington) River. North of that river live the Febi. To the south Kubo land abuts the territories of Samo and Gebusi speakers, while to the east it abuts that of the Bedamuni (Biami[18]) of the Great Papuan Plateau. The Strickland River generally marks the western boundary of Kubo territory, as well as a major linguistic and cultural break; the Pare and Awin across the river are, at best, only distantly related to the groups of the east Strickland Plain. In

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[17] This population estimate is based on discussion with John Fletcher, a missionary who spent several years living with Kubo. It is well below the estimate of 1000 Kubo suggested by Shaw (1973:193) but accords with that by Knauft (1985a:11).

[18] Kubo referred to the people who lived to their east as Biami. Those people themselves preferred the name Bedamuni.

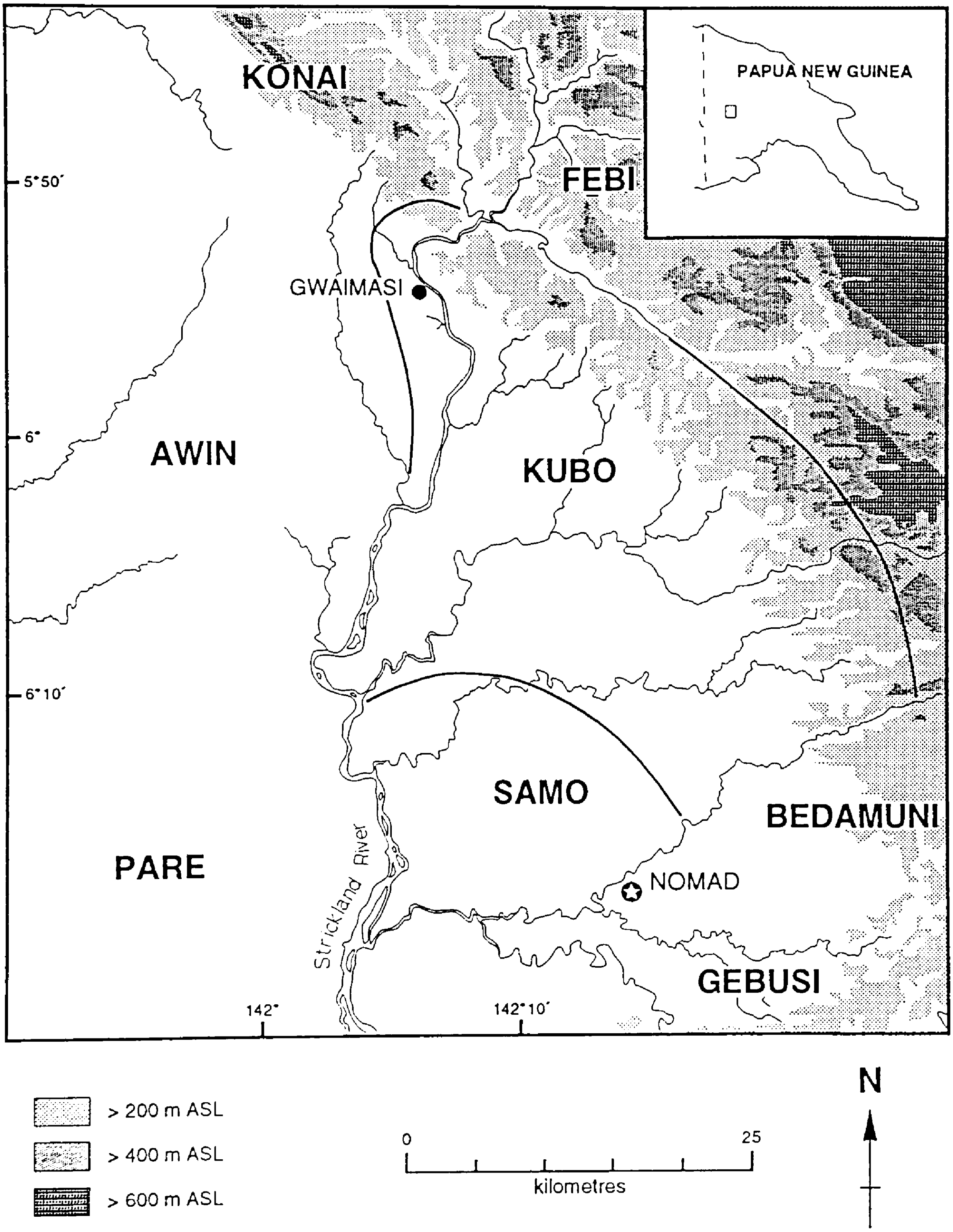

Figure 12 Territory occupied by Kubo people, and the identity of neighbouring linguistic groups.

the north, however, Kubo territory extends to a few kilometres west of the Strickland, and it is here that Gwaimasi was located. Konai speakers lived to the north and northwest of this area (Dwyer *et al.* 1993).

The area that Gwaimasi residents used for subsistence comprised the lands of two patrilineal clans, Gumososo and Gomososo, and a minor part of that of a third, Headubi (Figure 13). In 1986-87 Gumososo, who owned the land where the village was built, and Headubi, whose land spanned the river to the south, were the only Kubo clans with customary rights to land west of the Strickland. (This was not always the case; Kubo clans named Iodibi and Habiei had once held land there. By 1986 the former was represented by one only youth and its land, reduced to a small remnant, effectively subsumed within that of Gumososo. Survivors of the latter had fled to Awin neighbours after a devastating raid by other Kubo, and the clan was now identified as belonging with Awin.)

Kubo, Fe̱bi and Konai all belong to the East Strickland Plains group of languages. Shaw (1973, 1986) has analysed relationships between the various languages of the East Strickland Plain and of the Great Papuan Plateau. He has argued from linguistic evidence that the two groups originated as one, further to the east near Lake Kutubu. As this originating group migrated westward, more than 1000 years ago on the evidence of linguistic divergence, it split; one subgroup continued to expand westward onto the plateau, while the other spread southwest, around the south of Mt Bosavi, and then northward onto the eastern plain of the Strickland River (Shaw 1973:197). By the time they reached the mountains some of this latter group had begun to push across the Strickland. Eventually, the two groups met again, as Bedamuni people spread down the western slopes of the plateau onto the plain (this movement is still in progress; see Knauft 1985a:237, 1985b). Shaw considered that fear of raiding, by Bedamuni in particular, was responsible for at least some of the differentiation among Strickland Plain languages (1973:197).

The effect of these movements has been the formation of 'cognate chains' of languages, with neighbouring groups sharing as much as 80% of a language but with mutual intelligibility declining with distance. This creates difficulties for drawing language boundaries, and Shaw has argued that in some cases named entities should be seen as dialects rather than languages. Thus, while Konai and Agala (= Fe̱bi) could be

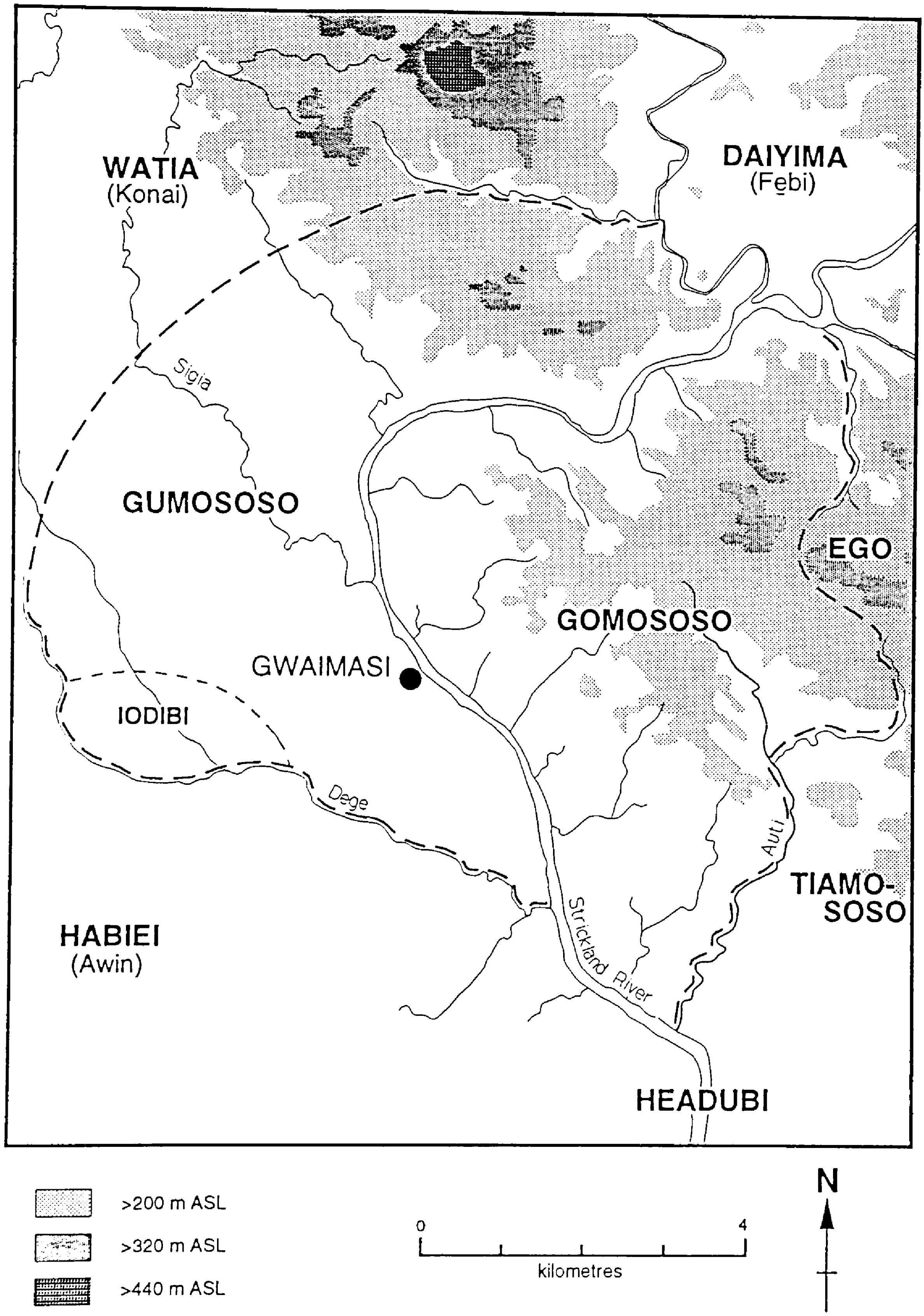

Figure 13 Approximate boundaries of Gumososo and Gomososo clan lands, and the identity of neighbouring land-owning clans. Where clans speak a language other than Kubo, this is indicated in parentheses.

seen as distinct languages, he suggested that Kubo, Samo, Honibo and Bibo (= Gebusi) were more correctly interpreted as dialects of the one language; these latter were, he claimed, showing signs of merging in the decade to 1983, perhaps as a result of increased interaction after government officers prohibited raiding (Shaw 1986:52). Shaw commented, however, that the people themselves did not recognise this larger entity; origin stories all connected the beginnings of each group to, or near, their present localities (see also Knauft 1985a:11). Certainly, Kubo to whom I spoke saw themselves as distinct from neighbouring groups, and said they needed to 'learn' Samo, as well as Konai, before being able to understand these languages.[19]

While Kubo may perceive themselves as distinct in both language and culture from other groups inhabiting the Strickland-Bosavi area, they in fact share with all those groups certain basic cultural and social characteristics. Several anthropologists have studied and written about people in this region: Shaw (1975, 1990) about Samo; Knauft (1985a,b) about Gebusi; Sørum (1980, 1982) and Beek (1987) about the Bedamuni; Kelly (1977, 1988, nd) and Dwyer (1990) about the Etoro; and, further afield, Schieffelin (1976) on Kaluli, Ernst (1978, 1984) on Onabasulu, Freund (1977) on Kasua, and Wood (1987) on Kamula. Certain common themes run through all these descriptions, which Knauft has summarized as follows:

> "In all groups, settlements were traditionally centred around communal residence in a central longhouse. Social organization is everywhere based on small dispersed patriclans, with males co-residing through a combination of agnatic, affinal and matrilateral ties. The ceremonial life of all groups has included evening seances led by spirit mediums, some kind of single, large celebratory transition into manhood, and all-night ritual dances at which adjacent settlements may aggregate. Politically, the area was highly decentralized, with little leadership hierarchy and no competitive exchange or other institutionalized status rivalry" (Knauft 1985a:6).

To this can be added the observation that in all groups marriages were arranged on the basis of some form, direct (Plains) or delayed (Plateau), of sister exchange.

The community that lived at Gwaimasi displayed many of the structural principles that characterized the region. In the following sections I introduce the individuals who

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[19] John Fletcher, a missionary who had spent some years with Samo before moving to Kubo country and who had learned both languages, felt that differences between Samo and Kubo, at least, were greater than Shaw had stated (pers. comm.) Knauft (1985a:371) found far fewer cognates between Kubor (*sic*) and Gebusi than Shaw found.

comprised that community, and discuss the relationships that structured both the community itself and its interactions with the wider social scene.

2.2.2 **Individuals**

Who lived at Gwaimasi? The question is not as straightforward as it seems. People of this region were referred to as 'semi-nomads' by early Australian patrols; indeed, the local government station was named Nomad in recognition of this supposed fact. That initial impression was wrong. But it is true that the people of this region travelled often, regularly visiting neighbouring communities for business or pleasure and staying overnight or for days or even weeks at a time. During such stays, they might hunt with the locals, process sago, or assist with felling gardens. They might even hold customary rights to harvest there (see Chapter 3); indeed, they may have come from land where their rights were fewer. What, then, distinguished residents from visitors? When did a visit become a change of residence?

I shall define residency primarily on the basis of long-term investment of subsistence labour in the area. Hunting and fishing do not fall into this category. Nor, despite the fact that sago can be stored, does sago production. These activities produce immediate returns; the meat or sago can be eaten within hours, or at least days, and the producer is potentially free to move on and seek the next meal elsewhere without having wasted effort. Gardening, on the other hand, involves delayed returns. A decision to establish a garden implies a commitment to remain within, or at least return to, the vicinity of that garden for many months to come; bananas, the primary crop for Kubo, did not produce fruit for eight months, and did not reach peak production till twelve months, after planting. Residents of Gwaimasi, then, were those who had established gardens in the local area and the children associated with them.

But such a definition is not sufficient by itself. Individuals could, and not infrequently did, choose to abandon their investment in gardens, to shift affiliation to another community (Dwyer & Minnegal 1992a). When, then, should residency be considered to have ended? The most appropriate answer lies in community perceptions. Usually, both the individual and the wider community had a clear sense of who belonged where, a sense that, even if not overtly expressed, was revealed in patterns of interaction.

This sense is perhaps most clearly illustrated by an example where individual and community perceptions were not congruent. Tufa, a young man of about 25 who could speak some Tok Pisin (NeoMelanesian Pidgin), was prevailed upon by people at Gwaimasi to come and live there to assist in communicating with us.[20] Though he complied with the community's request he did so under protest, and made it clear throughout the 10 months of his stay that he did not consider himself a resident of Gwaimasi. Although Tufa eventually planted a very small garden, and in many respects behaved as a resident, he declined to participate in the community-wide sharing of meat or other valued foods. Such foods were commonly divided into equal portions served on plates or trays provided by each resident; each share was then collected by the resident as his or her name was called. Despite repeated attempts by others to include him in this process Tufa would not provide a plate nor come when summoned. Thus his portion had to be carried and presented to him with formality, as a gift would be to a visitor. This contrast between sharing among co-residents and giving to visitors (cf. Ingold's [1986a:233ff] distinction between 'sharing *in*' and 'sharing *out*') was one of the clearest signs of community perception. In this case, as in others, I have decided to accept the community view - expressed in repeated attempts to share - and consider Tufa a resident.

On the basis of the foregoing criteria, there were 25 people resident at Gwaimasi during each month of my stay. They were, however, not always the same 25. Two men left permanently. A youth went back to school (five days' walk away) after a year off. Another young man (Tufa) moved in. Two men married, and their wives came to stay. One young woman married, and left to live with her husband. Four babies were born, one to an unmarried woman. Two of these were dead before I left, and another died within a month after my departure. (No adult residents died during the survey, but one old man died while visiting the village.)

In total, there were 31 people who considered themselves, or were considered by others, to be residents of Gwaimasi for some or all of the 15 month period I was there. Table 2 lists those individuals, together with details of sex, age, marital and reproductive status of each, and presents an **average** picture of the sex and age composition of the

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[20] We did not contribute to this arrangement and, in fact, initially assumed that Tufa had independently chosen to move to Gwaimasi in the hope of full-time employment with us. We did employ him on a casual basis, but not full-time.

Table 2 Individuals resident at Gwaimasi for some or all of the period September 1986 to November 1987.

NAME	AGE[a]	STATUS mar.[b]	rep.[c]	CLAN	CHANGES[d]
MALES					
Gugwi	45	M		Gumososo	
Wodai	45	W		Daiyima[e]	dep. 4/11/86
Simo	40	M		Gomososo	
Biseiō	40	M	+	Headubi[f]	
Mamo	35	M	+	Nomu	
Gwase	28	U/M		Gumososo	m. 30/1/87
Gwuho	25	U		Kofebi[e]	dep. 22/3/87
Filifi	25	U		Gomososo	
Sinio	22	M	+	Gomososo	
Tufa	21	U/M		Headubi	a. 19/1/87; m.
Maubo	20	U		Gumososo	22/8/87
Dogo	16	U		Iodibi	
Hegogwa	16	U		Ego	
Gawua	11	C		Gumososo	dep. 19/1/87
Okire	4	C		Headubi[f]	
Stiban	< 1	I		Gomososo	
Bede	< 1	I		Headubi	b. 9/1/87
baby	-	I		Nomu	b. 1/7/87
					b. 10/6/87; d. 11/7/87
FEMALES					
Gogo	45	W		Daiyima[e]	
Kose	40	M	+	Tiamososo	
Sisigia	30	M		Gomososo	
Mabei	25	M	+	Gomososo	
Gogoi	22	M		Ego	
Wafu	20	M	+	Headubi	
Bowa	20	U	+[g]	Gumososo	
Yasobidua	15	M		Domiti	a.m. 30/1/87
Mugwa	14	U		Gumososo[h]	dep.m. 30/1/87
Sagi	12	M		Nomo	a.m. 22/8/87
Boua	10	C		Gumososo	
Yasimo	7	C		Headubi[f]	
Sobosio	2	I/C		Gomososo	

a Ages are estimates only, based on birth order and related to known events.

b Marital status: W = widow/er; M = married; U = unmarried adult or youth; C = child; I = infant.

c Reproductive status: + indicates that a child was born during the survey period.

d a. = arrived; b. = born; d. = died; dep. = departed; m. = married.

e FEBI clan, not KUBO.

f Biseiō's father was of Bigiti clan, which belonged in the hills to the north and may have been Bogaia, not Kubo. Though Biseiō's identity as Bigiti was recognized he, and his children, were treated as Headubi by everyone in the village. He had been raised with Headubi from an early age when, after his father's death, his mother married a Headubi man. The association with Bigiti is unlikely to continue to his children.

g Bowa was unmarried. Her child died at birth, probably as a result of infanticide, and is not included in this list.

h Mugwa, an orphan, had been raised and was treated as Gumososo (her mother's clan) but her father was of Abusoso clan.

community. Given the dynamic nature of social life at Gwaimasi, as outlined above, it is not possible to characterise accurately either individuals or the community as a whole by this kind of 'snapshot' approach. Therefore, both changes in status, and resultant changes in community population structure, are indicated where relevant.

Despite the number of residential changes (11 of the 31 people listed in Table 2 either changed residence or were born during the 15 month period) no significant changes in sex or age composition of the population occurred. Numbers of males and females were much the same in all age classes. There was no-one older than fifty living at Gwaimasi, and a relative shortage of children aged 10 and below. Given the small size of the community these patterns might not be significant, but similar trends were noted (though not quantified) for neighbouring communities. It appears that in this region both the very young and those over 45 are particularly susceptible to disease; young children were particularly affected by malaria, while older adults suffered severely from respiratory diseases.

All these individuals were tied to each other in various ways. The rest of this section looks at the structure, rather than just the composition, of the community of people who resided at Gwaimasi. Figure 14 summarizes the major relationships between individuals, and distinguishes the organizational groups within which people operated.

2.2.3 **Households**

At the most basic level, people were grouped into households (see Figure 14). Households were potentially, though seldom actually, economically independent units, capable of producing all their subsistence needs. Each such unit, therefore, needed to contain at least one adult male and one adult female. Ideally such units comprised a nuclear family - husband, wife and any of their children not yet of marriageable age. Only four of the households at Gwaimasi were such nuclear families; the realities of life and death in this region often ruled out the ideal. Gogo's household, for example, comprised a widow and her two adult but unmarried sons; when Gwase married he set up his own independent household, leaving Gogo with one adult son. (Otherwise isolated children, orphans like Dogo and Mugwa, could most easily become attached to such non-ideal households.) Mamo's household included stepdaughters from his wife's previous marriage. In contrast, Gugwi's child Gawua, and stepchild Hegogwa, from a previous

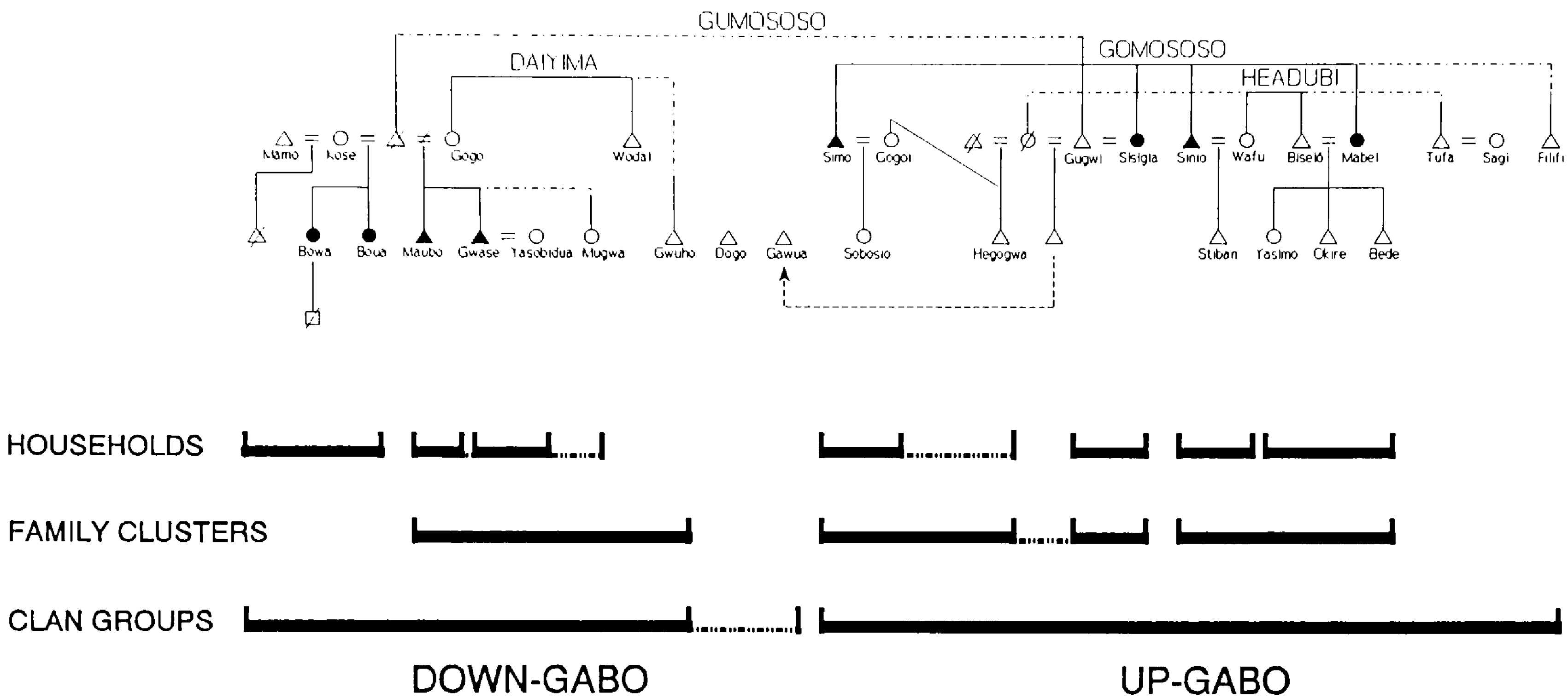

Figure 14 Genealogical and organizational relationships between residents of Gwaimasi. The two sibling sets that form the core of the community are indicated by filled symbols.

marriage chose not to live with him and his new wife.

In addition to these households several isolated men - bachelors and a widower - lived at the village; if the lad Gawua is included, then up to six were based there at any one time. These males generally acted in concert with one of the household for many subsistence tasks though the two youngest, Dogo and Gawua, displayed some flexibility as to the household with which they chose to associate. Filifi, however, strongly maintained his independence, and was the only unmarried male to maintain a house of his own.

These households constituted the primary 'task groups' of the village. While none was actually self-sufficient in terms of food consumed (Dwyer & Minnegal 1992a) each could, and often did, act independently in producing food - gardening, sago processing, and even hunting. Certainly the decision to initiate or participate in any subsistence activity was a matter for the individual household.

A comment on gender relations is warranted here. Kubo men and women displayed a warmth and freedom of association that was unusual by New Guinean standards (cf. Langness 1967; Meggitt 1964), and even by standards elsewhere in the East Strickland Plain (cf. Knauft 1985a:31-32; Sørum 1980:275, 1982:44). Physical contact between spouses in public - holding hand, resting in the other's lap, mutual delousing - was not uncommon. There was, as Knauft (1985a:32) described for Gebusi, some separation by gender in the longhouse with a distinct, partitioned-off womens's section, but this segregation tended to break down in bush houses and often disappeared entirely in small garden houses (and in the private family houses of the village). Such partitioning seems to have been concerned more with keeping men away from the wives of others than with separation of men and women *per se*. As Sørum (1982:44) noted for Bedamuni, women were not generally viewed as polluting. While a menstruating woman was considered vaguely dangerous, particularly to young unmarried males, she was not required to leave the longhouse and, if no other males were about, might chat freely with her husband. Though most marriages were arranged, Kubo, like Gebusi (Knauft 1985a:172), held strongly to a belief in romantic love, and felt that marriages should be love matches. In fact, though same-sex cohesion was valued and encouraged, couples at Gwaimasi often chose to spend their leisure time together.

By the end of my stay only one household, that of Mamo, was actually still living in the longhouse; all other households had private houses in the village, with separate hearths where food could be prepared and eaten apart from others. In fact, eating in private rarely happened; people regularly visited each other's hearths, and shared the food prepared there. The separation of hearths, however, served to underline the autonomous status of the household as actors within the community, capable of offering food and thus of establishing social relationships.

2.2.4 **Family clusters**

Households, while autonomous, were linked by various social ties which, in turn, were reflected in patterns of interaction between them. Thus, several distinct 'family clusters' existed within the Gwaimasi community (Figure 14). These consisted of paired households that were more likely to share tasks, and produce, with each other than with anyone else. Indeed, they frequently lived in adjoining houses and shared hearths as well.

The basis of these family clusters within Gwaimasi can be traced to marriage relationships. Kubo marriages were organized on the principle of sister exchange.[21] Sister-exchange is a fairly common idiom in New Guinean social structures (Weiner 1982), particularly so in the Strickland-Bosavi area. The principle itself is simple enough; ideally, two men marry each other's sisters, thus exchanging male and female substance in their children. But the structural motives underlying the exchange, and consequently its usual form, may differ. On the Papuan Plateau, for example, the ideology of 'sister-exchange' has been interpreted as primarily a means for ensuring lineage solidarity through enabling agnatic parallel marriages (Kelly 1977:120-127). In this context, Kelly argued, a norm of delayed reciprocity may be most appropriate to the continuity of exchange relations. Consequently, groups like Etoro and Bedamuni, while expressing an ideology of sister-exchange, prescribe marriage to FZSD (Kelly 1977; Sørum 1980:274). Actual exchanges were frequently delayed a generation or more, with a marriage seen as establishing the obligation to provide a wife for the son of the wife-giver.

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[21] The term 'sister-exchange' reflects a male perspective of marriage in these areas. I use it because the extant literature addresses the issue from that perspective. The women, of course, have exchanged brothers - and may have considerable say in the matter of choice. Where partners to a marriage exchange tend to live together, as in the Strickland-Bosavi area, 'sibling-exchange' may be a more appropriate term to designate the form of marriage.

On the East Strickland Plain, however, among Gebusi, Samo and Kubo, sister-exchange is interpreted much more literally. A 'sister' to be exchanged usually must be found within the man's own patriclan, not just within his clan. As Knauft (1985a:169) noted for Gebusi, people in this area normally "do not manipulate kin categories and terminology to ensure that the formal exigencies of sister exchange can in fact be met". Ideally, reciprocal marriages should occur simultaneously, and often they actually did. In any case, marital imbalances cannot be rectified in subsequent generations; people "recognize no right to receive a sister in marriage (and no obligation to supply one) because of an unreciprocated marriage in their FF's generation" (Knauft 1985a:167). (Nor, for that matter, do they express any preference for contracting marriages with the same lineages that their FF married into.) Failure to reciprocate within at least a few years is one of the major sources of conflict, of sorcery accusations and violence, in these societies (Knauft 1985a, 1987).[22]

Two marriages occurred at Gwaimasi while I was there. One was an immediate exchange; Gwase's new wife was delivered one day, and his 'sister', Mugwa, was taken to her new husband, two days' walk away, the next. The other marriage had been somewhat delayed, because Tufa had been only recently initiated when his sister married. As soon as he was eligible for marriage, some three years after initiation, his sister's husband placed considerable pressure on him to complete the exchange. In fact, Tufa considered himself too young to 'settle down' - he wished to see the world, or at least the Highlands, first - but the pressure (much of it from his wife-to-be) proved too great.

The immediacy of exchange involved in marriage arrangements among Kubo - paralleling the focus on immediate returns in other domains as well - means that the relationship between parties to such an exchange is particularly strong. Delayed exchanges are, in a sense, never complete; they serve to establish long-term alliances

[22] Unlike Highland societies in Papua New Guinea, people of the East Strickland Plain do not pay bridewealth or offer child-payments. They thus have no mechanism, other than reciprocation in kind, by which to compensate a woman's clan for her blood - i.e. her procreative substance (cf. Godelier 1986; Jorgensen 1991; Weiner 1982). Kubo men **are** expected to pay some compensation to their wife's or mother's clan when she dies, on the basis that the woman clearly had not been adequately cared for and protected from the spirits or sorcerers presumed responsible for all deaths. The concern is with demonstrating continued commitment to the alliance established through marriage, rather than payment for procreative substance (Shaw 1990:121).

between clans as reciprocal wife-givers. Immediate exchanges, on the other hand, create personal relationships. A man may have several sisters, but only one is his exchange sister, responsible for procuring him a wife.[23] A man may have many brothers-in-law but, again, only one has provided him with a wife. The resultant close relationship is likely to be reflected in patterns of co-residence and cooperation.[24] This was certainly the case at Gwaimasi.

Biseiō and Sinio married each other's sisters. The two families cooperated closely in many activities, clearing adjacent plots for gardens, or processing a sago palm together. Until Sinio's house was completed, in November 1986, they lived together in Biseiō's house, sharing the hearth. The bush house at Tagu Hau was built and owned jointly.

After his first wife died Gugwi eloped with Simo's sister. Though Gugwi later offered his step-daughter Gogoi in exchange[25] some tension remained between the two families. It was rare for them to cooperate directly and, in fact, both these families were fairly independent of all others. Their activities were indirectly linked, however, through Gogoi's brother Hegogwa who, while at the village, gardened with his step-father but lived with his brother-in-law in the house they jointly built. Before this house was expanded to include an outside hearth, Simo's family regularly cooked and ate at the hearth at Gugwi's house.

Gogo had outlived both her husbands, and now lived with her two sons on their land. When I first arrived at Gwaimasi two of Gogo's 'brothers' also lived at Gwaimasi. The older and closer of these, the widower Wodai, was attempting to negotiate marriage with Bowa, a daughter of Gogo's original husband. Had that attempt succeeded it could

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[23] The specificity of this relationship may exist before marriage. Shaw (1974:239) reported an unmarried Samo man as indicating a young woman and stating "'that unmarried girl over there is my exchange sibling. Later I will give her in exchange'".

[24] Shaw (1990:81) stated that there was little WB/ZH co-residence in Samo communities and argued that such co-residence "would be incongruous with the Samo rationale for alliance, namely external protection". Knauft (1985a:28, 163-164), however, reported at least 67.6% co-residence of these categories among Gebusi, and close cooperation between them. Godelier (1986:23-4) provides an illustration of similar close relationships established by sister-exchange marriage elsewhere in Papua New Guinea.

[25] While sister-exchange was considered the appropriate form for marriage arrangements, Kubo, as noted before, also held to the romantic view that marriages should be love matches. Exchanges were often organized after the fact, after a couple had eloped (cf. Godelier 1986:22ff).

well have been seen as an exchange for his sister. The negotiations failed and Wodai left after some months, having quarrelled with others in the village. In the meantime he, and Gwuho who left somewhat later, cooperated regularly with Gogo's family, building adjacent gardens and eating at Gogo's hearth in the longhouse.

No such relationship linked Mamo's family to any other family or individual. His marriage to Kose had apparently been leviratic[26], and not the result of an exchange. (Mamo's clan, Nomu, was cognatically linked to Gumososo, the clan of Kose's first husband; he was addressed as 'brother' by Gugwi and Gwase.)

2.2.5 **Clan groups**

The affinal ties that linked households were constructed out of, and indeed superimposed upon, an underlying emphasis on ties between siblings. The core of the community at Gwaimasi comprised two sets of siblings: two brothers and two sisters of Gumososo clan, and two brothers and two sisters of Gomososo clan (see Figure 14). Most other residents were affinally linked to one or the other of these two sets. People generally associated with the group to which they were most closely affiliated (single men were the most flexible in this matter) and, again, this was reflected in greater sharing of both tasks and produce within, compared to between, groups. The two groups each had one hearth that served as a communal focus, that at the longhouse for the Gumososo group and a large, covered hearth outside Gugwi's house for the Gomososo group.[27]

The close relations between siblings seen at Gwaimasi can be traced to Kubo notions of both descent and sorcery.

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[26] Leviratic marriages were not uncommon (cf. Shaw 1990). After Gogo's first husband left her she was married to one of his brothers, and when that man died she was expected to marry Gugwi. He, however, had just fallen in love with Sisigia and was not interested; nor was Sisigia prepared to share her husband when the matter was raised again later.

[27] Further enquiries in 1991 revealed another principle underlying community composition, one that crosscut clan identity. The four senior males at Gwaimasi - Gugwi, Simo, Biseiō and Mamo, all from different clans - were the surviving members of a single initiation cohort. Apart from Gugwi and Mamo, these four did not consider themselves to be siblings; unlike the pattern Shaw (1990:62) described among Samo, Kubo initiation cohorts do not comprise siblings but, rather, seem intended to link young men from several different clans.

Kubo, like other groups of the Strickland-Bosavi region, are organized into exogamous patrifilial clans. These clans, or *obi*, are the only named and enduring kinship groups among Kubo. But while *obi* identity may engender a diffuse sense of agnatic solidarity it is of little political importance. Kubo clans are often residentially dispersed, and may consist of two or more effectively autonomous units. Gomososo males, for example were to be found living at Gugwuasu, Waibi and Suabi as well as Gwaimasi in 1986-87, while Headubi males lived at Nanega, Sosoibi and Suabi as well as at Gwaimasi.

I lack the detailed information required to interpret these patterns among Kubo, but the little I have accords well with the description that Knauft (1985a:27-31,157-163) provides of Gebusi kinship and politics. According to Knauft (*ibid*:157), the fundamental political unit among Gebusi was not the clan but the patriline, "a group of individuals who can trace common descent vis-ã-vis one another" through actual relationships. Since genealogical knowledge throughout the East Strickland Plain tends to be very shallow[28], patrilines were usually small; they rarely extended beyond first cousins and Knauft reported an average of two male members among Gebusi patrilines.

Though these lineages were not named they had a distinct social reality. Knauft reported, for example, that more than half of all exchange siblings in Gebusi marriages came from within the patriline. The patriline tended to live and move together, to arrange spouses for its members, and to organize revenge when members were harmed.

The two core groups at Gwaimasi were patrilines. Simo and Sisigia, Sinio and Mabei were, I was told, 'true' siblings within Gomososo. This is unlikely to have been the case (there was some confusion about the identity of parents) but they were, in all probability, at least half-siblings. Certainly, they were more closely related to each other than any of them was to Filifi, their clan brother. (Filifi, in turn, had a consanguinal older brother who lived at Gugwuasu. Though they lived apart these two regularly visited each other, and Seakai was primarily responsible for the efforts to find Filifi a bride.) Gwase and Maubo, Bowa and Boua were also full or half-siblings, this time within Gumososo. Again they formed an obviously solidary unit, to which their clan brothers,

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[28] Many people at Gwaimasi could not remember their grandparents, either in person or by name. For Kubo, as for Gebusi, "the main agnatic terminological distinctions are those of generation, sex, and - in the individual's generation - relative age" (Knauft 1985a:157). Knauft added that the Gebusi term for grandfather is the same as that for 'distant relative'.

Gugwi and Gawua, did not belong.

The significance of the patriline in societies of the Strickland-Bosavi region is attributable to the same structural principles that underlie clan identity. While recruitment to a particular clan may have been based on descent the relationship between members appears to have been based on siblingship - on a notion of shared substance (Kelly 1977; Mimica 1980; Weiner 1982). The Strickland-Bosavi region is characterized by a belief that male substance, in the form of semen, is essential to maturation. Members of a patriclan ultimately have received their substance from the same putative ancestor; they share the same essence, and it is this perceived equivalence that constitutes clan identity. But semen is not enough for life. Children were actually seen as the product of the union of male and female substance; semen formed bones and menstrual blood the flesh (Kelly 1977:91). Thus, descendants of the same mother - or, more generally, of women from the same clan - also share some basic essence. Kubo certainly recognised establishment of relationship through the mother, though they did not name the matriline or any resultant corporate unit. Biseiō and Wafu, for example, had the same mother, but had fathers from different clans; they were certainly recognized as siblings. The effect of recognizing matrilateral consanguinity within a structure overtly based on patrilineal descent is to establish a measure of distance on the fact of relationship. Not all siblings are equally related; and the closest siblings are those who share both bone and flesh, those within the patriline.

The tendency for members of a patriline to reside together (Knauft [1985a:28] reports more than 90% co-residence of male members among Gebusi) is at least partly the result of practical considerations. While each clan holds rights in common to a well-defined tract of land individuals have particular claim to land that their fathers worked. Gwase, for example, indicated that the land north of the stream Sigia was 'his' particular country, and Biseiō claimed land immediately south of the stream Dege as 'his' portion of Headubi land (see Chapter 3 for more details of the system of land tenure). Members of a patriline, children of one man or maybe of close brothers, are likely to hold rights to the same block of country.

Another reason for surrounding oneself with one's closest agnatic kin is the ever-present fear of sorcery. Kubo consider sickness and death to be the result of malicious action; a spirit, sometimes acting on its own but more often under human direction, has been consuming the substance of the victim (see, for example, Dwyer & Minnegal 1988). Since the essence of siblingship may be seen as shared substance, a witch that attacked a close sibling in this way would be consuming itself[29]. Accordingly, close siblings are unlikely to ensorcel each other and thus are the ideal co-residents, a view shared by others in the Strickland-Bosavi area (Kelly 1976, 1977:135).

The two 'clan groups' that I have identified as comprising the community at Gwaimasi were centred on sibling-sets from Gumososo and Gomososo clans respectively. Each group, however, consisted of people from several different clans - direct and indirect affines of the core group. To avoid confusion, therefore, I will distinguish the two groups by use of the term Down-gabo for people affiliated with Gumososo, and Up-gabo for those affiliated with Gomososo, as shown in Figure 14. *Gabo* is a Motu term that Kubo have borrowed to refer to the village as a physical entity[30]; the two groups were spatially separated within the village, with houses of people affiliated with Gomososo located higher on the ridge than those of people affiliated with Gumososo (see 2.3).

2.2.6 **The village**

Despite all its internal sub-divisions the community as a whole formed a distinct economic and political unit. While the household may have been potentially self-sufficient in food production, the village was actually so. This production, though undertaken by individuals and households according to their own timetables, was in a real sense communal. Residents were seen as entitled to share in each other's produce (see 2.2.2).

With highly valued food, such as pandanus or pork, and with rare items the entitlement to share was overtly demonstrated; the foods were prepared at a single communal hearth, then carefully and publicly divided into equal portions for all residents

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[29] A corollary is that a threat to the substance of one individual will also be a threat to any close siblings. When Simo saw a large fish in a foothill stream - out of its normal place, and thus obviously a dangerous spirit - he had to undergo a form of exorcism to neutralize any attack. His brother Sinio had to undergo precisely the same protective ritual though he had not been present when the fish was seen.

[30] Traditionally, longhouses stood alone, and were referred to as *muso*, which means 'house'. With the development of separate family houses clustered around each longhouse a new term was called for, and *gabo* was adopted.

(unless currently subject to a particular taboo), irrespective of sex or age.[31] But even the everyday staples of sago and bananas, and of fish, were commonly shared. Such foods usually were not prepared communally, nor was distribution subject to the same public scrutiny; rather, individuals delivered raw food to each other's houses. This distribution, it seemed, occurred irrespective of individual needs. Each afternoon, with considerable flurry and excitement, people handed out whatever they had obtained that day - and were likely to receive equivalent goods from others (Dwyer & Minnegal 1992a). The sharing of raw foods, particularly plant foods, is rarely reported in the literature. At Gwaimasi, it emphasised that what was entailed was a right to share produce, rather than just to receive the hospitality of the hearth (see 8.1 for further discussion).

Membership of a social unit entails responsibilities as well as rights. At Gwaimasi, such communal responsibility was seen most clearly on occasions involving interaction with outside interests - other villages, western mining companies, and even the spirit world.

Everyone contributed to the feast held to mark the completion of our house (September 20, 1986); it was, after all, as much a public statement to invited guests that Gwaimasi had effected a coup in getting us, with our money, to stay as it was a welcome for us. And at *kasimes*[32], a large feast to which several neighbouring communities were invited (January 2-3, 1987), particular individuals contributed the domestic pigs that were eaten with the awareness that it was Gwaimasi's contribution as a whole that would be assessed (see p.79). Similarly, all males hunted game for the prestation of dried meat carried to the feast held at Gugwuasu (May 13-14, 1987), and prestations of food received at this and other feasts were carried back to the village to be shared among all residents.

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[31] Wild pigs and cassowaries were almost always cooked in ovens built outside Gugwi's house, the focal hearth for Up-gabo. Domestic pigs, on the other hand, were always cooked in ovens outside the longhouse, the focal hearth for Down-gabo. These public distributions, then, underlined difference at the same time as they emphasized unity.

[32] The meaning and origin of the term '*kasimes*' is unclear. It is not unlike *kosa* or *gisaro* or *gosei*, the names used among Etoro, Kaluli and Bedamuni, respectively, for a major ceremony entailing dance. But, though dances were held on three occasions at Gwaimasi, and we attended others elsewhere, I heard '*kasimes*' used in relation to only the one occasion. John Fletcher believed it to be a corruption of 'Christmas' and related to the feasts that people had observed held by Australians at Nomad.

A rather different, but related, example concerned the small mining exploration camp north of Gwaimasi. Though the company involved had the names of particular individuals on its books as caretakers the people themselves saw maintenance of the camp as a communal responsibility. The money, and the food, received for ongoing maintenance while the camp was not being used (as opposed to that paid directly to individuals for specific tasks in the week that company officials were present) was distributed equally among all members of the community, irrespective of age.

Finally, everyone in the community combined to organize the seance and several curing dances held in May and August 1987 (see Dwyer & Minnegal [1988] for a brief description of these events; cf. Knauft 1985a; Shaw 1975, 1990).

The above instances all concern immediate political, economic and spiritual (or health) interests. They point to a fundamental difference between the residential group as a unit in its own right and the subgroupings discussed earlier. Households, family clusters and clan groups have some reality beyond immediate practical considerations; that is, they can be understood in terms of underlying structural principles. The same cannot be said of the community as a whole. The two sibling sets that formed the core of the Gwaimasi community were not particularly closely related. Why, for example, did the Gomososo group not choose to live with Headubi, with whom they had at least as many ties? Or even with others of their own clan?

Residential communities in the Strickland-Bosavi area can best be seen as temporary assemblages of related people who have come together for practical purposes (cf. Beek 1987:17-18; Kelly 1977:134-144; Knauft 1985a:27-31; Sørum 1980). As Kelly remarked for Etoro, these assemblages are not organized by lineality, nor in relation to clan or lineage territory. But nor are they random. The particular configurations that are likely to arise are contingent upon historical circumstance (cf. Dwyer's account of the establishment of Bobole, an Etolo community; 1990:17-8). Gwaimasi itself was built in response to the establishment of a mining exploration camp at the mouth of the stream Sigia in late 1985 (see 2.1.7). That camp acted as a focus to pull together several families which had previously established bush houses and gardens in the general area. Without that focus those families may well have proceeded in different directions, some affiliating with the community at Nanega, or with the emerging community at Sosoibi. (Sosoibi, in fact, declined after Gwaimasi was established, and several of its occupants eventually affiliated with Gugwuasu.)

Because of the absence of underlying structural ties the community at Gwaimasi, like others in the Strickland-Bosavi area, was basically unstable. At best, it was unlikely to last beyond the life of the village; as Kelly (1977:133) noted for Etoro, "the abandonment of one longhouse and the construction of another often occasions a substantial change in community membership", as people adjust to current distributions of ready resources, to changing relationships, or just to the desire for a change of faces. In fact, community composition would rarely remain the same even for the three to four year life of an average settlement. Throughout the Strickland-Bosavi area intra-community tensions were commonly resolved through violence or departure. Consequently, the flow of people between settlements was considerable. Kelly (1977:136), for example, reported that 11.5% of Etoro men changed residence in the 15 months of his fieldwork, largely as a result of witchcraft accusations. Sørum (1980:275) also noted a high frequency of shifts between settlements among Bedamuni, while Knauft (1985a:27) reported that the average Gebusi male changed residence every four and a half to five years. At Gwaimasi four of 14 adult men, and three of ten adult women, changed residence in the 14 months of records.

Community instability in this area appears related to the fact that, as Sørum (1980:275) noted for Bedamuni, "solidarity beyond the 'brother group' [the patriline] is precarious: it has to be created and recreated continually".

Viewed in this light, the intracommunity sharing at Gwaimasi, with its public and often exuberant nature - and particularly the daily sharing of raw plant foods - can be seen as a means of both establishing and maintaining a sense of communality, of solidarity (Dwyer & Minnegal 1992a). The role of giving in creation of relationships between individuals has long been recognized (eg. Mauss 1969); at Gwaimasi, it served as public recognition of a relationship that had no structural basis and therefore existed only in its acknowledgment. Similarly, participation as a unit in intercommunity feasts can be seen as a public statement by the residents, to each other and to the world at large, that this was indeed a community - and a successful one at that.

2.2.7 The wider scene

While the community at Gwaimasi may have been an economically, politically and in some contexts even a ceremonially independent unit it was by no means socially isolated. Residents of Gwaimasi spent an average 16.5% of all nights (1537 of 8015 person-nights) outside the local subsistence zone. Most visits were to neighbouring communities, but visits to Suabi or Dahamo (two days' walk to the southeast and northwest respectively) were not uncommon and at least three residents travelled much further, to Nomad or Kiunga. Conversely, few days would go by without visitors arriving to stay for a night, a week, or even longer. In 14 months, the maximum number of visitors on any one night was 43 people who came from all directions and as far as two days away for a feast.

Visiting was not associated with residential structures beyond the level of the village. Knauft (1985a:22-23) described a pattern of related small and large settlements among Gebusi; larger 'village' settlements, with an average 46 residents, usually acted as the social and ceremonial focus for several smaller 'hamlets', each with an average 18 residents. These complexes of village and related hamlets could, according to Knauft, be considered distinct communities. Such integrated settlement hierarchies were not apparent in the area around Gwaimasi.[33]

Gwaimasi was located at the northwestern edge of Kubo territory. Consequently, only one of the three neighbouring communities, Gugwuasu, was predominantly Kubo. Several Kubo from at least one Headubi patriclan lived at Nanega, but that village was dominated by Konai, while Wagohai to the north was a F̱ebi community. Even Gwaimasi was not a pure Kubo village; as many as three F̱ebi people were resident there at one time.

Shaw (1990:34), writing about Samo, distinguished the types of interaction within dialect or linguistic boundaries, characterised by sharing of both goods and relationships, from those that crossed these boundaries, which were characterized by trading and raiding. Such a contrast may well have held for people near the centre of group

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[33] Gwaimasi itself, with its associated scattered bush houses, could perhaps be taken as a scaled-down version of the settlement pattern that Knauft described among Gebusi. Use of bush houses, however, seems rather different from that of Gebusi hamlets.

territories, but is not applicable to those near the peripheries, such as Gwaimasi. Gwaimasi residents had affinal ties not only with Konai and Fe̱bi but also with Awin (probably Habiei; see p.58). Conversely, they recalled raids by their fathers and older brothers that targeted not only Konai and Fe̱bi but also other Kubo.

This pattern of permeable ethnic boundaries appears to have been common in the Strickland-Bosavi area. Kelly (1977:11-16), reported that as many as 15% of Etoro marriages were contracted with people of other groups, particularly Bedamuni and Onabasulu, while Knauft (1985a:8) reported that "marital and trade relations cross all of the Gebusi's inhabited borders". Intermarriage also often resulted, as with Gwaimasi and Nanega, in mixed residential communities, as people continued their patterns of affinal co-residence. In fact, it seems that the linguistic and cultural groups which have been distinguished on the East Strickland Plain had no corporate identity as such.[34] Rather, they comprised several autonomous communities, each of which acted independently in "contracting whatever alliances and marital relations it could with adjacent settlements" (Knauft 1985a:8). Communities usually sought to establish a "circle of protection" (Shaw 1990:97) around themselves. Proximity, then, was a strong motive for establishing friendly ties, irrespective of ethnic identity.

Since both Konai and Fe̱bi share with Kubo the basic idioms of East Strickland Plains cultures - they dress the same way, live in similar houses and have similar expectations of socially appropriate behaviour - the adjustments required by intermarriage and co-residence were minimal. Most people at Gwaimasi were, it seemed, at least bilingual; they could certainly understand, even if they were hesitant to speak, the language(s) of neighbours.

This ease of interaction between apparently distinct ethnic groups raises another issue. Ethnic identity may be, as Wagner (1978:105), writing of people in the Karimui area east of the Great Papuan Plateau, remarked, "complex, unimportant or highly changeable". While the residents of Gwaimasi (apart from the three Fe̱bi) had no doubt about their identity as Kubo, others were less certain. Many people at Suabi insisted to us that Gwaimasi was a Konai village. Suabi, it seems, was far enough from the eastern boundary of Kubo territory for its precise location to be largely irrelevant to people living

[34] Government and mission practices may be encouraging the emergence of a stronger emphasis on ethnic identity as an organizing principle.

there; the river formed a useful approximation.[35] But the people at Gwaimasi may have had their own reasons for manipulating identity. These people had recently split from a larger community to the west (see below), and their emphasis on cultural ties to Kubo, the people east of the river, may have been a political statement supporting, if not justifying, that split.

Ethnic identity, then, played little part in directing patterns of interaction beyond the village. Rather, such patterns must be understood in terms of the history of personal relationships and the specific details of recent events.

Historically, Gwaimasi's main ties were to Nanega. From 1979 till 1984 most residents of Gwaimasi - and many of those from the three neighbouring communities - lived at Sesanabi, some four hours' walk to the northwest. This large community, situated on Konai land, had assembled at the behest of an ECP pastor (see 2.1.7b); when that pastor died the people dispersed, probably in fear of the unknown sorcerer responsible. After a period living in bush houses an attempt was made to reconstitute the community in a new location. Building was started on the banks of Dua, a little southwest of the original Sesanabi, but when surveyors from Esso arrived on the banks of the Strickland River in late 1985 these plans were disrupted. A split developed between those who advocated building a new village near the exploration camp and those who wished to remain at New Sesanabi. The two groups eventually formed the communities at Gwaimasi and Nanega (the latter on the site of what was to have been New Sesanabi), respectively.

Through 1986, some tension remained between these two communities as a result of the original disagreement.[36] People at Gwaimasi, as the breakaway community, felt a need to justify themselves, to demonstrate that they had made the 'correct' choice and had formed a viable village. To this end they organised *kasimes*, a feast and dance at which several domestic pigs were to be killed (see p.74). Nanega residents not only attended but

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[35] Use of the river to approximate social boundaries also caused ambiguity as to Administrative responsibility for Gwaimasi; see footnote 14.

[36] Peter Dwyer and I, as potential sources of money, were drawn into the disagreement. Immediately after our arrival messengers were sent to Nanega to invite them again to come and build at Gwaimasi and so share in the future wealth. Several people came to inspect us but, having assured themselves that we had no intention of building an airstrip, decided to remain where they were.

also brought three very large domestic pigs of their own; Gwaimasi immediately increased its planned contribution to at least match that of the visitors (total weight, not number, was most important; Dwyer 1993). A sense of competitive exchange, perhaps not institutionalized but nonetheless real, underlay interaction between the communities at least on this occasion.

Events like *kasimes*, in which people participated as members of a community, were not common. Most contact between Gwaimasi and its neighbouring communities, including Nanega, consisted of private visits by individuals and families. People visited each other for a wide variety of reasons: to harvest nuts from trees that they owned; to discuss arrangements for marriages or funerals; to escape tensions within their own communities; or just for a change of scenery. Also, Kubo, like Gebusi, "love to congregate and are easily persuaded to join a gathering elsewhere" (Knauft 1985a:26); young men, in particular, regularly visited other communities to attend all-night dances. In fact, young unmarried men from Gwaimasi spent significantly more time away from the local subsistence zone than did others (424 of 1856 nights compared to 1149 of 7732 nights; $\chi^2=70.2$, $p<0.0001$), reflecting both their comparative lack of family responsibilities and their interest in courtship.

The pattern of visits between communities was largely a cumulative expression of the agnatic, affinal and matrilateral ties that connected the individual members of those communities. The tendency for clans to be territorially dispersed (p.37) meant that most people had 'brothers' in several places, and the recognition of matrilateral siblingship (p.39) extended this network further. Young men also spent considerable time with their *samo*, their co-initiates who, unlike the pattern Shaw (1990) described for Samo, often came from different communities.

The usual distribution of these relations, and the reasons for visiting in the first place, meant that private visits were largely restricted to the communities immediately adjacent to Gwaimasi. But not all visiting was of a private nature. Gwaimasi was not isolated from the modern world, nor did the people living there wish to be. Participation in that world, however, usually necessitated travel to Suabi or Dahamo at least. (Suabi was generally preferred because it was in Kubo country, but there was also a perceived tie to Dahamo through enfranchisement via Kiunga.)

Gwaimasi residents were engaged in minor attempts to establish cash crops, were being solicited to invest money in a trade store at Suabi[37], and were trying to petition the government for a road through their area; all these interests required trips to, and visits from, people at Suabi. Many residents travelled to Dahamo to vote in elections for the national government. One youth left to attend grade six at a school north of Kiunga, and another wished to attend the new school planned for Suabi. Modern medical services were recognized as potent (provided that the underlying cause of illness - spirit attack or sorcery - had been neutralized first), but could only be obtained from Suabi or Dahamo. On several occasions people carried their children to the aid post at Suabi for assistance, or to Dahamo for inoculations, but the distance was considered too far to carry adults. Finally, once a month or so we employed two people to carry mail to Suabi, and to bring back mail and occasional supplies.[38] At least 69% of all nights spent beyond the communities immediately adjacent to Gwaimasi (855 of 1228 person-nights), concerned such non-traditional motives.

2.3 INTERACTION

Although I have described them separately, the geographical and social landscapes within which people at Gwaimasi moved were not independent.

The socially defined groups of residents discussed in Section 2.2 were strongly mapped in the spatial arrangement of the village. This is obvious in Figure 15, which places a schematic version of Figure 9, the layout of the village, over a summary of the kinship diagram from Figure 14. Each household, as noted before, had a separate house and hearth. Those houses were not randomly sited. Families linked by close affinal or matrilateral bonds, particularly partners to a marriage exchange, built adjoining houses.

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[37] Joshua, the primary solicitor, was of a Gomososo patriline based at Suabi. He appealed to agnatic loyalties in his request for funds.

[38] The carriers, usually men, were selected by the community. Not infrequently, they appointed visitors who wished to earn some money. Although these journeys were stated to be for the purpose of carrying our goods the people employed usually took the opportunity to visit friends and relatives at Suabi, and to do some shopping for themselves and others at Gwaimasi. Various private matters were also dealt with on these trips; on one occasion negotiations for a marriage were finalized. Our arrangement may have determined the timing of visits to Suabi, but not all the visits themselves.

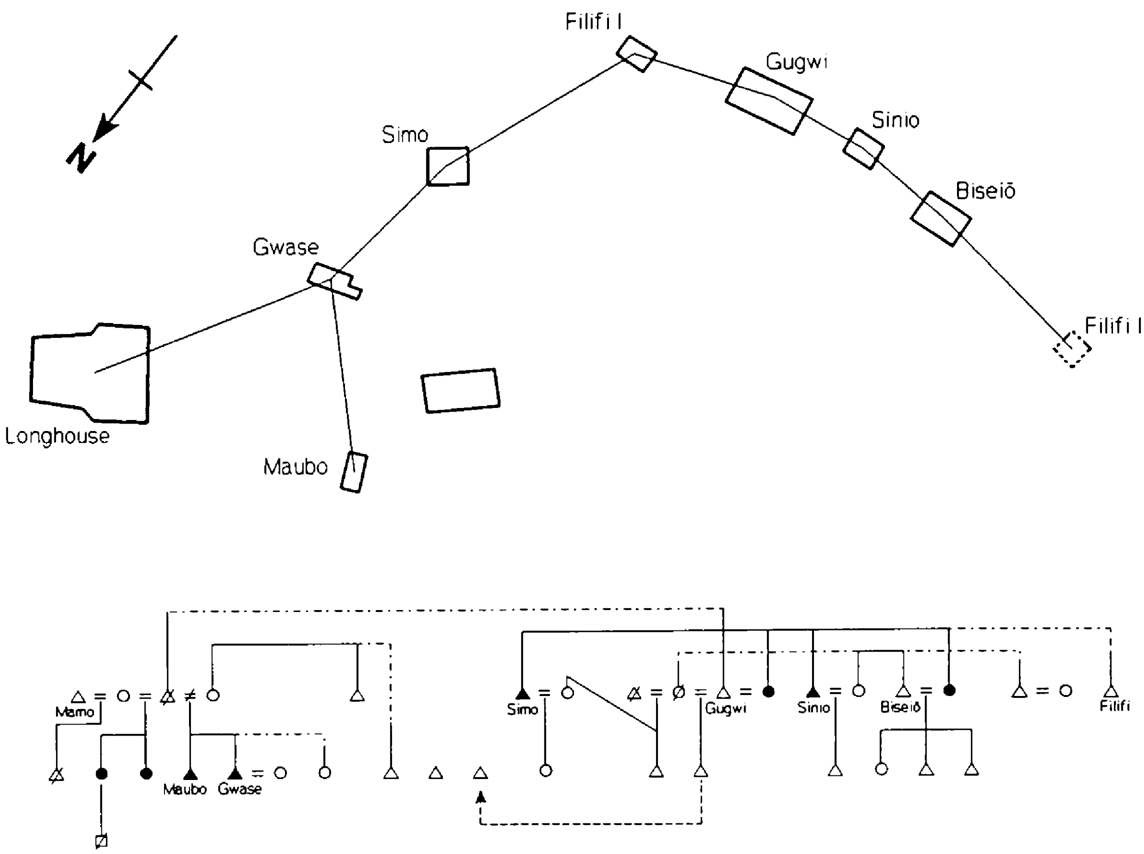

Figure 15 Spatial arrangement of village houses mapping social relationships between occupants.

In fact, each of these 'family clusters' at one stage shared a house, or at least a hearth. The two 'clan groups' - sibling sets from Gumososo and Gomososo clans respectively, with their affines and dependants - were spatially separated within the village. Houses of the former, the group I refer to as Down-gabo (see p.73), were built toward the eastern end of the village, where the levee sloped down to the longhouse before dropping abruptly to the river; they were perceived as being downhill (*mukomo*). Houses of the latter, the group I refer to as Up-gabo, were built across the top of the levee, towards the western edge of the village. Our house (originally intended as a government patrol house) was positioned between the two groups, further emphasizing the fact that they were perceived as distinct; for us and, indeed, for other residents, it proved a useful location from which to observe activities within the village.

Social affiliation was also reflected in the spatial arrangement of procurement activities. The 'family clusters' at Gwaimasi, like co-resident affines and matrikin among Gebusi, tended not only to "reside in the same house, [but also to] undertake communal foraging and sago processing activities, and keep adjacent gardens" (Knauft 1985a:163-

164). Again, however, it was at the level of 'clan groups' that the strongest patterning occurred. Down-gabo residents concentrated nearly all their activities to the north and west of the village, while Up-gabo residents worked areas to the south and east. This patterning was revealed most clearly in the location of gardens and bush houses, but was reflected also in choice of hunting and fishing locations (see Chapter 3 for details). As will be shown below (7.2.3), these choices had major consequences for the quantities and types of fish caught by the two groups.

The boundary between the areas used by the two groups did not correspond to that between the territories of their focal clans. Each group used both Gumososo and Gomososo land. The areas favoured may have reflected recent historical associations of the particular patrilines at Gwaimasi; as noted earlier, for example, Gwase claimed special rights to the land north of Sigia (p.40; see also next Chapter). This in itself, however, does not explain the general separation of activities, since people still held rights to use any of their clan's land,

Finally, the two 'clan groups' at Gwaimasi had different patterns of interaction with people from other communities. Again, there was a spatial component to the difference. People from the north and west stayed at the longhouse, and ate at the hearths of Down-gabo people. Visitors from the south and east usually stayed in and ate at Up-gabo houses; even formal visitors from these directions usually stopped first at Gugwi's hearth before proceeding to the longhouse. The corollary also held; Down-gabo people were more likely to visit Nanega, Wagohai and Diwosuhau (106 of 154 nights spent with neighbouring communities) while Up-gabo people more often visited Gugwuasu and Sosoibi (130 of 173 nights spent with neighbouring communities). In this case the difference certainly reflected past patterns of intermarriage and alliance. Its effect, however, was again to place people in different physical contexts when it came to fishing.

CHAPTER 3
SUBSISTENCE AT GWAIMASI

This study is concerned with fishing behaviour at Gwaimasi. But fishing, as I have noted before, was a comparatively minor component of subsistence in this area; local people had access to other sources of meat, and other activities to occupy their time. The availability of equivalent resources through one's own or others' efforts, and the competing demands of alternative activities, presumably would have affected the fishing decisions that people made. Thus, neither the motivation for fishing nor the organization of fishing effort can be understood in isolation from broader subsistence arrangements at the community. This chapter provides a general overview of subsistence activities at Gwaimasi, in order to establish a context for more particular discussion of fishing behaviour.

3.1 SUBSISTENCE ACTIVITIES

People living at Gwaimasi in 1986-87 subsisted on a combination of (1) shifting cultivation, (2) processing of sago palms, (3) collecting forest products, including those of arboriculture, (4) hunting terrestrial and aquatic animals, (5) pig husbandry and, to a minor extent, (6) wage labour. This section examines these activities. For each, I outline the role played in overall subsistence. I then discuss the demands each activity imposed on spatial and temporal patterning of behaviour, and the ways activities were scheduled to accommodate those demands. My concern, throughout, will be with broad patterns of activity associated with production, and not with quantitative analyses of that production; details of subsistence behaviour at Gwaimasi have been published elsewhere (see Dwyer 1993; Dwyer & Minnegal 1990, 1991a,b, 1992a,b, 1993a,b, in press a,b).[1]

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[1] Kuchikura (in press) and Suda (1990, 1992, 1993) have provided details of subsistence behaviour at other Kubo communities. Their papers refer to southeastern communities that had been established for fifteen years or more by the time of study in 1988 and which, with 62 and 106 residents respectively, were significantly larger than Gwaimasi. Though themes were similar, the details of behaviour at these communities

The components of subsistence listed above are, in general terms, characteristic of all Kubo communities. The contribution each makes to the whole, however, will depend on the particular mix of environmental zones available; most Kubo communities, for example, do not have the Strickland River at their doorstep, nor access to the extensive swamp forests found west of the river. In addition, the activities emphasized within these components may be highly dependent on the particular mix of interests and abilities displayed by members of a given community; hunting in this region, for example, is characterized by individual specialization in relation to tactics and targets (Dwyer & Minnegal 1991a). Finally, the importance of different components may change not only with the seasons but also through the life history of a community; people may shift from almost total reliance on sago as carbohydrate to almost total reliance on bananas as a village becomes established (Dwyer & Minnegal 1993b, in press a). What follows, then, is not to be taken as a description of 'Kubo subsistence' in any abstract sense. It refers only to subsistence patterns at Gwaimasi in the 14 months from September 1986.

3.1.1 Shifting cultivation

People at Gwaimasi obtained, at a rough estimate, around 3000 kcal per person per day from staple plant foods during the survey (Dwyer & Minnegal in press a). Approximately 60% of this total came from gardens, 50% as bananas and the other 10% as tubers. Gardens also provided a steady supply of leafy vegetables, while the timber felled within garden areas provided firewood and served as breeding places for edible fungi and beetle larvae. Two basic types of gardens could be distinguished - large unfenced plots of bananas (*hame hai* = trees are felled) and smaller plots, often fenced, planted primarily with tubers (*sogo* = to plant). These characterizations reflect dominant themes, they are not absolute; at least some bananas, tubers and other small crops were planted in all gardens.

Banana gardens comprised about two-thirds of the area planted by residents of Gwaimasi during the survey. Individual or family plots averaged 0.20 ha (range 0.03 - 0.52 ha; n = 23), with bananas planted at a mean density of 13.82/100m^2. The first bunches of bananas were available for harvest within nine months of planting, with

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were somewhat different from those seen at Gwaimasi (Dwyer & Minnegal in pressa,b).

production peaking at twelve months and effectively over by nineteen months after planting (Dwyer & Minnegal 1993b). A variety of tubers (taro, yams and sweet potato), leafy greens (eg. aibika, acanth spinach, highland pitpit) and recent introductions (eg. corn, beans) were scattered in suitable spots throughout the area, but most were short-term crops that were harvested before the bananas reached maturity. Crops that were slower growing and might last as long as the bananas themselves (sugarcane, lowland pitpit and cassava) were planted at the edges of the garden, while tree crops which would far outlive the life of the garden (fruit pandanus, okari nuts, breadfruit) were planted as isolates or as small clumps in suitable spots (see 3.1.3).

Tuber gardens were smaller than banana gardens, with an average plot size of 0.07 ha (range 0.01 - 0.21 ha; n = 16), and had a less obvious succession of crops. Bananas plants were not common in these gardens; mean planting density was only $1.95/100m^2$. Instead, taro tended to dominate though, again, this was usually interplanted with a range of small crops. Two gardens consisted almost entirely of sweet potato and, in another two, lowland pitpit predominated. In addition, small plots of yams, usually fenced, were sometimes planted within banana gardens.[2] These small gardens provided variety to the diet, rather than staple foods.

All gardens at Gwaimasi were cut from secondary forest. Banana gardens were established only in areas where tree ferns, which characterize early regrowth, had been completely shaded out by maturing forest trees. Local people asserted that if an area were replanted with bananas before forest succession reached this stage (estimated as about 15 years from previous felling) the crop would be poor. Tubers, on the other hand, did not require such a long fallow, and would grow well in places where tree fern still grew. They, and other small-crops, were said to grow best on relatively flat ground and were usually planted on the tops of ridges. Near Gwaimasi, however, the primary constraint on garden location was drainage. The need for adequate drainage effectively restricted potential garden sites to levee banks beside the Strickland River and some of the major streams, or to an occasional rise within the backswamps. Figure 16 maps the location of all gardens made, maintained or harvested during the survey period. As can be seen, gardening activity in 1986-87 nearly always entailed close proximity to the river.

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[2] Yam plots appear to have had an importance beyond that of subsistence, and may be relics of earlier horticultural practices (Dwyer & Minnegal 1990).

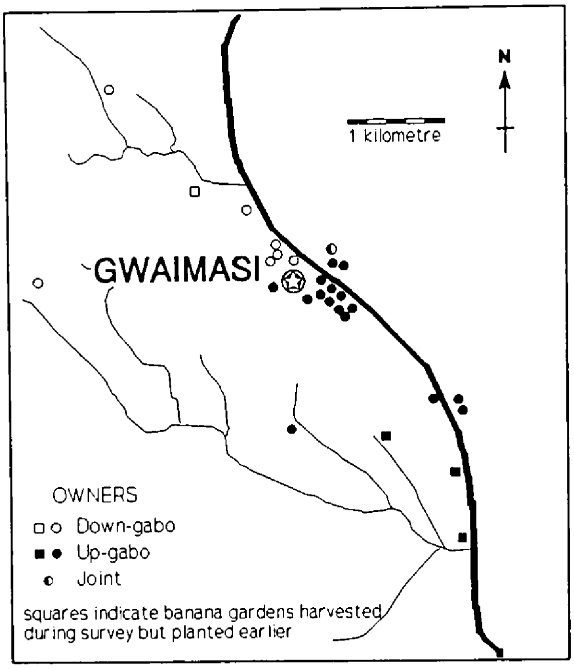

Figure 16 Location of gardens planted or harvested by residents of Gwaimasi between mid-September 1986 and mid-October 1987.

Families and unmarried males gardened independently, an independence reflected in the variation in size of areas planted by different households during the survey.[3] Often, however, two or more households (particularly partners to a marriage exchange) cooperated by establishing contiguous plots, thus reducing the labour of clearing and felling. The right to establish gardens was conferred by residency, not by clan identity, and all households at Gwaimasi owned plots of bananas on Gumososo land near the village. Clan affiliation did, however, affect the location of those plots. As Figure 16 shows, gardens of Down-gabo residents (Gumososo) were north and northwest of the village, while those of Up-gabo residents (Gomososo) were to the south and southeast. With one exception all gardens established east of the Strickland River belonged to Up-gabo residents. (The exception was a garden established by two unmarried males, of Gumososo and Gomososo clans respectively, who exchanged sisters in marriage shortly after the study.)

In the 14 months from September 1986, Gwaimasi residents planted a total of 3.86 ha of gardens, 2.62 ha of which were banana gardens. Gardens were started in all months of the year (Dwyer & Minnegal 1993b). A reduction in gardening activity between September and November, coincident with an expected reduction in monthly rainfall, may

[3] Some of this variation may have evened out over a longer timescale (though this is not necessarily so; see Dwyer & Minnegal 1992a) but, here, I am primarily interested in patterns of relative effort through the survey.

have reflected seasonal constraints on planting of bananas.[4] The pattern was diffuse, however, and surveys suggested that season of planting had little effect on productivity of gardens. Different households thus could, and did, follow very different planting regimes (see Dwyer & Minnegal 1992a).[5]

Gardens were initiated by clearing undergrowth and small saplings in the selected area. This was a task for all the family; though tedious, it required no more than a bushknife. (This being the case, women had considerable control over initiation of gardens. Only once, during 14 months, was a clearing initiated by women not subsequently planted and felled.) With undergrowth gone, and before trees were felled, it was time to plant. Collection of planting materials, particularly banana suckers, could be time-consuming and laborious; a new garden of average size would require transport of as many as 300 banana suckers, each weighing near a kilogram, from old garden sites. Again, both men and women contributed but men, with access to canoes, could transport larger loads more rapidly than could women. With crops planted, and given a few days to settle in, trees were felled. At this point men came into their own; although women freely handled axes, and used them regularly to prepare firewood, no woman took any part in felling trees at a garden. (There may have been a restriction on climbing which, since many trees were cut above their buttresses, several feet above the ground, would have precluded women from this activity.) Tubers were weeded a couple of months after planting, and bananas were weeded as they began to set fruit - in both cases primarily by women - but otherwise people engaged in little maintenance of gardens. When gardens began to produce, women were responsible for most of the day to day harvesting. If a large harvest was due, however, men would do much of the work.

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[4] At Gwaimasi, in 1986-87, most bananas (85% of the total) were planted in the months December to March and August (Dwyer & Minnegal 1993b). In contrast, Shaw (1990:41) reported that neighbouring Samo people planted most bananas in June and July to coincide with relatively dry weather. Without knowing the data on which Shaw based his conclusions I cannot resolve this apparent contradiction. There may be, in fact, no strong seasonal constraints on growing bananas in this area; the patterns reported may be artefacts of short-term variation.

[5] Of crops other than bananas grown at Gwaimasi, only yams (*Dioscorea alata* and *D. esculenta*) displayed marked seasonality, with nearly all yams planted in September-October (Dwyer & Minnegal 1990). Lowland pitpit (*Saccharum edule*) flowers seasonally but, at Gwaimasi in 1986-87, little was planted and the associated activity was not obviously seasonal.

Each of the tasks associated with establishment and maintenance of gardens required several days, at the least, of intensive labour (for details, see Dwyer & Minnegal 1993b). Clearing, planting and felling had to be done in close succession. Kubo working style entailed frequent interruptions of labour, but people were unlikely to move far from the primary task. As noted before, most gardens established in 1986-87 were sited on the levee bank along the Strickland River. Gardening, then, kept both men and women close to the river for several days at a time at irregular intervals through the survey.

3.1.2 **Processing sago**

Sago flour (*wo*), obtained from palms of the species *Metroxylon sagu*, provided approximately 40% of the energy from staple plant foods eaten at Gwaimasi in the 14 months of the survey, but its importance varied through that time (Dwyer & Minnegal in press a). Unlike gardening, sago-processing provides immediate returns; it can thus be used to buffer variation in the availability of garden produce. Through much of 1986, before the new gardens of the village came into production, sago provided nearly all carbohydrate eaten. That contribution dropped in later months, but there was evidence that sago production continued to be used to buffer short-term fluctuations in availability of bananas (*ibid*); during the survey, sago contributed between 10% and 80% of plant carbohydrate consumed in different months. Sago flour itself is a poor-quality food, providing little other than calories, but the activities involved in its procurement did offer some additional nutritional benefits. People ate the heart of palms as a vegetable, incubated beetle larvae in unprocessed portions of trunk, and fed pith to domestic pigs. The opened palm trunk and piles of waste pith at processing sites also attracted wild pigs and birds, which could be ambushed from hides (see below).

Gwaimasi residents had at least 30 names for varieties of sago palms. Most of those names referred to domestic varieties, but the two 'wild' varieties were by far the most common in the local subsistence area. The distinction is important. Wild palms belonged to the land, and members of the clan whose land it was could allocate their use. Domestic palms, on the other hand, which had not 'come up by themselves' but had been deliberately planted, belonged to the person who had planted them. Both men and women planted and owned palms, and passed on rights in those palms to their children.[6] An

[6] In contrast, among Bedamuni, only men planted sago palms, though both women and men could inherit palms (Beek 1987:22).

individual could, in this way, have rights to sago palms on the lands of several different clans, rights established through historical association rather than corporate identity. The two categories of palm tended to be spatially separated; wild palms grew in swamps, which made for less pleasant working conditions, whereas people usually planted palms in more congenial locations, in gullies draining drier land near their houses and gardens.

Figure 17 shows the location of palms processed in the 14 months of the survey. Most were within the backswamps west of the Strickland River, where extensive stands of wild palms were to be found. Again, clan affiliation affected the spatial patterning of activities, with Down-gabo residents working palms to the north and west of the village, and Up-gabo residents more likely to process palms to the south and east. The pattern is blurred, however, by the tendency for as many as five women to participate in processing a palm. In general, Down-gabo women processed more palms than did women from Up-gabo, probably reflecting the fact that they, as Gumososo wives and daughters, had unambiguous rights to wild palms in the vicinity of the village (Dwyer & Minnegal in press b).

Sago palms take about 15 years to reach maturity, then flower and die. Palms should be processed before flowering and seeding, which uses up much of the starch previously stored in the trunk, but otherwise there are few constraints on timing of harvest. Processing itself requires the availability of adequate quantities of water, but this was rarely a problem given the rainfall at Gwaimasi. There was no evidence of seasonality in patterns of sago processing during the survey. People did, however, adjust their processing activities to some extent according to both the demands of gardening and the productivity of their gardens (Dwyer & Minnegal in press a). Because households differed in their gardening schedules, patterns of sago processing activity also varied.

Extraction of sago flour from *Metroxylon* palms is a labour-intensive activity. The palm is felled, the trunk opened and the pith fragmented with a pounder.[7] The pith is

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[7] At Gwaimasi, sago pounders (*mogong*) consisted of a head of carefully flaked chert set in a wooden handle (Minnegal 1991). The chert heads (*tibi mogong*) were manufactured by men from stone obtained from the stream Sigia. Pounding and washing sago was, by convention, a woman's task, yet I saw no women knapping stone. Men's control over an implement essential for sago processing could be interpreted as a means of controlling the production process itself. On at least one occasion, however, a woman improvised a pounder from a broken cobble and such tools (*yu mogong*) were acknowledged as effective; Kubo women living at Suabi regularly used *yu mogong* rather than *tibi mogong* to process sago.

then transferred to a trough, usually made from the bases of fronds from the palm, and kneaded with water to release starch grains from the fibres. Starch-laden water is filtered into a settling trough from which, after some hours, the wet flour is transferred to special finely-woven bags for storage. Sago flour can be stored for up to three months if kept damp under waste pith, and for at least a year if wrapped in leaves and buried in mud.

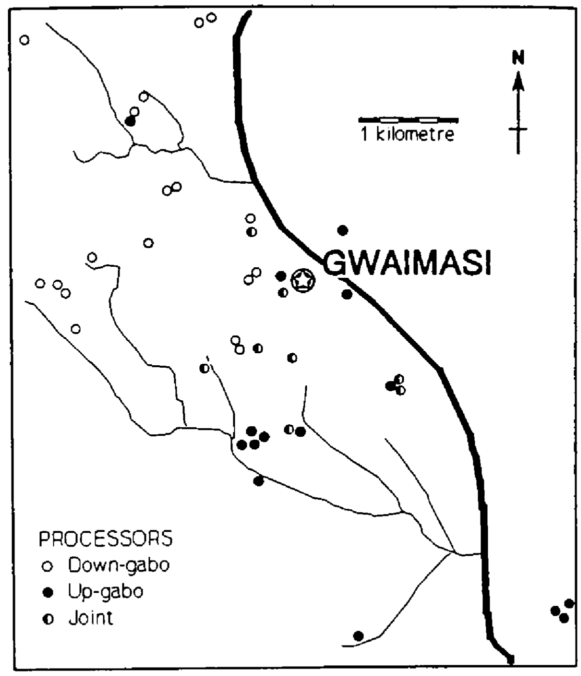

Figure 17 Location of sago palms processed by residents of Gwaimasi between mid-September 1986 and mid-October 1987.

Residents of Gwaimasi processed between 42 and 45 sago palms in the 14 months of the survey.[8] Each entailed an average 10 days of labour, usually shared by two or more workers, and provided a mean of 117.6 kg of flour (range 20.8 - 276.3 kg; n=26). Women contributed most of that labour. Most of the work by men, less than 10 percent of the total hours, occurred on the first day of processing; men usually (but not always) felled the palm and opened the trunk. The time-consuming and repetitive tasks of pounding and washing pith generally were left to the women. These roles were conventional, not legislated. Both men and women were capable of performing all tasks if necessary; on at least one occasion a woman felled the palm, and men would occasionally help by pounding pith for their wives.[9]

In most cases, processing of a palm was completed over a run of consecutive days. Sago processing thus placed people in the vicinity of backswamp streams for several days at a time. While women were occupied for much of that time, accompanying men and children were free to engage in other activities nearby.

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[8] Records of processing activities in September and October of 1986 are incomplete (see Dwyer & Minnegal in press a).

[9] Youths and initiated bachelors were occasionally required to process small quantities of flour for use at curing ceremonies; two palms were felled for this purpose during the survey.

3.1.3 **Collecting**

Collecting plant foods from the forest was an everyday, though minor, part of life at Gwaimasi; people would gather a few leaves (especially of *hō*, the tree *Gnetum gnemon*), or fallen nuts or fungi on their way to or from other activities. The raw materials for housing, clothing, ornamentation and tools also were obtained from the forest: construction materials were obtained in swamp forest, in the form of sago midribs and fronds, and the stilt roots of a species of pandanus; bark for fibre and baskets, striped palm fronds for skirts, and the black palms required for the best bows and arrowheads, were located on drier ground; the cane grass used for arrow shafts, and the Job's tears for beads, grew in open places along the river and streams; the bamboos for bowstrings, and for the broad, sharp-edged, arrowheads required to kill large game, came from the foothills some distance from the village; and the stone for tools used to manufacture these and other items came primarily from the bed of the stream Sigia, north of the village. Most of these resources were encountered close to the village, and taken as required. Some, however, such as the bamboo (*igie*) for arrowheads, were located well away from usual activities, and procurement necessitated specific collecting trips of a day or more.

On occasion, people from Gwaimasi made specific trips to harvest large quantities of fruit or nuts from trees in the forest, particularly fruit pandanus (*Pandanus conoideus*), breadfruit (*Artocarpus* sp.), okari nuts (*Terminalia* sp.) and galip nuts (*Canarium* spp.). These were not strictly forest resources. All were cultivated species; people had planted many, if not most, of the specimens in the local subsistence area. They were, however, scattered as individual trees, or small groves of a few trees, through advanced regrowth forest. (Unlike their neighbours on the Great Papuan Plateau, Kubo did not maintain extensive orchards of tree crops such as pandanus, preferring to establish several scattered plantings; cf. Dwyer 1990). Tree crops, like others, are planted in garden clearings, but do not produce till well after the rest of the garden has been abandoned, and may continue to do so long after the garden has reverted to forest. Consequently, people must go away from current areas of gardening activity to exploit them.

All these tree crops were seasonal. Fruit pandanus (*koiye*) produced some fruit all year round, but availability peaked between September and December when it was eaten on most days. Breadfruit (*doiye*) were available in small quantities until early December in 1986, then again from late April in 1987. Okari nuts (*dugaiō*) were available till late

August in 1986, and in smaller quantities from late March to mid-July in 1987. One species of galip nut (*haga*) was harvested from at least August to December in 1986, another (*kose*) was harvested from mid-September to December 1986. Both okari and galip trees were mast fruiters, producing large crops only once in two or three years.

As with sago palms, fruit and nut trees belonged to the person who had planted them, or to his or her children. (Again, both men and women could plant and own trees.) Passing individuals usually were free to pick up any fruit that had fallen, but only the owner had the right to harvest from the tree itself. Fruit pandanus were most abundant, usually harvested on day trips that rarely involved more than three hours of travel. Given the long productive life of some nut trees, however, people were likely to have rights to trees in a variety of often distant locations. People made trips of several days' duration to harvest such distant crops and, given the dispersed distribution of trees, these trips often covered a lot of ground.

3.1.4 **Hunting and fishing**

People at Gwaimasi obtained, by New Guinea standards, a large amount of protein from wild animals - a minimum of 40 grams per person per day from vertebrate animals alone in the 13 months of the survey (Dwyer & Minnegal 1991a; cf. Dornstreich 1973; Dwyer 1985a; Hyndman 1979; Ohtsuka 1983; Townsend 1969).[10] Their success was accomplished by using a diverse array of strategies and tactics to pursue a wide variety of species. At least 83 species of vertebrates and 13 species of invertebrates were caught during the survey, and many others were reported to be edible; only the freshwater crocodile and three species of birds were known not to be eaten. Prey selection clearly was broadly based.

Wild pigs (*o fia*) provided most of the meat eaten at Gwaimasi; 70 were killed in the local area during the survey, providing 1327 kg of edible meat (27.2 g

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[10] Suda (1992) and Kuchikura (in press) have reported much smaller amounts of protein procured from animals at two villages in the southeast of Kubo territory (c. 8 g and 18 g protein/person/day respectively). Those villages were larger than Gwaimasi and had been established 15-20 years before the survey in 1988. Local game may well have been depleted as a result.

protein/person/day).[11] These animals were most often obtained in the forested foothills east of the Strickland River or north of the stream Sigia, hunted by men and youths armed with bows and arrows[12] and accompanied by three or more dogs. Most pig hunts were successful within a few hours. Men made no secret of their intention to hunt and people at the village openly discussed their expectation of eating pig that day. Longer hunts, entailing one or more nights absence in the foothills, were undertaken only when it was intended to obtain more than a single pig. Such trips were associated with intercommunity events; one pig usually provided more than enough meat for all at Gwaimasi.

Some wild pigs were obtained in the extensive backswamps south and southwest of the village, by shooting from blinds built at current or recent sago workings and by trapping within felled sago palms. Ambushing from a blind was attempted often but with little success. By contrast trapping, though usually successful, was seldom attempted. The technique had two immediate disadvantages; a large sago palm, with starch suited for human consumption, had to be sacrificed and there was a delay of from three to four weeks between setting the trap and making a capture. In September 1987, Gwaimasi residents switched from hunting pigs to trapping them (with three captures in October) after a distemper epidemic reduced the local population of dogs from nineteen to four and made hunting impractical (Dwyer & Minnegal 1992b).

Cassowaries (*djiwo*, the double wattled cassowary) were comparable in size to wild

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[11] Estimates of protein content, here and elsewhere in this section, are based on values provided in Ohtsuka & Suzuki (1990: appendix); wild pig and cassowary are considered to have 20 g protein per 100 g edible portion, and fish to have 15 g protein per 100 g edible portion. (Edible weight is calculated at 0.65 of bag weight for pig and cassowary, and 0.85 of cleaned weight for fish.) Consumer days are calculated as the total number of nights that a person slept either at the village or within the subsistence zone associated with the village, with allowance made for reduced consumption by children (see 8.1.2). The consumption rates given in this section are based on 9772.9 adult-equivalent consumer days; if my partner and I, and a friend who visited briefly, are excluded from the count this would fall to 8956.9 consumer-days.

[12] There were no shotguns available to people at Gwaimasi in 1986-87. Bows and arrows were made from locally available materials using traditional techniques and tools. Chert cores, made of stone from Sigia, were used to shave bows. Chert flakes from the same source were preferred for shaping and sharpening arrows and arrowheads of both bone and wood (Minnegal 1991). Metal knives were widely available, but said to be less effective than stone for these tasks. Similarly, when it came to butchering the catch, knives of split bamboo were often preferred as sharper than metal knives.

pigs, but obtained much less often; only 18 were killed during the survey, providing 243.5 kg of meat (5 g protein/person/day). In contrast to pigs, cassowaries were taken most often in swamp forest. Again, they were hunted by men and youths armed with bows and arrows but dogs, being unable to run well through swamp, were not used in the chase.

Women did sometimes capture a wild pig or cassowary, and at least once during the survey a women went out with the express intention of procuring a pig. The animals caught were usually small, and most had been held by a dog roaming the forest while the woman was engaged in other tasks. Women did not use bow and arrows (though girls did play with toy versions) and did not, to my knowledge, set traps; they thus lacked the means to secure larger animals.

Though returns from wild pigs and cassowaries were impressive when averaged over the duration of the survey, their contribution to the diet was erratic. Meat from these animals was brought in on only 56 of the 399 days of records, with numbers in any month ranging from one to ten for pigs and zero to four for cassowaries (Dwyer & Minnegal 1991b). Because Kubo were able to preserve meat for two months or more by smoking, the potential existed to compensate for uneven returns by delaying consumption. But preservation by smoke-drying was time-consuming, and the prevailing ethos dictated enthusiastic consumption and sharing of available meat. Except where prestations were pending, most meat was consumed within three days of capture.

The irregular availability of meat from large game animals was buffered to some extent by procurement of other terrestrial and arboreal prey. Larvae and pupae of weevils harvested from sago palms were a major supplementary source of both protein and fat, harvested from prepared palms in the backswamps in at least 30 of the 57 weeks of the survey. Palms had to be prepared six to eight weeks before harvest, however, and, though hauls could be large, poor timing or the activity of pigs often reduced success. Many small prey items were encountered incidentally, in the course of other activities or while walking to or from gardens or sago-processing sites; lizards, snakes, small mammals, insects and insect larvae of various sorts were taken in this way by both adults and children. Such captures came predominantly from the levee bank zone where people gardened, not because the animals were more abundant in that zone but as a reflection of other activity patterns. In fact, the levee banks where people lived and gardened were relatively unimportant in the pursuit of wild animals. Nearly everywhere in this zone, the structure and composition of the forest was an artefact of human disturbance but, in contrast to some other tropical regions (eg. Nietschmann 1973; Linares 1976; Peterson 1981), the impact of people had not enhanced abundance of the species commonly sought. Larger animals also could be procured though casual encounters. Dogs occasionally located bandicoots in burrows, and alerted people working nearby to the find. (Women were most often in a position to take advantage of these events, and were responsible for 9.5 of the 15 bandicoots captured during the survey.) Men carried bows and arrows at all times when travelling, and watched for any sign of prey. They would divert to pursue anything substantial seen, but were rarely successful in these contexts. Procurement of birds (eg. hornbills, megapodes, crown pigeons) usually necessitated more deliberate effort - construction of a hide near feeding locations or nesting sites, and several hours spent waiting in ambush.

These minor strategies contributed relatively little to the overall amount of meat procured and, though captures were relatively frequent, they were not usually predictable. More reliable supplementation of the meat from large game animals came from aquatic animals.

More than 1378 fish (*dio*) were caught in the Gwaimasi area during the survey, providing 573 kg of edible meat (8.9 g protein/person/day). Fish thus contributed less than a third the amount of protein obtained from wild pig and cassowary. But fish were available much more regularly than large game animals. People at Gwaimasi obtained fish on at least 227 of the 399 days of the survey; there was only one week in which no fish were caught.

Fish, and fishing, are the subjects of analysis in the rest of this work. I will say little about them here, beyond noting that most fish were obtained either by men diving in streams of the backswamps, or by men and women setting lines in the Strickland River. But fish were not the only prey obtained from rivers and streams. Crayfish (*die*) and large freshwater shrimp (*guwo*) were often encountered and taken while diving for fish; the actual numbers caught were not recorded, but hauls of up to 2.5 kg were seen during the survey.[13] Smaller crustacea were occasionally caught by hand in the small streams near the village. Three species of turtle were caught also during the survey. One small

[13] Kuchikura (in press) recorded more crustacea than fish produced by fishing in streams near the village of Giwobi at the southern edge of Kubo territory.

species (*dife*) was encountered in backswamp streams while diving for fish. The two larger species, *gwohegu* (the pitted-shelled turtle, *Carettochelys insculpta*) and *habua* (the soft-shelled turtle, *Pelochelys bibroni*), were available only in spring (October-November) when they entered clear streams, such as Sigia, in search of nesting sites. These animals (or rather, signs of their nesting) were usually discovered incidentally while travelling along Sigia, but occasionally they were the target of specific hunts if a feast was planned at the appropriate time of year; three soft-shelled turtles were caught and held alive for a feast to mark our departure in November 1987.[14]

Aquatic animals, unlike terrestrial animals, are not opportunistically encountered in the course of other activities. (The turtles mentioned above are encountered only because they leave the water.) Procurement of aquatic animals, whether by direct pursuit or by trapping, thus entails a deliberate departure from those other tasks. But this does not mean that fishing is divorced from such activities. In fact, as will be shown later, fishing was often embedded, not within other activities as such but within the contexts where those activities occurred; people usually fished in streams near where they were gardening or processing sago, and chose techniques and strategies accordingly.

Most of the animals eaten by people at Gwaimasi, whether terrestrial, arboreal or aquatic, were actively hunted or trapped. Many of the species sought were located, or most easily obtained, in particular environmental zones or even at particular places. In addition, many of the hunting strategies and tactics employed were best suited to particular species or, in the case of fish, sets of ecologically similar species. As a consequence, the search image, during single episodes of hunting was usually narrow. People sought a particular species or set of species within a particular environment using a particular tactic; they went to dive for fish, to set baited lines, to hunt cassowary or pig, or to sit in hides at the mounds built by megapodes or high in fig trees where hornbills fed. When searching for one category of animals people seldom deflected to take another (Dwyer & Minnegal 1991a).

One consequence of the narrow focus of most hunting episodes was to favour role specialization. I have noted already that men and women at Gwaimasi obtained animals in

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[14] At Waibi, 40 - 50 km down the Strickland River from Gwaimasi, 17 pitted-shelled turtles and a soft-shelled turtle were taken at one nesting beach for a feast in October 1986.

different ways. Not surprisingly, perhaps, given the limitations of the strategies that they freely used, women obtained only 9% of the edible weight of vertebrates taken by residents during the survey. But men also differed greatly in the contributions each made to the total catch. Those differences can be attributed to the species that individuals chose to target, and the strategies each preferred to use. Some men hunted pigs or cassowaries, others fished, and yet others targeted birds or small terrestrial prey. Some pursued mobile prey, others preferred to ambush or trap. Some dived for fish, others clearly preferred to set lines. The choices made reflected individual interests, knowledge and skills relevant to hunting.

Not all hunting skills were equally productive. In fact, those who specialized in hunting large terrestrial game procured at least twice as much meat as others during the survey, and more than ten times as much as some. But this differential production did not translate into differential consumption. Large hauls of meat, whether pig, cassowary, turtle or fish, usually were brought back to the village and distributed publicly to all present. Smaller hauls were less formally shared (not everyone necessarily partook of each haul) but, nonetheless, it was rare for someone to miss out while others ate. With comparatively large amounts of protein available on a fairly regular basis at Gwaimasi, there was little motivation for people to hide game from the community (cf. Beek 1987:145ff).[15] People often ate part of their catch in the bush during the day, but made no secret of this and the knowledge undoubtedly played a part in patterns of distribution back at the village.

Among Kubo, rights to hunt and fish are nominally vested in the land-owning clan.[16] In effect, however, only regular procurement of large hauls is restricted. Anyone encountering a pig or cassowary while travelling over another's land is free to shoot it, but is expected then to bring the animal to the local community for distribution. Smaller prey, including fish, can simply be eaten by the traveller. Residents of a village on land other than their own (a common condition, given the tendency for affines and

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[15] The only example of hiding meat that I saw was when we gave a small fish to a young boy visiting from Suabi. Seeing other lads approach, he hid the fish under a plate, ignoring it until all were gone and then carrying it away under his shirt. This behaviour may have reflected the fact that people at Suabi - with a population of more than one hundred - had much less access to meat than did those at Gwaimasi.

[16] See 7.1.1 for further discussion of this topic, especially as it relates to fishing.

coinitiates to reside together) make more regular use of that land than do those just passing through. Because they share with co-residents any returns obtained, however, those who own the land do not miss out as a result; in fact, owners may benefit from the particular skills of their co-resident guests. Thus co-residence at a village confers at least informal rights to procure animals in the surrounding area. Given the specialization that characterized hunting by Kubo, relatively free access to hunting and fishing locations would allow all to make best use of their skills.

3.1.5 **Pig husbandry**[17]

Like most people in New Guinea, Kubo raised some pigs as domestic animals.[18] These domestic pigs (*o wai*) were not particularly important for nutrition; from September 15, 1986 to October 18, 1987, people at Gwaimasi obtained only 25 grams of meat per person per day from domestic pigs (Dwyer 1993). As elsewhere in New Guinea, however, these animals played an important role in mediating relations both with people from other communities and with the spirit world. Thus, for example, six domestic pigs, contributed equally by Gwaimasi and Nanega, were killed and eaten at *kasimes*, a feast that affirmed the relationship between the two communities (see 2.2.7). Domestic pigs were demanded in death payments, and the meat of a domestic pig was an integral part of curing ceremonies, used to placate the spirits responsible for illness (Dwyer & Minnegal 1988). Such pigs, then, were too valuable to be killed and eaten simply within the community; in 14 months this happened only once, after considerable provocation as a result of the pig raiding gardens.[19]

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[17] Much of this section summarises material in Dwyer (1993).

[18] In 1986-87 only dogs and pigs were kept as domestic animals at Gwaimasi. A cat was purchased at Suabi in 1987, and brought to the village as a pet, but did not live to breed. Occasionally, a cassowary chick was kept in captivity with the intention that it be carried to Kiunga for sale, but none lived long. Small birds and mammals sometimes were kept as pets, but again most died after a few days; these were not eaten. By 1991, however, domestic chickens had been introduced and cassowaries were successfully being reared in captivity for meat and for use in social exchanges (Dwyer & Minnegal 1992b).

[19] Although the initial motivation for killing this pig may have been pragmatic, the occasion was still constructed within a social frame. Two pigs were killed that day. Despite the provocation, the offending pig could not be slaughtered until an exchange had been arranged.

The social dimension implicit in production of domestic pigs was emphasized by the rules governing their consumption; a pig could not be consumed by its owner, or by anyone of the owner's clan. These animals were purely a medium for exchange, and were always killed in a context of exchange. Often that exchange was reciprocal, entailing the simultaneous distribution of meat from two pigs, one contributed by each of the participating groups. (Live pigs were not transacted; indeed, exchange of live animals would not have been feasible given local management practices which, as described below, emphasized development of a close bond between a pig and its caretaker.) Though the tangible currency was meat, the essential contribution to the exchange appears to have been labour; meat from domestic pigs and from wild pigs was not considered equivalent for the purposes of exchange.[20]

The number of pigs kept by Gwaimasi residents during the survey ranged from 7 to 13 (0.27 - 0.54 pigs per person). Most of these animals were the offspring of domestic sows that had been left in the bush to mate with wild boars, but a few had been captured from wild sows. Whatever their breeding, piglets were not 'owned' before capture; unwanted piglets could be killed and eaten without the social constraints applying to the older animals in which labour had been invested (twelve piglets were disposed of in this way during the survey). Because adult pigs could be safely approached only by their regular caretaker, however, the owner of a sow had considerable control over disposal of its offspring. He or she could invite others to participate in catching a litter, with each piglet subsequently belonging to the person responsible for its capture. Both men and women could own pigs, but men played very little part in their care and maintenance; the primary caretaker was always a woman. That caretaker, even if not the nominal owner, had considerable say in the subsequent disposal of the pig.

Care of domestic pigs at Gwaimasi entailed a mix of foddering, foraging and herding. Piglets usually were caught and brought to the village when two to four weeks old. At first, each was carried about continuously by the woman who would become its primary caretaker, petted often and fed premasticated titbits. As bonding developed, and the animal grew, it was trained to be led and tied by a rope attached to one leg. At about

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[20] By 1991, the meat of cassowaries raised in captivity was considered an appropriate exchange for that of domestic pigs (Dwyer & Minnegal 1993b). Successful rearing of these birds entailed considerable investment both of time and labour in construction of cages (to keep the birds in and dogs out) and provision of feed.

four and a half months its ears and tail were cut to mark its domestic status, and males were castrated; only then was the pig allowed to forage in the forest untethered and unattended by its caretaker. For a year or more, however, the caretaker led the pig from the village each day to forage, and tethered it again at night. These pigs also often accompanied their caretakers to activity sites away from the village, herded along at a comparatively slow pace to allow the pigs to forage. On occasion, women would spend several hours in the forest just herding their pigs to attractive foraging locations. Through this time, women carried food for the pigs to eat both morning and evening; bananas and the pith from sago palms were the staple fodder provided. At about eighteen months, pigs were taken to a site in the backswamps away from the village and released to forage independently until required. The caretaker would visit occasionally, to check the animal and ensure that the bond was maintained, but little work was involved at this stage; at most a sago palm might be felled and opened to provide extra food if the pig was showing signs of wandering further afield. When required for slaughter, a pig was brought back to the village by its caretaker, tethered under the longhouse, and fed until the day of the feast.

Dwyer (1993) has characterised Kubo pig management as time-intensive, rather than labour-intensive; unlike gardening or sago processing, it required regular investment of time rather than periods of intensive effort. Pig management was often embedded in other activities undertaken by caretakers, and strategies followed by different women varied according to their commitments to gardening and sago processing.

3.1.6 **Wage labour**

In 1986-87, residents of Gwaimasi received between K1700 and K2000 (K80 - K100 per adult)[21] from work for a mining company that briefly considered reopening explorations in the area (see 2.1.7) and from occasional work for, and purchases by, my partner and me. Little of the money was spent on food; some was used to purchase the means of procuring food (axes, bushknives, fishing tackle) or of preparing food (cooking pots) but most was spent on clothing. The small quantities of rice and tinned fish that

[21] The Kina is approximately equivalent in value to the United States dollar. In 1986-87 that value fluctuated between about $1.40 and $1.70 in Australian currency.

were purchased served as feast foods, more important for their social significance than for their contribution to diet. Thus, a representative from Gwaimasi presented a tin of fish and a kilogram of rice to his equivalent from Nanega at the feast held in January 1987, and was embarrassed to receive twice as much in return - yet approximately 450 kg of domestic pork was available at the same feast. Again, at Gugwuasu in May 1987, rice and tinned fish was cooked and small servings distributed to all present at an intercommunity gathering at which several hundred kilograms of smoked meat were exchanged.

In addition to the limited amounts of food purchased from trade stores, people at Gwaimasi received quantities of rice, tinned fish and tinned beef from the mining company. We provided rice and tinned fish for the whole community on two occasions, and regularly shared small quantities of food prepared at our hearth with others present. In all, as much as 50 kg of tinned meat and a similar quantity of rice was consumed by residents of Gwaimasi during the survey. Non-traditional foods, then, were a minor, and erratic, component of the local diet. The work entailed in procuring both money and food, however, did have some effect on patterns of movement within and beyond the local subsistence zone, and thus on other activities. (I have restricted analysis of wage labour to adults - that is, to those expected to contribute a full day's work to subsistence. Females were expected to do so by the time they reached marriageable age at twelve or thirteen, while males were unlikely to be constrained by subsistence demands until perhaps fifteen. The money received by children from sale of small items or for brief tasks is included in community earnings, but the little associated labour is considered incidental and excluded from calculations.)

Much of the money received from my partner and me (K494 of K1445) was for work before and after the survey period. In late August and early September 1986, we employed five men and five women to construct a house for us. In November 1987, at the end of our stay, we employed the same numbers (but not all the same individuals) to carry our equipment the two days' walk to the airstrip at Suabi. During the survey itself, we employed people to carry mail to and from Suabi every month or so, necessitiating an absence of at least four days. We also paid people to cut firewood every six weeks, a task that took at most a few hours. The local residents indicated who was to be employed for these tasks, and ensured that the jobs, and the money, were widely shared within and beyond the community[22]; it was rare for the same individual to be engaged on two consecutive occasions. Men were much more likely than women to undertake the journey to Suabi to deliver or collect mail, a distinction that reflected general patterns of movement in this area; married and marriageable women residents spent only 10% of survey nights (325 of 3250) outside the subsistence zone, compared to the 22% of nights (916 of 4230) that men and youths spent elsewhere. In fact, women only carried mail for us if they were travelling for some other reason as well. Cutting firewood, in contrast, an activity based at the village itself, was shared much more equally by men and women.

In addition to employment, we regularly bought local foods and paid for fish skulls and associated information. Procurement of these funds entailed little diversion from normal patterns of activity. Some additional labour will have been entailed in harvesting and carrying food from gardens, and in processing sago, but much of this would have been offset by the food that was shared at our hearth - the equivalent, on average, of one large meal per day that was shared among those present in our house at mealtimes. Food was purchased from all households, and from women and children as well as men, so the income from sale of food, as well as any imposition, was widely dispersed. Purchase of skulls and other scientific specimens had minimal impact on subsistence behaviour; only skeletal parts that would otherwise have been discarded were bought, and there was no time constraint on their delivery (see 4.1 for further details and discussion). Men benefited most from these purchases, in that they procured most animals, but women and children also brought in the remnants of their captures for sale. Finally, towards the end of our stay, we purchased a number of material culture items for ourselves and for the Papua New Guinea National Museum at Port Moresby. Only new items were purchased, but many were pieces that had been in the process of manufacture before we declared our interest. Again, both men and women provided items for sale.

On arrival at Gwaimasi we had no knowledge of the Kubo language, and proved slow learners. Most Kubo, in contrast, were proficient with languages and at least bilingual, but in 1986-87 few spoke the languages that my partner and I understood. One youth living at Gwaimasi when we arrived spoke good English. He returned to school in January 1987, and the community invited another young man, who spoke some Tok Pisin, to stay. We employed these two individuals on a casual basis throughout the survey, for

[22] Payments by us to people from other communities totalled K372.

occasional formal discussions and to interpret general conversations and events. Though the actual time entailed would have averaged about two days per month, the disruption to their time would have been greater; to some extent at least, the community considered them responsible for us.

In February 1987, employees of Esso PNG arrived intending to recommence explorations for gold in the area; they employed most local men (and no women) to repair the campsite that the company had established in late 1985. The plans were aborted after a few days, when the exploration lease was sold to another company, but the men of the village earned up to K25 each for their efforts, as well as a daily ration of rice and tinned fish or tinned beef. The community, moreover, was charged with responsibility for maintenance of the camp until the surveyors should return. In principle, this entailed several hours' labour each Friday, with the workers entitled to share two tins of fish from the stores left at the site. All members of the community (men, women and children) participated at times in that labour, but work groups varied in composition from week to week as individual interests shifted. The unsupervised labour was not onerous and, because the camp was at the junction of a major tributary with the Strickland River, people often took the opportunity to set fishing lines while they worked. Nevertheless, enthusiasm for the task faded as time passed, revived only briefly, in late April 1987, by the arrival at the village of a helicopter, the occupants of which reportedly handed over money (a sum of several hundred Kina was mentioned, but could not be confirmed) to the puzzled residents before departing again without a mutual word having been understood. Little work was done at the campsite after June.

Sources of money and store-foods were intermittent at best for people living at Gwaimasi; anthropologists and mining exploration companies are no basis for a reliable income. The fact that the two coincided in their appearance at Gwaimasi in 1986-87 meant that residents of that village had greater access to these resources than usual, and certainly more access than did neighbouring communities. The boom ended with our departure (though we, and mining companies, have occasionally and unpredictably returned since that time). But even during our presence, wage labour was a minor activity for residents of Gwaimasi. In the 399 days of the survey, adult men at Gwaimasi spent, on average, a maximum of 22 days (5.5% of their time), and adult women an average 4.3

days (1.1% of their time), in tasks specifically directed at earning money or tinned fish.[23] These numbers probably overestimate the actual commitment of Gwaimasi residents to wage labour during the survey; they are based on a count of half-days or days of work, but most of that work was casual, and often interrupted to pursue other interests. In as much as the work was associated with particular locations, however, - with the mining exploration camp, or with our house at the village, or with the track to Suabi - the numbers give a reasonable indication of opportunity costs associated with wage labour at Gwaimasi.

3.2 DISCUSSION

Subsistence activities at Gwaimasi were characterized by great diversity and flexibility. People had access to a range of alternative strategies for procurement of resources, and households shifted between these more or less independently in response to changing circumstances and opportunities. Thus, on any day, some families or individuals might be clearing new gardens, others weeding gardens prepared months before, and yet others processing sago or harvesting wild yams from patches of regrowth in the forest. Hunting and fishing strategies varied not only with individual skills and experience but also with the opportunities presented by other tasks. Patterns of pig husbandry, too, varied in response to the activities of the caretaker; thus, at any time during the survey, there were pigs being foddered at the village, others regularly tethered in the forest while gardens were prepared or weeded nearby, yet others taken to the swamp each day to forage near a sago-processing site, and some left in the bush to forage freely for themselves. Even wage labour showed this pattern of flexibility, with composition of workgroups regularly changing in response to the circumstances and interests of potential participants.

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[23] In comparison, Suda (1993) estimated that Kubo men at the village of Testabi allocated only 2.1 percent of their time to cash labour in 1988, and women 1.3 percent of their time. Testabi was larger than Gwaimasi, had been established for several years, and was only three hours walk from the government station at Nomad which not only purchased food at a regular small market but also attempted to provide an outlet for cash crops such as chillies. Sources of income were thus more regular than at Gwaimasi. Yet the proportion of time allocated to cash labour at Testabi was less than one-fifth that reported by Suda for other areas of New Guinea.

Kubo work patterns, with no task sustained for more than three or four days without a break, and with regular interruptions through any day for food, gossip, or simply a change of pace, display the same flexibility as seen with choice of subsistence strategies. The composition of workgroups, too, was variable. Groups of men only, or of women only, formed often for particular tasks - hunting, fishing, felling trees, weeding and sago processing - but these were neither necessary not permanent associations. Husbands and wives worked together more consistently, but their activities were often co-ordinated rather than interdependent; a woman might process sago, for example, while her husband fished in a nearby stream. There were clear expectations of male and female responsibilities among Kubo, but for the most part these were expressed as conventions, they were not legislated. Both men and women were capable of most, if not all, subsistence tasks and free to undertake them if necessary - an attitude that, again, enhances the autonomy of individual actors.[24] Where cooperation may benefit both parties, as with clearing of adjacent gardens, initiation by one person could be expected to stimulate others to follow suit. And events such as intercommunity feasts, in which everyone at Gwaimasi had a stake, were likely to generate cooperative effort in preparations. But these feasts came but once or twice a year. In general, the actions of others affected subsistence choices at Gwaimasi as much in a negative as in any positive sense; that is, an individual was less likely to go hunting, or process sago, or harvest pandanus, if others were doing so.

The variation and flexibility seen in subsistence arrangements at Gwaimasi is not generally characteristic of horticultural peoples in New Guinea or elsewhere. Dwyer (1990:157), for example, described subsistence among Etolo people, culturally related to Kubo and living some 50 km further east on the Great Papuan Plateau, as organized such that "people did similar things at similar times" and, indeed, usually in similar places. Such a statement, as Dwyer (in press:12) has noted, could never be made about Kubo. But there are groups elsewhere in New Guinea where subsistence organization does display the variation and flexibility seen at Gwaimasi - groups such as the Saniyanö

[24] The absence of exclusive male and female roles in the division of labour is also reported from other societies in the Strickland-Bosavi area (Kelly nd:Ch.2).

(Guddemi 1992) and Sanio/Hiowe (Townsend 1969) of the Sepik hinterland.[25] Guddemi (1992) has argued that the subsistence style displayed by these groups more closely resembles that of hunter-gatherers than of other horticulturalists. The resemblance does not depend on the practice of hunting and gathering as such though, as among Kubo, this is often a regular component of subsistence. Rather, it rests in the autonomy of action that characterizes these groups, and in the highly variable subsistence arrangements that result. As is the case among hunter-gatherers (Bird-David 1992b), households, and to some extent individuals within households, act autonomously in pursuit of resources with the result that strategies followed vary from individual to individual, and from time to time. The emphasis on immediate returns in social production and exchange among Kubo similarly reflects and reinforces this theme of independent action (Dwyer in press; Dwyer & Minnegal 1992a).

The flexibility of subsistence arrangements at Gwaimasi has clear implications for the study of any particular component of subsistence. As I noted at the beginning of this chapter, no component of subsistence exists in isolation. The fishing decisions made by an individual, for example, will reflect the circumstances and opportunities that flow from other choices, and fishing behaviour can be expected to change with shifting patterns of subsistence activity. Clearing gardens on the river bank presents different fishing options than does processing sago in the swamps. But any patterning of fishing behaviour associated with such considerations will be buffered at the level of the community by the tendency for members of that community to differ in their subsistence commitments; on most days, there were people from Gwaimasi working on the riverbank and others in the swamps. Thus in the community as a whole, as distinct from the individuals who constitute that community, spatial and temporal patterning of fishing behaviour is unlikely to reflect constraints associated with, or resulting from, other activities. Changes in the frequency of fishing, in the places where people choose to fish, or in the techniques they choose to use, can be examined simply in terms of constraints on fishing itself.

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[25] These groups are located in areas geographically analogous to that occupied by Kubo, where foothills meet the sago swamps of the lowlands north or south of the central ranges. The organization of subsistence may be one that, as Guddemi (1992:331) noted, is "*locally* specific to the type of region where they live". Here, I am more concerned with the implications of the flexible organization of subsistence for the study of a particular aspect of subsistence, rather than with broader questions about determinants of that organization.

CHAPTER 4

DATA COLLECTION

Of the many species of vertebrates captured and eaten by people at Gwaimasi fish offered particular advantages for the analysis and understanding of behaviour directed at the procurement of meat. Fish were caught more regularly than other categories of vertebrates (ie. mammals, birds, reptiles and frogs), so there were more fishing events to analyse. In addition, the great range of species, techniques and distinct locations used in fishing - and the comparative ease with which they could be identified and recorded - meant that shifting patterns of fishing behaviour could be relatively easily identified. Fishing, then, offered an excellent opportunity for quantitative analysis of a component of subsistence behaviour. But any quantitative analysis can be only as good as the data available. This chapter introduces my data on fishing behaviour at Gwaimasi.

The first section of the chapter begins with a description of the ways in which data on fishing behaviour were obtained. It summarizes the kinds of data collected, and discusses limitations of those data. Then it goes on to discuss problems inherent in the procedures used and the implications these have for analysis and interpretation.

While fish and fishing behaviour provide the raw material for analyses, my ultimate interest lies in the ways that fishing behaviour at Gwaimasi responded to changes in size and composition of the community. The second section of the chapter, therefore, moves away from fishing to describe the kinds of data available concerning patterns of residency and mobility at Gwaimasi.

4.1 FISH DATA

4.1.1 Collecting data

Data on fishing behaviour at Gwaimasi were obtained in two ways. First, skulls of all fish caught by residents of, or visitors to, Gwaimasi in the 57 weeks from September 15, 1986 to October 18, 1987 were purchased; these provided an objective measure of number, type and, ultimately, size of fish obtained during that time. Secondly, when skulls were brought in for purchase, information was sought regarding identity of the fish, who caught it, where it was caught and how it was caught. Additional details about time and context of capture, and of consumption, were recorded where available.

Purchase of skulls was based on a technique used by Dwyer (1983:147-149; 1990:103-119) to record hunting of mammals among Etolo (Etoro) of the Southern Highlands Province of Papua New Guinea; similar techniques have been used to record utilization of wild animals elsewhere in Papua New Guinea (eg. Hide *et al.* 1984:293-294). Prices varied according to size of the fish and condition of the skull, ranging from as little as 2 toea for small gudgeons to 20 toea for the intact skull of a large catfish.[1] Once purchased, skulls were dried over a fire and then stored until the end of the survey, when their assigned identities were checked, lengths measured and otoliths removed to be taken back to Australia. A series of specimens of each Kubo taxon was lodged with the Natural Resources Unit of the University of Papua New Guinea at Port Moresby, and another series was brought back to Australia for use in determining scientific taxa associated with the Kubo names.

People were offered additional money for a skull if they brought the fish in to be weighed and measured before consumption. Fish were weighed with Persola spring balances, to an accuracy of within one percent. Recorded weights were total weight less gut contents (ie. 'treated' weights); Kubo clean and gut fish immediately on capture, retaining the emptied entrails for consumption. Measurements indicated that less than 10% of live weight was lost in the cleaning process, and that this percentage was similar for all species. Likewise, there was very little difference in the ratio of edible meat to waste for the different species of fish. Waste from fish cooked and eaten by my partner and me was consistently around 12% of treated weight; waste from fish eaten by Kubo was probably marginally less. Because analyses in subsequent chapters of this thesis deal

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[1] People at Gwaimasi had had little experience of money before my partner and I arrived. They knew of its uses, but did not understand the relationship between different denominations. Thus, the price of an item at the store might be reported as "two kina, two kina, one kina" (ie. K5), or "three twenty toeas and a ten toea" (ie. 70t). This caused some difficulties when we tried to retrieve coins paid out for skulls and food by offering notes in exchange. The problem was solved by using a chart of pencil rubbings that displayed all combinations of coins equalling one Kina. This also ensured that our relative pricing policy was understood and had the intended effect.

only with fish, and are not concerned with their relative contribution to the diet, treated weights are not converted to edible weights or, more hazardously (cf. McArthur 1977), to either calorific or protein equivalents.

Questions about the fish from which skulls came were asked in the Kubo language. Hegogwa, a 15-year-old resident of the village who had had five years of primary schooling at a mission school at Rumginae north of Kiunga and spoke good English (the only person at Gwaimasi other than us with any English at all), provided initial assistance with the language. The basic technical questions were easily learned: "*e hu ko*" (= what is its name?); "*kome ba habeibo*" (= who caught it?); "*hoi kage habeibo*" (= in which stream was it caught?); and "*feseia ba habeibo*" (= was it caught by line?), or "*audi ba diabo*" (= was it speared?). Our pronunciation and grammar improved with time but, from the outset, Hegogwa had indicated to other people what it was that we wished to know. Answers were recorded as given. Clarification or translation was obtained later, if required, from Hegogwa and, after he left in January 1987 to return to school, from Tufa, who spoke some Melanesian Pidgin.

4.1.2 **The data**

In all, 2040 fish skulls were purchased in the 57 weeks of the survey, with details recorded for another 19 fish. Of the 2059 fish for which information is available, 1378 were caught within the local subsistence zone associated with Gwaimasi[2], and it is these that are the focus of analysis in the following chapters.

The 1378 records do not comprise information about all fish caught within the local subsistence zone during the survey. The fragile skulls of some very small species of fish, especially rainbowfish, were routinely eaten, and we received no specimens. In addition, even the robust skulls of catfish occasionally broke during cooking, or were stolen by dogs before they could be delivered to us. The loss of rainbowfish skulls cannot be accurately quantified, but it appeared that these species were only casually pursued, and did not contribute much either in number or in weight to the diet of people at

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[2] A few of the remaining 662 skulls were from fish caught by residents of Gwaimasi while visiting neighbouring communities. Most were brought in by visitors to Gwaimasi before our purchasing rules were tightened; see 4.1.3a.

Gwaimasi. The rate of loss for other skulls is more easily assessed; of the 440 fish that had been weighed, less than 2% (n=8) of skulls were later damaged and not brought in for purchase. In all, I estimate[3] that the fish represented in my records probably comprise at least 92% by number, and 98% by weight, of all fish caught within the local subsistence zone. Those records (included as Appendix 1) show, for each fish, several categories of information.

First, there is information obtained from inspection of the skulls themselves:

1. Species - the Kubo name for the fish.

   Initially, only the name offered by the person who brought in the skull was recorded. Later, as we learned to identify the different taxa from their skulls, these names were checked against our own assessments. Discrepancies were few; of 477 fish taken locally in the first two months of the survey, only 15 (<3%) were 'incorrectly' identified by the person delivering the skull. Where discrepancies did occur the records used in this thesis employ my identifications.

   Scientific names associated with the various Kubo taxa have been provided by P. Kailola, then of the Department of Zoology, University of South Australia, G. Allen of the Western Australian Museum and R. McKay of the Queensland Museum. (See 5.2.1 for more details.)

2. Skull length - the maximum length of each skull.

   The length of each skull was measured in millimetres. Skulls of most species were measured from the rostrum to the posterior tip of the dorsal spine. Those of the four species of gudgeon were measured from the rostrum to the foramen magnum. Some skulls (<4% of the total; n=84) were unable to be measured because of damage; most of these (>60%; n=51) belonged to a single species of small gudgeon. With non-gudgeons, broken skulls were matched to others of known length.

3. Weight - actual or reconstructed 'treated' weight of fish.

   Weights were recorded for 440 of the fish caught during the survey, and for another 14 fish that my partner and I caught during the following month. Where an adequate sample of weights was available from a given species, a regression

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[3] Based on a very generous guess of 100 rainbowfish eaten during the survey.

equation of skull length against weight was calculated. Using those equations, approximate weights were inferred from skull length for all fish of that species. Regressions for nine species were based on samples of ten or more individuals; these species accounted for 79% (n=1089) of all captures in the local subsistence area. Where the sample of weights available from a species was not adequate for confident calculation of regressions, weights were estimated from regressions calculated for closely related species. Where skull length was not available the fish was assigned the modal weight for its species. (See Appendix 2 for details of these calculations.)

Secondly, information was obtained by asking questions of those who brought in the skulls:

4. <u>Date</u> - when the fish was caught.

   This usually records, as the label suggests, the actual date on which the fish was caught. When fish were caught and eaten during a stay at a bush house, or brought back smoked from such a stay, it was not always possible to assign date of capture accurately[4]; for these fish the date recorded is that of return to the village. Date of capture was usually, but not always, also the date of consumption.

5. <u>Stream</u> - where the fish was caught.

   The name of the stream where the fish was caught was recorded for 93.0% (n=1282) of the fish procured within the local subsistence area. Initially, the name of this stream was recorded exactly as it was reported. Major streams, however, could have more than one name (eg. Wua or Gedei for the Strickland River, and N<u>o</u> as an alternative name for Dege). In these cases the most commonly used name has been selected for use in the records. Designation of capture locations along streams is attempted only for the Strickland River; when people specified that a fish came from the mouth of a particular stream, that junction (= *hafi*) has been recorded as the location of capture. (See Section 5.2.2

[4] Kubo had distinct terms for 'yesterday' (*i*), 'today' (*aufi*) and 'tomorrow' (*idiba*). They also had general terms for 'before yesterday' (*woi*) and 'after tomorrow' (*woidiba*), but these terms do not specify exactly how long before or after. When people at Gwaimasi in 1986-87 wished to be more precise they specified the day of the week. Without calendars, or any consistent weekly ritual (Sunday prayer services were held intermittently), they were very good at keeping track of the days.

for more details.)

6. <u>Technique</u> - how the fish was caught.

Details of procurement technique were recorded for 93.8% (n=1293) of all fish procured within the local subsistence area. Only the two major fishing techniques - linefishing and spearfishing - are distinguished in the records; these account for 94.3% (n=1219) of all captures within the local subsistence zone. The various minor techniques are lumped within the category 'Other'. (See Section 5.2.3 for more details.)

7. <u>Person</u> - by whom the fish was caught.

Capture could be directly attributed to a particular individual for 84.1% (n=1160) of all fish procured in the local subsistence area. When people went fishing together it was not always possible to distinguish who caught what in the total haul. In those cases (12.5% of records; n=171), the fish was attributed jointly to the two or more individuals involved. Subsequently, its value was distributed among those individuals according to a formula calculated on the basis of their respective direct attributions (see Appendix 3 for details). In only 3.4% (n=47) of cases was the person responsible for capture of a fish effectively unknown. Only residents of Gwaimasi are distinguished by name in the records. Others are simply identified as visitors, though often the particular person responsible for a catch was known.

Thirdly, I have classified both the fishing event and the fisher on the basis of related observations:

8. <u>Capture context</u>

This identifies whether the fish was caught within the local subsistence zone or outside it. Within the local subsistence zone, fish caught by people based at the village (departing from and returning to the village on the day of capture), are distinguished from fish caught by people based at bush camps. Fish caught while returning to the village from a stay elsewhere, or brought back smoked from such a stay, are further distinguished as 'transitional'.

9. <u>Consumption context</u>

This identifies whether fish were eaten by people based at the village or by people based in the bush. For each category it also distinguishes fish shared by people at the village or bush camp from those fed to dogs, pigs or cassowaries[5], or sold to us. When we received gifts of fish, or were included within a larger distribution, the fish was classified as shared.

10. Affiliation

This identifies the clan group - Down-gabo or Up-gabo (see 2.2.5) - with which the person who caught the fish was affiliated. For most residents, affiliation was obvious. Gawua and Dogo, the only ambiguous cases, did most of their fishing while in the company of Down-gabo residents, and have been classified as Down-gabo for the purpose of analysing fishing behaviour. Visitors are distinguished from residents, and have been classified as associated with Down-gabo or Up-gabo according to their place of origin (see 2.3). Where a fish was jointly attributed to individuals of two or more of these categories it has been identified as such. Subsequently, when its value was distributed among the individuals associated with its capture (as in Appendix 3; see 'person' above), separate affiliations were also recorded.

Field notes also contain other relevant information. For many fishing episodes, but certainly not all, it is possible to extract information as to who ate the fish and where, who else was present on the fishing trip, the duration of the trip, and what other activities were undertaken during the trip.

4.1.3 **Problems with procedures for collecting data**

Procedures used for data collection are more than just the mechanics of recording; they represent attempts to overcome the problems entailed in procuring adequate data. Published studies of foraging or hunting behaviour usually indicate an awareness of such problems. Some (eg. papers in Hames & Vickers 1983; Smith & Winterhalder 1992b) attempt to relate choice of research techniques to those problems. Few, however, make any attempt to discuss the nature of the data that result from a chosen technique, or to assess the implications for the proposed research. With the trend in the last decade to

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[5] Giving fish to domestic animals was not a common practice. Over the 13 months of the survey 16 fish were fed to pigs, two to cassowaries and one to a dog. Most of these instances were probably related to temporary restrictions on consumption of fish after sexual intercourse (see 7.2.2b).

increasing quantification of data, papers may have extensive details of sample sizes and measurement techniques, error factors and the frequency with which scales were zeroed (eg. Hurtado & Hill 1990:301), and yet fail to discuss the validity of sampling in the first place, or whether it is reasonable to assume that the food brought back to camp provides an adequate approximation of diet. Different techniques of information-gathering carry with them their own potential sources of error or distortion. These, too, are rarely discussed in detail, though the implications for analysis of such distortions may be considerable.

In what follows I discuss the rationale for selecting the procedures described for collecting data on fishing behaviour at Gwaimasi, and assesses possible problems and implications for analysis arising from use of those procedures.

Accurate information on foraging behaviour and returns is notoriously difficult to collect. Foragers - in this case, fishers - usually disperse in different directions at the start of the day, often deep into the forest, and may return later with only some of their haul. For the researcher, in fact, foraging, and hunting in particular, may seem almost an 'invisible' activity (Beek 1987:63). Even with a community of only 25 it is not possible to follow everyone through the day. In many contexts sampling can prove a valuable technique (eg. Hill & Hawkes 1983; Marks 1977; Stocks 1983). In small communities, however, particularly where variation between individuals and through time is high, sampling may produce biased results. Nor, for that matter, can observers always follow selected subjects through the course of a day; social concerns aside, an observer may be a serious handicap to anyone engaged in activities that require great skill, resulting in distorted patterns of behaviour (Beek 1987:63; Dornstreich 1973:272). Detailed recording of food brought back to a central camp (eg. Hurtado & Hill 1990) often underestimates actual returns; it may not accurately account for food eaten during the day. In any case, such recording is necessarily so intrusive that it can be continued only for short periods; it is useful for rapid quantitative sampling, but is less amenable to the study of variation through a year or more. Nor can recording of food brought back to a camp, of itself, provide information about the locations visited or the strategies and tactics employed in obtaining that food. Ultimately, this information must come from the people themselves. But reliance on reporting alone can produce biased results; often, for example, people may neglect to provide information on smaller items (Yost & Kelley 1983:207; Beek 1987:140).

The procedures used for collection of fishing data at Gwaimasi represent an attempt to avoid some of the problems outlined above. Recording of skulls provided an objective measure of quantities obtained - both as number and, through calculation of regressions, as weight. Because the fish itself did not have to be seen, reliable records could be obtained for items eaten away from the village. And, since people themselves chose when to bring skulls, the technique was not particularly intrusive for longterm studies. Purchase of skulls served also to ensure that the information received about fishing episodes was usually current and reliable.

But this method of data collection has its own problems. The only published assessment of these problems of which I am aware is Dwyer's discussion of the technique used in his own study of Etolo (Etoro) hunting. Dwyer (1990:106) perceived three potential difficulties associated with purchase of skulls as a means of monitoring hunting returns, all ultimately arising from the financial basis of the technique. First, there may be "reservations and constraints operating within [the] culture regarding the proper way to behave with captured game" which conflict with the necessarily public nature of purchase and associated interrogation. Secondly, I was interested in fishing at Gwaimasi alone, but the initiation of a "highly localized cash economy" in fish skulls might create the temptation for people to look beyond the local community for a source of skulls. Thirdly, and probably most serious, the financial incentive created might significantly alter the pattern of fishing; in Dwyer's words (*idem*), I "wished to record what people did in a normal year and had just rendered the year far from normal".

Kubo are not Etolo. And Dwyer's research interests in the Etolo study were rather different from mine at Gwaimasi. The problems he identified have different implications for my analyses than those he discussed. The three basic problems themselves, however, were the same, and Dwyer's summary provides a useful frame for addressing them. In addition, one further problem needs to be discussed, a problem relating not to the method of data collection itself but to the nature of the data that this method produces; purchase of skulls, and of information about those skulls, can document only the outcomes of successful fishing episodes, not fishing activities *per se*.

I shall discuss each of these four problems separately, beginning with the last.

(a) Fishing success and failure

Not all attempts to catch fish succeed, even when the fishers are as experienced as the people at Gwaimasi. Set lines may snap, or their bait may be stolen. Streams may be just a little too murky to see and spear fish, though it seems worth a try. Thus any method of data collection that relies on recording captures - recording only successful episodes - will not give a comprehensive picture of fishing activities.

Attempts were made to monitor unsuccessful fishing episodes at Gwaimasi, but with varied results. When someone left the village with a towel thrown over a shoulder and a fish-spear in hand I could be fairly sure of his intentions. Fishing lines were less visible, but major linefishing trips usually entailed use of a canoe. In both these sorts of instances it was easy to confirm speculation by questioning later in the day. But much of the fishing done at Gwaimasi was embedded within other activities (see 5.3). Lines might be set near a garden where people were weeding or harvesting. Or someone might take a short break from such a task to spear a couple of fish in a nearby stream. Documenting such practices was straightforward; quantifying them was another matter. Because of the small population size, and the known tendency for individuals to differ dramatically in hunting and gardening effort (Dwyer & Minnegal 1991a, 1992a), normative reconstructions using spot samples of activities would not have been helpful. (In fact, understanding variation among individuals is crucial to this thesis.) Ultimately, then, it proved impossible to obtain comprehensive information on fishing effort at Gwaimasi as opposed to fishing success.

The limited information available about fishing effort appears to pose a major difficulty for the thesis. The theoretical frame within which I am operating would seek to explain fishing decisions in terms of the relationship between potential returns and the effort that must be invested to procure those returns. The data available, however, address only the question of returns.

But the problem may not be as serious as it at first appears. I am primarily interested in **relative** patterns of behaviour - in the way that decisions change as elements of the environment, particularly the social environment, change. The information that accompanied skulls documents changes in choice of strategies. If, for each strategy, returns can be considered proportional to effort, then they can be used to document relative changes of effort within strategies.

Whether returns can, in fact, be considered proportional to effort is another matter. In some cases they probably were. The productivity of set-line fishing, for example, is largely proportional to the number of lines used. In the case of strategies for which skill, or simply physical fitness, eyesight and speed of reflexes, are important - as, for example, with spearfishing - return for effort may differ considerably between individuals. My assumption might hold for each individual but be invalid for comparisons between individuals. Limitations of analysis arising from this set of problems are discussed in detail where they arise in the following chapters. In most of the critical analyses, the community is regarded as a single resource-sharing group (justified in 8.1), and individual variations in return for effort can be disregarded.

(b) Conventions regarding the asking of questions

Privacy tends to be a scarce commodity in small communities. Little can be done without the interested scrutiny of neighbours, and gossip is an integral part of social life. Procurement and consumption of game, too, usually cannot be done without being observed; sago thatch walls may keep out interested eyes, but the smell of cooking meat penetrates and the scraps of meals remain as evidence.

Many societies use conventions and reservations to create a sense of privacy where sago thatch cannot. Within the Strickland-Bosavi region, for example, Beek (1987:153-157) described how the Bedamuni "jealously guard ... the prerogatives of the individual" within the local community in their conventions of sharing and generosity. While there was a publicly expressed ethos that food, and meat in particular, should be shared it was up to the individual to distribute items, and several socially sanctioned strategies existed by which sharing could be avoided. For example, an item that had been kept out of direct view could be declared not to exist, despite general knowledge to the contrary, and thus need not be shared. To ask about such an item, and thus drag it into the public domain, would be considered decidedly impolite. Dwyer (1990:106-107) described similar Etolo 'rules' that precluded the asking of direct questions. Among Etolo, as among Bedamuni, one rarely asked about the game that someone had caught, or even commented on it, because to do so was to express a desire for the item and place an obligation on the owner to hand it over. The contents of a bilum, the ubiquitous Papua New Guinean open-weave string bag, therefore, were effectively invisible till brought out into the public domain by the owner. Public display of an item, however, constituted an invitation for those present to partake of it.

Such conventions can make life very difficult for a researcher whose primary interests necessitate the asking of detailed questions about hunting activities and returns. At the Etolo community of Bobole, Dwyer eventually solved this problem by encouraging development of special status for his house; it became " neutral ground ... a sanctuary where conventional norms no longer applied" (Dwyer 1990:109). At Gwaimasi the problem never arose.

People at Gwaimasi did have rules about appropriate behaviour with respect to sharing game. The rules that existed, however, appeared to be concerned not with maintaining privacy, with ensuring the rights of the individual, but with emphasising community rights. People displayed no concern about asking direct questions. Quite the contrary. As we left the village to explore for the first time we were startled by a loud voice from the other end of the village demanding to know "*noi kage iya*" - where are you going? Such blunt questioning was not restricted to us; people regularly demanded of each other information as to plans for, and outcomes of, a day's activities. It was possible to deflect such questions with an evasive answer ("*a budia iya*" - I'm going upstream), but not to ignore them. Nor were the contents of a bilum sacrosanct. When I caught my first fish, a perch weighing all of 50 g, I carried it home wrapped in the usual leaf package; within minutes the package had been spotted, torn open without ceremony and my success announced with great glee to the village at large. Several times we saw people inspect and comment on the contents of a bilum before the person carrying it had had time to put it down.[6]

In effect, residents of Gwaimasi were openly expressing their perceived right to know about, and thus to share in, the produce of other residents (see 2.2.6 and 8.1).[7]

Gwaimasi, then, could be seen as an ideal location to conduct research of the sort

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[6] Note that this did not occur when large game - pig or cassowary - was brought to the village. On these occasions people usually remained out of sight until the hunter had deposited the carcass at the communal hearth and returned to his house.

[7] The differences between behaviour of people at Gwaimasi in this respect, and that described by Dwyer for the culturally related Etolo people at Bobole, are remarkable. It is possible that those differences were related to the difference in size of the two communities. Bobole comprised four longhouse communities totalling 109 individuals, compared to the 25 residents of Gwaimasi; sharing on the comprehensive scale seen at Gwaimasi might simply not have been possible in the larger community. Dwyer, however, having lived with both groups, considers that the differences ran much deeper, reflecting a fundamental difference in ethos between Kubo and Etolo (pers. comm.).

described here. With the emphasis that the community itself placed on the right to know, there were no difficulties in asking questions about particular fishing episodes. Nor did people have any inhibitions about publicly displaying skulls, or even the fish themselves. The perceived right to share did not seem threatened by our introduction of monetary value for skulls; people often shared out the money they received, or handed over rights to the skull with the fish.

In fact, the primary difficulty encountered arose from the tendency for skulls, and thus the money they represented, to be shared as well as fish; skulls were commonly brought to us by someone other than the person who had caught the fish. Kubo had strict rules governing the use of proper names. Only close agnatic kin could refer to an individual by name; others used kin terms or nicknames. Until we learned many of the possible nuances of relationship that linked people in the community, as well as reciprocal nicknames and variants of proper names, the risk of confusing the identity of the actual fisher was considerable. The problem was resolved by taking polaroid photographs of all residents and regular visitors. These were mounted on a wall, and used to check identifications; if there was any ambiguity, the person who delivered a fish skull could be asked to indicate the photograph of the person who caught the fish.

(c) **Expanding markets**

Within a few weeks of our arrival at Gwaimasi the word about our interest in skulls had spread. Residents of Nanega came to the feast held to welcome us, and then invited us to a reciprocal feast to be held at their village a week later; immediately upon arrival we were confronted with a request to buy sixty fish skulls - the result of a week's intensive fishing both for the feast and for our money. Then a group of people from Sosoibi appeared at Gwaimasi with another forty skulls. A little later, Sinio and Mamo returned from a mail run with the skulls of forty fish obtained by people at Suabi. And finally, in mid-October, a party of Awin people arrived from Dahamo, two days walk to the northwest, with 200 skulls for sale. Our fame had spread across two days of walking and two language groups in less than two months; we began to have nightmares of planeloads of skulls being flown in from Daru.

The reaction our apparent market in skulls generated was easy to understand, and even to sympathise with. Opportunities to earn money had been extremely limited in this region; now, it seemed, we had identified a wonderful new cash crop. Despite appearances, however, it was information we were buying, not skulls. We had no interest in fish obtained outside the local subsistence zone associated with Gwaimasi. In any case, our funds were limited. We could not afford to finance the fishing activities of half a dozen communities. But the proffered skulls could not simply be rejected; they might too easily have been proffered again with a new batch of skulls from Gwaimasi. Initially we bought all skulls, irrespective of origin, at the standard rate. As more and larger collections began to arrive, however, a new strategy was called for. Foreign collections of skulls were purchased - at a rate far below that applicable to Gwaimasi skulls - in order to establish rights of disposal, and then publicly thrown into the fire.[8]

The large collections soon ceased to arrive, but there remained the possibility that some entrepreneurial Gwaimasi residents would see an opportunity to increase profits by selling skulls from elsewhere as their own, or that they might be prevailed upon by relatives from neighbouring communities to do so. Quite apart from monetary considerations, without reliable information the skulls would be useless.

Many of the skulls received were obviously fresh, with scraps of adhering flesh and brain. For such skulls there was usually little doubt about provenance. Only a few days' storage in the thatch of a bush house, however, was enough for insects to render a skull spotless. A few more days, and smoke-staining would be apparent. These were the skulls that posed problems of reliability. Attempts to assess reliability were based on the assumption that while people probably knew their animals well, and could identify what they had caught or eaten, they were less likely to be able to identify skulls. With some intensive effort at the beginning of the survey we learned to distinguish skulls of at least the common Kubo fish taxa. From then on, any discrepancy between the proffered identification of a skull and our own assessment of identity was cause for closer interrogation.

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[8] Although we did not realize it at the time this was a very effective message. Kubo apparently expected public demonstration that goods were valued. Because pig jaws were often trophied, we explained that we would simply inspect, measure and mark them and then return them to the person responsible. Accordingly, we handed over a Kina for the first jaw that was brought, and later returned it. We received no more jaws, despite persistent requests. No more, that is, until a visitor decided, some months later, to test our professed willingness to pay. We did so, stuck the jaw in our wall as a trophy rather than returning it, and received the jaw of every pig killed from then on. All were kept and displayed, so people had visible proof of our stated interest.

As it happened, there were few suspicious incidents. On one occasion, a lad stole three skulls from his 'brother' and presented them as his own catch. Since none of the names he gave matched the skulls, and since he claimed to have caught by line in the Strickland River a species previously only reported from well up side streams, his attempt at deception was obvious. We retained the skulls, refused payment, and sorted out the story a month or so later when the brother saw his missing skulls on a shelf; the boy was teased for several days afterwards. On another occasion, a visitor presented two skulls of fish that he claimed had been caught and eaten the day before, while he was in the local subsistence zone, although they were thoroughly dried and smokestained. In general, however, I am satisfied that the skulls included in my records were legitimate.

Reliability of the information that accompanied the skulls was another matter for concern. When the person who had caught the fish carried the skull the details of location and technique of capture could usually be recorded with confidence. When the skull was presented by someone other than its procurer we attempted to confirm details with the fisher as soon as possible. Often, a delay of some days had occurred between capture of fish and presentation of their skulls. If there was any doubt, in such cases, as to the information that belonged with a given skull, the details were recorded as unknown.

(d) **Possible effect on fishing effort**

My greatest concern with purchase of skulls as a method of data collection lay in its possible impact on frequency and pattern of fishing activities. Those patterns were precisely what I wished to explore, and I planned to do so within an explanatory frame that modelled decisions in terms of relative costs and benefits. Yet we had just introduced an entirely new form of benefit to the system. To what extent might this influence the decisions that people at Gwaimasi made? And was any such impact necessarily a matter for concern?

The model that I have proposed for the relationship between fishing behaviour and the size of resource-sharing groups is based in the assumption that fish have a declining marginal value. Fish are food. They may, of course, be shared or given away, and thus a fisher may obtain social as well as nutritional benefit from his or her catch but, basically, I have assumed that the benefit to be gained from a fishing decision was constrained by the nutritional value of the catch to its potential consumers. There was no further benefit to be gained by bringing in more fish once everyone had eaten their fill.

Only if this held could I expect to see any correlation between fishing behaviour and the size and composition of resource-sharing groups.

A cash reward for the fish changes this calculation. Money, unlike fish, can be stored indefinitely. It could be used also to negotiate a much wider range of tangible material and social benefits. We had set up an apparently insatiable market for local skulls; in contrast to the nutritional value of fish, the monetary value of fish skulls did not decline as the number already obtained increased. Consequently, there was a real possibility that people would go fishing simply to obtain skulls, with no consideration as to need or desire for the meat that came as a by-product. If this were the case, then the data would not address the questions of interest to me.

Avoiding the distortions that financial rewards for data threaten to produce entails walking a delicate tightrope. People must be offered enough to warrant the trouble of retaining and bringing in skulls in good condition, and yet not enough to encourage putting greater effort into procurement.[9] But how much is enough?

The answer can be discovered only by trial and error. We made some mistakes at first. Payment for skulls was to be scaled according to weight of the fish from which they came; any increase in value of a fish would thus have been proportional to its nutritional value, and net rankings should not have changed. Initial pricing policy, however, was developed in ignorance of relationships between skull length and fish size. As a result, during early weeks we paid more than twice as much for skulls from catfish as for skulls from perch of similar weight. We were also not paying enough, initially, to encourage people to bring their smaller fish, particularly perch, to be weighed before consumption; we were receiving skulls, but could obtain very few of the associated weights required for calculation of skull-length/weight regressions.[10] Such gross errors were rapidly detected and corrected; within two months the techniques associated with purchasing skulls had

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[9] Hide *et al.* (1984:293), who used systematic purchase of skulls as part of their study of utilization of wild animals in South Simbu, Papua New Guinea, also commented on the need to keep prices low "to discourage hunting undertaken specifically for sale" of skulls.

[10] The fact that perch were less likely to be brought in to be weighed may also have reflected the tendency, which certainly existed, for smaller fish to be more often eaten in the bush while larger ones were regularly returned to the village to be shared with others. At first, however, even perch brought back to the village were not carried to us for measurement.

been fine-tuned. At the same time, these initial mistakes provided encouraging evidence that the price range within which we were operating was not excessive.

Three kinds of evidence support this view. The first concerns patterns in the fishing record itself, the second depends on observations of behaviour after we ceased buying skulls, and the third reflects the attitude of people at Gwaimasi to money and their use of it.

Fishing behaviour at Gwaimasi, as demonstrated in Chapter 6, showed strong correlation with short-term and long-term fluctuations in weather. This is to be expected; it reflects associated changes in availability and accessibility of fish. Within those weather-related patterns, however, unusual variations in fishing effort can be traced to cultural factors. Parents, for example, virtually ceased to fish for six months after the birth of a child (see 7.2.2c). The proffered explanation cited a restriction on eating fish until the child had teeth - but made no mention of any restriction on the sale of skulls. But the money we offered for skulls was not enough alone, it seems, to encourage new parents to fish.[11] The largest single haul of fish we recorded was obtained in October 1987 - 13 months after we had opened a market in skulls - when 20 fish were obtained on a poisoning expedition organized to get meat for a house-opening party. Despite the potential for such comparatively large hauls poisoning was rarely used during the survey, and all instances of which we knew were related to planned feasts. Again, the implication is that the prospect of money for skulls was not sufficient to alter choice of fishing techniques.

It remains possible, however, that people simply increased their fishing effort within conventional forms - by fishing a little more often, by staying a little longer or, perhaps, by travelling a little further to a more productive stream. To examine this possibility we stopped buying skulls on 18 October, 1987 - one month before our final departure. Daily notes were still kept of fishing activities from the village, evidenced by patterns of movement, the equipment people carried, the size and contents of bilums at the end of the day, and the usual free flow of gossip. Such anecdotal data needs to be regarded with caution, but I saw no marked decline in frequency of fishing or in the size

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[11] In contrast, despite the existence of a *de facto* restriction on consumption of crocodile meat (Dwyer & Minnegal 1988), people at Gwaimasi occasionally killed crocodiles for their skins, which they sold at Kiunga.

of hauls produced during the month after buying of skulls ceased.

I do not mean to imply that the money we offered for skulls had no effect on fishing behaviour. It did, at least when we first arrived. Our first day of purchases was one of the most frenetic we were to experience, not because people had saved skulls in anticipation but because everyone went fishing for the day. In this case novelty, rather than the money itself, might have been the motivating factor; people were also preparing for a feast to mark completion of our house, at which fish were to feature. Three weeks later, however, two men we had hired to carry mail to Suabi brought in more than 20 fish - a very large haul - the day before their departure. The weather had been dry for a few days, so a spearfishing expedition was not unexpected, but I have little doubt that anticipation of a shopping spree at the Suabi store played a part in the timing of this particular effort. Those men, and others who visited Suabi in the first couple of months, brought back western clothing, axes, cooking pots, kerosene lamps, soap, matches - and fishing lines.

The early interest in our money, and in the goods it could buy, was intense. That interest, however, did not last. Before long, people were displaying a distinct reluctance to undertake employment for which they had previously competed. Trips to Suabi lost their appeal and, though we still paid, our mail often had to wait until someone had another reason for wishing to make the journey. The change is easily understood. In our first couple of months at Gwaimasi several hundred kina were paid into the community - largely as payment for construction of, and clearing around, a house. (In fact, compared to earnings from such establishment tasks, and later from sale of food and firewood, fish skulls were a relatively minor source of income.) Once everyone had new clothes, new plates and pots, an axe each and so on, there was really nothing left on which to spend money, and so money lost its value.[12]

I am confident, therefore, that the desire for money played no significant role in determining fishing behaviour beyond those first couple of months. More importantly, money, like fish themselves, had limited use value to people at Gwaimasi - limited by the

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[12] Shaw (1990:180) described a similar loss of interest in cash crops by Samo, near Nomad, which he attributed to the fact that "there was only one store in the entire region and, therefore, little opportunity to purchase goods with the money earned". In any case, after two harvests they "had bought all they needed" and so attended to the crop - chillies - only when the need for petty cash arose.

number of people on which it could be spent; appetite for money, like appetite for food, could be sated. Consequently, my initial assumption, that potential value of a foraging decision will depend upon size and composition of the resource-sharing group, should hold despite the existence of a financial component to calculations.

4.2 RESIDENCY DATA

People at Gwaimasi were very mobile. Each family had at least one bush house, to which it would go for days, or even weeks, at a time - to process sago, or hunt, or just to get away from the village. And everyone had relatives or friends at neighbouring villages whom they would regularly visit, for business or pleasure or both. Further afield were trade stores, and western medical services - basic though these were - and sometimes government activities. Though 25 people were based at Gwaimasi it was common, in fact, for more than half to be sleeping elsewhere on any one night; at times as few as four were left in the village. And people at neighbouring villages were just as prone to travel. Few days would go by without visitors arriving at Gwaimasi to stay for the night, or a week, or even longer.

The day-to-day variation in number and identity of people staying at the village of Gwaimasi provides the basis for exploring ways in which decisions about fishing behaviour were affected by size and composition of the resource-sharing group. This section of the chapter addresses the procedures by which details of residency and mobility were documented.

4.2.1 Collecting data

The whereabouts of all residents of Gwaimasi, and the identity of any other people staying either at the village or elsewhere in the local subsistence zone, were recorded for each night of the survey period. This information was obtained by both direct observation and inquiry.

Kubo have detailed rules governing appropriate behaviour on arrival at, and departure from, a village other than one's own. These rules, together with the enthusiasm Kubo display on such occasions, made the task of recording such movements at Gwaimasi fairly simple. Arrival of visitors was usually announced by loud whooping. The visitors then usually proceeded directly to the longhouse where men were formally welcomed with shared tobacco smoke and food. Because of the layout of Gwaimasi (see Figure 9, in 2.1.4), this meant that they paraded in single file almost the entire length of the village, and immediately past our house, allowing an accurate record to be kept. (Arrival time, particularly for larger groups, tended to be late afternoon, when we were usually present.) Departures, too, tended to be public and protracted affairs, necessitating individual farewells to all residents. Again, accurate records could be kept.

Movements of residents were less easy to document directly. People usually departed from, and returned to, their own houses. Return after an absence of more than a couple of days was usually the cause for some excitement, as was departure to visit another community; both held promise of news and gossip. People leaving to spend a few days at a bush house within the local subsistence zone, however, often did so unannounced. In order to keep track of such moves, each evening a note was made of people visible around the village; with an average of 19.2 people present on any night, the task was not difficult. Anyone not seen or accounted for was enquired about the next day.

If details were not known in advance, the whereabouts of residents not at the village on a given night was ascertained by gossiping either with the people themselves on their return, or with others in the village. As well as recording where people had slept[13], we noted any information as to the purpose of an absence, or the range of activities undertaken. Often, people brought in skulls of fish caught while away. The information that accompanied the skulls, particularly in relation to the streams from which fish had come, proved a useful means of tracing movements. Occasionally, too, we visited people in the bush, thus confirming reports of their location and obtaining additional information with regard to daytime activities.

Visitors seldom spent nights in the local subsistence zone away from Gwaimasi itself. The primary exceptions were a true brother of Filifi, and his family; they had left the community shortly before our arrival but retained some rights to at least one garden in the area. In most cases when these or other visitors stayed elsewhere than at the village,

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[13] "Where did you sleep?" (*Na kage tiabo*) was the standard Kubo way of asking where a person had been staying. Shaw (1990:21) noted that Samo also expressed residency in terms of where one slept.

they came to Gwaimasi first before leaving for the bush house or camp where they were going to stay. Their movements could be monitored by observation and gossip, in much the same way as those of residents. Where visitors proceeded directly to a garden house (see below) monitoring was more difficult, but again gossip usually indicated the occurrence.

My partner and I were ourselves away from Gwaimasi on 20 nights of the survey period; seven of those nights were spent outside the local subsistence zone. Duration of those absences ranged from one to four nights. In most cases, we could not, while away, be sure where other people spent the night within the local subsistence zone; I am confident of details for only four of the 20 nights. There are thus 16 nights without complete records of residency. Absences from the local subsistence zone, however, could be confidently reconstructed, as could the presence of any visitors. For the purposes of analysis I have decided simply to classify all people as either within the local subsistence zone on those nights, or away from it. Those 16 dates were discarded from analyses of variation in community size and composition.

4.2.2 **The data**

The residency data used in this thesis fall into three basic categories:

1. Individual

   For each resident there is a detailed record of where he or she was based each night from September 15, 1986 to October 18, 1987. The record distinguishes between nights spent at Gwaimasi, those spent elsewhere within the local subsistence zone and nights spent further afield. In addition, it identifies 'transitional' days, those on which the resident returned to Gwaimasi from elsewhere. This information allows comparison of individual fishing behaviour in different contexts and, by allowing adjustment for differential patterns of absences, comparisons between the fishing behaviour of different individuals (Chapter 7).

2. Gwaimasi

   For each day of the survey there is a record of how many people spent the night at Gwaimasi, as well as details of the identities of those people. Residents have been distinguished by name. Visitors have been recorded by name where known, and otherwise by place of origin. Where the name of a visitor was not known, or could not be reconstructed from later knowledge, at least details of sex and age class were noted. This information allows me to plot the changing size and composition of Gwaimasi as a food-sharing community, and thus to test for correlations between those variables and patterns of fishing behaviour (Chapter 8).

3. <u>Bush houses</u>

For each bush house (see 2.1.5), there is a record of all the nights that it was occupied during the survey, as well as identities of the people who stayed there on each of those nights. Note that not all nights in the bush were spent in bush houses. Hunting trips, particularly those to the foothills, often entailed overnighting in hastily constructed temporary shelters (or under a tarpaulin). Such camps are not included in this category for analysis. This information allows me to reconstruct the size and composition of any group staying at each of several specific locations in the bush, as well as duration of occupancy for each visit.

Together, records for Gwaimasi, for bush houses and for other sites within the local subsistence zone allow me to follow changes in the number and distribution of potential fishers, and thus to standardize for this variation in reconstructing patterns of fishing behaviour (Chapter 6).

4.2.3 Problems associated with data collection

The procedures used to collect information on residency and movement of individuals at Gwaimasi - observation and informal questioning - were far less intrusive than those for collecting fish data. Consequently, the problems encountered were of a quite different order.

Some initial problems were associated with learning to recognize the faces we were seeing and the places we were hearing about. These were solved with time and experience. The names and faces of residents rapidly became familiar, as, indeed, did those of regular visitors. By the time that purchase of fish skulls was initiated, the movements of these individuals could be fairly confidently traced. Eventually we learned most people who visited from neighbouring communities and many of those from further afield. In the meantime, we were able to record at least place of origin.

Similarly, it took time to locate all the bush houses to which people referred. Indeed two, Koto and Duwa, were never actually located, the former because it was abandoned early in our stay and the track disappeared, the latter because it was within the foothills to the east of the Strickland River.

Other problems related to the nature of the recording procedure; although we might know where an individual had been based while away from the village we could not record details of their movements from that base. This problem usually only arose when people were visiting another community, beyond the local subsistence zone associated with Gwaimasi, and so does not directly concern me in this thesis. There was one context, however, in which this problem does warrant further discussion. Usually, as noted before, visitors who spent time in the bush around Gwaimasi left from, and returned to, the village. Toward the end of 1987, however, the situation became more complicated. Mamo's family was spending increasing amounts of time at the bush house at Udiadai. This house was, in fact, closer to the Konai hamlet at Diwosuhau than it was to Gwaimasi, and Mamo was clearly building ties to the emerging community there. Occasional visits to both places indicated that some direct visiting was taking place, but it proved impossible to document the extent of this interaction. Records for Udiadai, therefore, must be considered suspect. As it happened, however, the streams near that house produced few fish, and this house rarely featured in my records.

One final point needs to be made. Our presence at Gwaimasi almost certainly had some influence on patterns of residency and mobility. Apart from the novelty we represented, the potential to earn money may well have encouraged people to spend more time at Gwaimasi than they would otherwise have done. In addition, during the early months of our residency people took turns to watch over us, staying near to ensure we were fed and safe from the physical and spiritual dangers of the area. (By mid-December, they apparently had decided that we could manage reasonable well by ourselves.) But such shifts in behaviour are of no great concern to this thesis. My interest, here, lies with the effect of changes in group size and composition, not in the motives for such changes.

CHAPTER 5

FISHING AT GWAIMASI - AN OVERVIEW

The data collected at Gwaimasi comprise a detailed record of fishing within the local subsistence zone during more than a year. In this chapter, I provide initial, descriptive analyses of those data. The intention is twofold: to provide a broad overview of fishing at Gwaimasi within which to position the particular analyses of subsequent chapters, and to introduce the definitions and classifications that structure those later analyses. The first section of the chapter summarizes overall returns, the frequency with which people fished, and the average size of hauls produced. The second section looks more closely at where and how those hauls were obtained, and at the kinds of fish they comprised. For each of these parameters the broad categories that will be used for analysis are introduced, and explained in terms of relevant characteristics. Where applicable, difficulties that arose in recording and classifying responses are discussed.

5.1 PRODUCTION OF FISH

At least 1369 fish, totalling 662.5 kilograms (treated weight), were caught within the local subsistence zone associated with Gwaimasi in the 57 weeks from September 15, 1986 to October 18, 1987.[1] Those fish were obtained in a total of 9028 fisher-days, giving an average catch rate of 15.2 fish and 7.3 kg of fish per 100 fisher-days (Table 3).[2] Fisher-days, here and elsewhere in the thesis, are calculated as the total number of days that a person capable of fishing slept either at the village or within the subsistence zone associated with the village during the survey. (Where relevant, fisher-

[1] Of the 1378 fish for which records were obtained during the survey, 9 fish, totalling 11.8 kg, are assumed to have been caught in the three days before the survey began, by people staying at bush houses at the time (see Appendix 3).

[2] The decision to express catch rates in terms of the catch per 100 days is based on aesthetic considerations. The values given avoid the awkwardness of multiple decimal places that would be required to contrast numbers of fish caught daily in different conditions, but can easily be converted to daily rates.

Table 3 Number and weight of fish recorded as caught within the Gwaimasi area between September 15, 1986 and October 18, 1987.

	FISHER-DAYS	TOTAL CATCH		CATCH per 100 days	
		no.	kg	no.	g
ALL potential fishers[a]	9028	1369	662.5	15.2	7339
Adults only[b]	7608	1309	651.9	17.2	8569

[a] Includes all individuals more than five years old.
[b] Excludes all individuals less than fifteen years old.

days will refer to the sum of those values for defined sets of individuals.) At Gwaimasi, men, women and children - both residents and visitors - fished. The youngest child to catch a fish during the survey was six years old, and the initial values for fisher-days in Table 3 assume that all those aged five and over were capable of fishing. But fishing requires some skill and knowledge that can only be acquired with experience. If individuals younger than fifteen are excluded, the catch rate increases slightly to 17.2 fish and 8.6 kg of fish per 100 fisher-days. The catch rate varied greatly through the survey, from as high as 215 g of fish per fisher-day in September 1986 to as low as 20 g per fisher-day in February 1987. But people fished at all times of the year; there was only one week, during the survey, in which no fish was caught in the local area.

Fish were obtained within the local area on at least 227 of the 399 days surveyed. At the village itself, where accurate daily records could be kept, fish were procured on 191 of the 383 days for which records were available. It was unusual, however, for more than two or three individuals to bring in fish on the same day; in fact, on more than half of the days when fish were brought to the village (107 of 191 days) the catch was obtained by a single individual. The 867 fish, weighing 407.3 kg, known to have been caught in the local area by people based at the village or by those arriving at the village from elsewhere, were the product of no more than 378 successful days of fishing by

Table 4 Frequency of successful fishing by people based at Gwaimasi, or arriving at the village from elsewhere, during the survey.

	FISHER-DAYS		
	total	with fish	% of total days with fish
ALL potential fishers[a]	6619	378	5.7
residents	5200	328	6.3
visitors	1419	50	3.5
Adults only[b]	5593	362	6.5
residents	4463	317	7.1
visitors	1130	45	4.0
resident men	2385	217	9.1
resident women	2078	100	4.8

[a] Includes all individuals more than five years old.
[b] Excludes all individuals less than fifteen years old.

individuals (see Table 4).[3] In other words, individuals fished successfully, on average, on only 5.7% of days that they were based at, or returning to, the village - once in every 17.5 days.

As might be expected given the skills required, children brought in fish less often than adults; if those younger than fifteen are excluded from calculations, the frequency of successful fishing days rises to one every 15.5 days (6.5% of all days). Adults, too, varied in their fishing success. Residents caught fish more frequently than visitors, and men more frequently than women. Even resident men, however, procured fish on only 9.1% of possible days - on average, every 11 days. Clearly, people at Gwaimasi fished much less frequently than the availability of fish for consumption might suggest.

[3] Another 20 fish, weighing 28.5 kg in all, were caught and brought back for a feast held at the village in the first week of the survey (see 2.2.6). (Of these, 15.4 fish weighing 22.2 kg are assumed to have been caught after the survey began.) These fish were smoked and pooled before distribution, and I cannot attribute any to either a particular fisher or a particular day of fishing.

In most cases, the fish procured by an individual on a given day were obtained as the result of a single distinct fishing expedition. Occasionally, however, an individual who had procured fish in one context would fish again later in the day, perhaps using a different technique or in a different stream system. For the purposes of analysis, a distinct 'fishing episode' has been recorded each day that an individual obtained fish using a particular technique (tactics are not distinguished) or from a particular stream system (streams within a system are not distinguished), or when the fisher was known to have returned to the village between captures (see Appendix 4). Successful fishing episodes in the Gwaimasi area produced, on average, 2.42 fish weighing a total of 1144 g (Table 5). Because it is likely that returns from some fishing episodes that occurred during prolonged stays at bush houses have been conflated in my records, Table 5 also provides separate details for village-based fishing episodes, those where the fisher left from, and returned to the village; the average number of fish caught, and the weight of those fish, is somewhat reduced relative to values based on all fishing.

Though people at Gwaimasi did not fish often, and usually obtained only small hauls when they did so, they caught a wide variety of species from many different stream systems, and by several techniques. The next section looks at these aspects of the catch.

5.2 MAJOR PARAMETERS - what, where and how

Of the various categories of information recorded for each fish, three in particular will form the focus of analysis in following chapters. An individual, having decided to fish, must choose which kinds of fish to target, where to seek them and how to secure them. Prey choice (species of fish), patch choice (stream) and choice of fishing technique can all be expected to reflect the costs and benefits associated with different options - and to change as the benefits to be gained change with size of resource-sharing group. My analyses will concentrate on identifying patterns, and changes in patterns, within these three parameters of choice.

Because the three are necessarily interrelated (feasible techniques, for example, may be limited by choice of stream), it is impossible to discuss any one of these parameters without at least an awareness of the options available in the others. The following discussion provides a basic introduction to the fish species, streams and fishing

Table 5 Average size of hauls obtained by people fishing in the Gwaimasi area during the survey.

	EPISODES	CATCH[a] no.	CATCH[a] kg	AVERAGE HAUL no.	AVERAGE HAUL g
ALL FISHING[b]	560	1353.6	640.4	2.42	1144
VILLAGE-BASED FISHING	338	669.1	309.8	1.98	917

[a] Excludes 15.4 fish, weighing 22.2 kg, which could not be attributed to particular fishing episodes (see footnote 2).

[b] Some episodes that occurred while based at bush houses may have been conflated in reporting, so these numbers may underestimate the numbers of fishing episodes and overestimate sizes of hauls.

techniques used within the local subsistence zone associated with Gwaimasi between September 15, 1986 and October 18, 1987. For each parameter, I survey the range of responses encoded within my records and discuss the basis for grouping those responses into the broader categories that will be used for subsequent analysis.

5.2.1 **Fish species -** ***Dio***

People fishing within the local subsistence area associated with Gwaimasi caught at least 23 different species of fish, from at least eight families, between September 15, 1986 and October 18, 1987 (Table 6). The species recorded ranged from gudgeons and rainbowfish, weighing less than 30 g, to eels that weighed as much as 10 kg. Numerically, the catch was diverse (Table 7), with the four dominant species being a forktailed catfish (*Arius taylori*), an eeltailed catfish (*Plotosus papuensis*), a perch (*Hephaestus habbemai*) and a gudgeon (*Oxyeleotris fimbriata*); together, these comprised two-thirds of the total catch. By weight, however, the catch was dominated by catfish; more than 84% of the total weight of fish procured in the survey period came from catfish, with most of this coming from two species, *Arius taylori* and *Plotosus papuensis*. Some species, in contrast, appeared very rarely. One, a species of jewfish which local

Table 6 Species of fish caught within the Gwaimasi area between September 15, 1986 and October 18, 1987.

SCIENTIFIC NOMENCLATURE[a]	KUBO NOMENCLATURE
Forktailed catfish	
Arius taylori[b]	*soigia* (= like *soi*) small specimens were sometimes referred to as *soigia diau*, or just *diau*, but were recognized as the young of this species
Arius leptaspis	*soi*
Arius latirostris	*gumo*
Arius augustus	*ouwuahia* (= Strickland man)
Cochlefelis spatula	*djau*
Hemipimelodus crassilabris	*okaibo* (= pig *kaibo*) sometimes *o dio* (= pig fish)
Eeltailed catfish	
Plotosus papuensis	*aiōdio* (= thorn fish) sometimes *muso* (= house), particularly for large specimens
Neosilurus equinus	*twe*
Neosilurus sp.[c]	*da* once *Wua da*, for a specimen from the Strickland River (= Wua)
Neosilurus ater	*yasa*
Porochilus meraukensis	*aiyō* (= blood)
Perch	
Pingalla lorentzi	*tobaga* sometimes *towe* (= to know)
Parambassis gulliveri	*awasu* sometimes *diati dio* or *wo tobaga* (= sago *tobaga*)
Hephaestus habbemai	*bō*
Hephaestus fuliginosus	*togowo* sometimes *baubu* (= bible) or *ado*.
Gudgeons	
Oxyeleotris fimbriata	*sa*
Oxyeleotris herwerdenii	*sabo*
Bostrichthys strigogenys	*kigi* (= to scrape)
Mogurnda cingulata (?)	*kaibo*
Mullet	
Crenomugil heteocheilus	*tio*

continued on next page...

Table 6 continued...

SCIENTIFIC NOMENCLATURE[a]	KUBO NOMENCLATURE
Jewfish *Nibea* sp.[d]	 *semesi dio* (= cement fish) one specimen only; not previously known to people at Gwaimasi
Eels *Anguilla* spp.	 *goi* three named subcategories - *goi de* (= true eel) *goi dibe* (= lightning eel) *goi tibu* (= eel that sits) (also *kokwa*, a very large eel that lives in the Strickland River; probably mythological)
Rainbowfish Fam. Melanotaeniidae	 *kaufo* there were named subcategories - e.g. *ko kaufo* - but few specimens were recorded

[a] Assignment of scientific names to Kubo taxa has been based on identification of skulls collected at Gwaimasi. Scientific names for the forktailed catfish were provided by Dr P. Kailola, then of the Zoology Department, University of Adelaide. Most other species were identified by Dr G. Allen, of the Western Australian Museum. R. McKay, of the Queensland Museum, identified the bass and confirmed some other identifications.

[b] This identification is not positive. Kailola (pers. comm.) decided that this was the probable identity of *soigia* but noted that, since there were very few confirmed specimens of *Arius taylori* held in museums, it was not possible to make a positive identification from cranial material alone.

[c] This species was very similar to *Neosilurus equinus*, and Allen (pers. comm.) was not certain that it constituted a separate species. *Twe* and *da* were distinguished by Kubo on pattern of colouration, and I could consistently distinguish two forms in the skulls.

[d] This species has not been described in the scientific literature, but at least one specimen was collected by Roberts in the Fly River (Roberts 1978; McKay, pers. comm.).

Table 7 Number and weight of fish of different species obtained in the Gwaimasi area between September 15, 1986 and October 18, 1987.

SPECIES	NUMBER	WEIGHT (kg)
Forktailed catfish		
Arius taylori	377	138.80
Arius leptaspis	80	67.04
Arius latirostris	69	49.33
Arius augustus	42	67.00
Cochlefelis spatula	28	27.11
Hemipimelodus crassilabris	12	6.92
Eeltailed catfish		
Plotosus papuensis	151	183.99
Neosilurus equinus	54	21.70
Neosilurus sp.	11	2.13
Neosilurus ater	8	2.79
Porochilus meraukensis	38	1.78
Perch		
Pingalla lorentzi	215	30.57
Parambassis gulliveri	5	1.20
Hephaestus habbemai	81	7.59
Hephaestus fuliginosus	8	6.86
Gudgeons		
Oxyeleotris fimbriata	174	7.16
Oxyeleotris herwerdenii	1	1.45
Bostrichthys strigogenys	3	0.24
Mogurnda cingulata (?)	2	0.04
Mullet		
Crenomugil heteocheilus	4	3.91
Bass		
Nibea sp.	1	2.00
Eels		
Anguilla spp.	10	44.66
Rainbow fish		
Fam. Melanotaeniidae	4+[a]	0.11

[a] Many more rainbow fish were caught than were recorded. Skulls of these small fish were fragile, and rarely survived cooking.

people could not recall having encountered before, was represented by a single specimen, while representatives of some other species were caught on only two or three occasions.

While the catch was diverse it did not include all species that would have been present in the Strickland River and its tributaries. No lists of fish species to be found in the Strickland drainage have been published, but a detailed survey of fish in the Fly River drainage, west of the Strickland River (see Figure 6, in 2.1), recorded at least 47 species as probably present in the zone from about 50 m to 200 m ASL (Maunsell *et al.* 1982:88-89; this list included at least 11 of the species caught at Gwaimasi, and closely related analogues of some others[4]). People at Gwaimasi recognized the existence of, and had names for, several species of fish that were not caught during the survey period. Large barramundi (*Lates calcarifer*; = *doa*) were sometimes seen near the surface in the Strickland River and, though none were caught during my survey, these presumably were taken on occasion; one barramundi skull had been trophied in an old house by the river. A number of large bass (*Lutjanus goldiei*; = *ae*), were caught by net at Waibi, a village to the south, in November 1986, but people at Gwaimasi did not have a net suited to the capture of this species. Other species, such as pipefish (Fam. Hemirhamphidae), were also regularly seen in the Strickland, but not accessible given the fishing techniques available at Gwaimasi. In addition, Kubo had names for at least eight kinds of very small fish found in the clear tributaries of the Strickland River which they seldom bothered to catch.

Because my prior knowledge of fish taxonomy was limited, I relied on the nomenclature that local people used (see Table 6) when identifying fish for my records.

Kubo taxonomies are generally shallow, consisting of named life-form taxa with multiple included generics but no named intermediate taxa, and some generics that are not affiliated with a life-form category.[5] People at Gwaimasi classed all fish as *dio*. They did recognize broad subdivisions within this lifeform - particularly the division between fish with scales (*dio gehaidia*) and those without (*gabo dio*). Names for these

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[4] The scientific nomenclature of Papua New Guinean fish is in a state of flux and some names used in 1982 are no longer current.

[5] The terms used to designate taxonomic rank (life-form, generic, specific) follow Berlin (1992; see also Berlin *et al.* 1973; Brown 1984). These terms are in more general use than those used by some ethnosystematists (eg. Bulmer 1970, 1974; Dwyer 1976) who have worked in Papua New Guinea.

subdivisions were elicited only after some prompting. They were entirely descriptive and I have doubts about their true lexical or taxonomic status; they are probably best considered as covert categories (Berlin 1992:176-7).[6] Most of the names elicited for fish were generics, and nearly all were mononomial terminal taxa. Only eels and rainbowfish, comprising the largest and smallest of local fish respectively, were subdivided with a few binomial specific names. In these cases, however, though people recognized the existence of named sub-categories they rarely bothered to distinguish them when delivering skulls.

Synonyms existed for many of the generics (see Table 6), though they were not commonly used. A few of these related to size classes within a given species - eg. *muso* as large *aiõdio*, *diau* as small *soigia*. These names were not always used, however, and often given with a stated recognition that the fish in question was, in fact, an *aiõdio* or *soigia*. Some synonyms may have been borrowed from neighbouring language groups. Others - eg. *baubo* (= bible) for *awasu* - may have been recently coined.

People at Gwaimasi were generally competent at identification of fish; in only 15 cases did the name given by the person delivering a skull not match my subsequent assessment. Some individuals, however, were definitely better at identification than others. Both interest and familiarity probably played a part in this. Women, who tended to catch far fewer fish than men, were often less sure in their identifications, and were more likely than men to provide names that did not match the skull.

If asked, people usually justified their identifications of fish by appeal to physical characteristics, such as shape of head, or pattern of colouration. Ecological factors, such as the type of stream in which the fish might be found, did not play an overt part in identification, but did contribute in some ambiguous cases (cf. Boster & Johnson 1989). For example, several misidentifications concerned two closely related species of eeltailed catfish, *twe* (*Neosilurus equinus*) and *da* (*Neosilurus* sp.). Both were said to, and did, occur in all major streams west of the Strickland River; *twe*, however, dominated in one system, while *da* dominated in another. The associated expectations occasionally led people to identify specimens incorrectly, doing so on the basis of the stream system from which the fish came. Other forms of misidentification also related to expectations and

[6] The emerging influence of the Seventh Day Adventist (SDA) church among Kubo may give the distinction between fish with scales and those without greater salience; this church prohibits the eating of scaleless fish.

probabilities; unusually large specimens of *soigia* (*Arius taylori*), for example, were occasionally identified as *ouwuahia* (*A. augustus*), though these species are easily distinguished.

It was unusual that people declared ignorance concerning the name of a fish. When the skull of *semesi dio* (= cement fish) was brought in, for example, we were told its name with great confidence; only later did we discover that no-one recalled ever seeing this type of fish before, and that the name had been devised on the spur of the moment. That name referred to large bony concretions on the skull that recalled the form and texture of cement, which people had seen used as a building material at government and mission stations.

Establishing the scientific referents of Kubo taxa posed some difficulties. We collected reference skulls only[7], but fish taxonomy is usually based on external characters such as scale counts and fin positions (eg. Allen 1991; Munro 1967). Though, with time, we could consistently separate all Kubo taxa on the basis of skull attributes these attributes are not familiar to most scientifically trained workers. A paucity of scientific knowledge about fish in the region compounded the difficulties. For example, *soigia*, the forktailed catfish that dominated the catch at Gwaimasi, has been tentatively identified as *Arius taylori*, a species previously known to science from very few specimens. P. Kailola, who identified the skulls of forktailed catfish, and G. Allen, who provided other identifications, both have extensive field experience with the New Guinea fish fauna. R. McKay is one of the rare ichthyologists with experience in identification of skeletal remains, particularly from archaeological sites, but was hampered by the lack of comparative skulls from New Guinea freshwater fish.

The correspondence between Kubo taxa and scientific taxa was very high, approaching 100% (the one possible ambiguity concerned the identities of *twe* and *da*; see footnote c in Table 6). In my analyses, I have used scientific identifications; since Kubo did not name intermediate taxa, species are grouped according to scientifically recognized family relationships.

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[7]All collections had to be carried a two day walk to the nearest airstrip at the end of the survey, so bulk and weight were significant constraints. Transport of entire preserved specimens, which require careful packing, would have posed major logistical problems.

5.2.2 **Streams** - ***hoi***

The annual rainfall of nearly six metres in the vicinity of Gwaimasi contributes to numerous streams that drain into the Strickland River.

These streams marked the land for Kubo. Streams bounded a clan's land. They defined and specified places; houses were built, a pig shot or a palm processed, and ancestors made decisions that determined the shape of the world today, near the headwaters (*hobe* = tail) or mouth (*hau* = egg/source?) or by the side (*kigi*) of a particular stream. And streams traced people's journeys over the land; upstream (*bu*) and downstream (*u*), this side (*ba*) and across (*efei*), expressed the essence of direction for Kubo.[8]

Streams also provided fish. Between September 15, 1986 and October 18, 1987 people caught fish from at least 36 distinct streams within the Gwaimasi local subsistence zone, ranging from the Strickland River itself down to trickles only a few centimetres deep. Figure 18 presents a schematic map illustrating the relative distribution of streams named in my records, and Table 8 summarizes the catch from each. Though streams throughout the local subsistence zone were visited, and fish obtained from most of these, the catch was not evenly distributed. More than a third of all fish (36.5% by number; 43.4% by weight), came from the Strickland River. Another 19.2% of fish (21.2% by weight) came from Dege. No other stream contributed more than 4% of the catch, and 18 streams produced less than ten fish each.

People at Gwaimasi made no terminological distinctions among streams on the basis of size or any other variable. Major ecological differences could be recognized, however, and for purposes of analysis I will group streams on the basis of broad, geographically-distinct zones. Much of the area west of the Strickland River was explored in detail, and mapped with stopwatch and compass; I have inspected, and can trace with considerable accuracy, the location of all major and many minor streams there. The east bank of the Strickland River could only be reached by canoe, and was thus less accessible for exploration, but I know at least approximate locations for all named streams to the east. On the basis of this information it is possible to distinguish several distinct stream systems.

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[8] Shaw & Shaw (1973), reported a similar focus on location and direction in Samo perception and language.

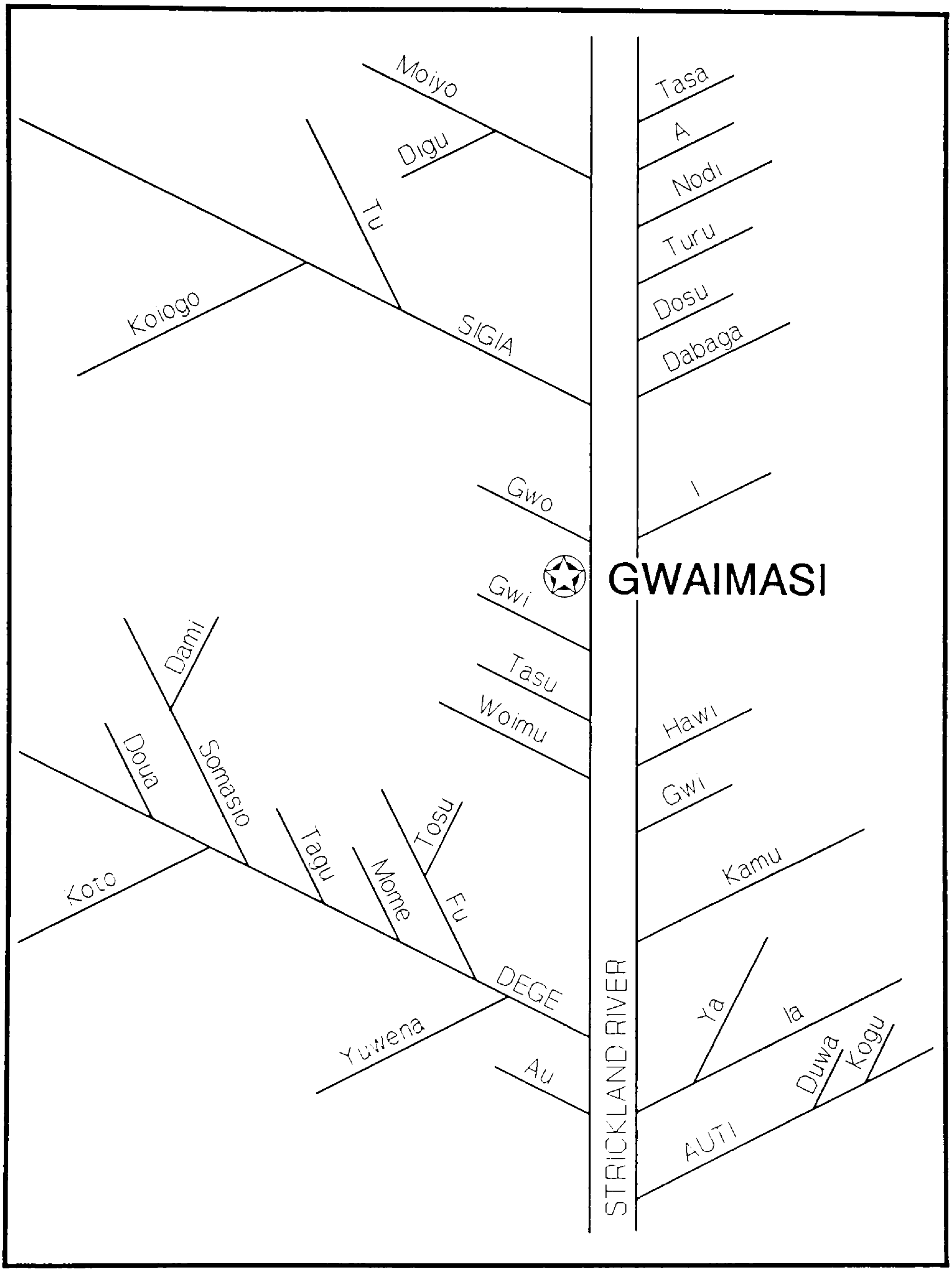

Figure 18 Streams within the Gwaimasi area from which fish are known to have been obtained between September 15, 1986 and October 18, 1987.

Table 8 Number and weight of fish obtained from different streams in the Gwaimasi area between September 15, 1986 and October 18, 1987.

STREAM	NUMBER	WEIGHT (kg)
Strickland River	503	288.22
Dege		
Dege	264	139.92
Doua	1	0.10
Koto	53	30.98
Somasio	41	17.23
Dami	7	0.37
Tagu	25	8.53
Mome	12	8.53
Yuwena	36	9.60
Fu	20	6.34
Tosu	3	0.19
Sigia		
Sigia	40	12.86
Koiogo	12	6.28
Tu	20	7.31
Other western streams		
Moiyo	5	0.43
Digu	1	3.33
Gwo	4	0.11
Gwi	2	0.10
Tasu	2	0.09
Woimu	1	0.03
Au	1	0.99
Eastern swamp streams		
Auti	31	26.57
Ia	19	9.82
Ya	9	3.54
Kamu	12	14.22
Eastern foothill streams		
Duwa	13	6.27
Kogu	49	2.06
Gwi	4	0.10
Hawi	1	0.03
I	44	9.18
Dabaga	9	0.33
Dosu	9	0.38
Turu	1	0.04
Nodi	9	0.38
A	4	0.18
Tasa	15	0.60
UNKNOWN	96	59.37

1. Strickland River

The Strickland River - known locally as Wua, or Gedei - dominates the landscape about Gwaimasi. By the time it reaches this area, several hundred kilometres from its source in the highlands to the north, the Strickland River is about 80-100 metres wide. Always fast flowing and silt-laden, it can rise or fall several metres overnight in response to rain in the mountains; its frequent changes seem largely independent of local conditions.

Local conditions, on the other hand, are essential to other streams in the Gwaimasi landscape. Most of these streams are short, perhaps three or four kilometres long, rising and falling according to local rainfall and responding rapidly to any change. They are not, however, all similar. Gwaimasi was built where the Strickland River flows out of the central ranges onto the plains. To the north of the village, and east across the Strickland River, lay the *bi sa* - foothill country, rising rapidly to the limestone of the Karius and Muller ranges. To the south and west lay *igie sa* - backswamp country, flat, damp, and often partially inundated (see 2.1.2). The streams that drain these two zones are very different.

2. Dege and its tributaries

Dege, a stream which joins the Strickland River about one and a half hour's walk south of Gwaimasi, drains the backswamps. Ten to fifteen metres wide at its mouth, it usually runs clear and slow, with deep pools fringed by overhanging trees that contribute to a buildup of leaf litter and other debris, and a sandy-muddy bottom conducive to growing the water plants that feed and shelter fish. But heavy rain can rapidly turn Dege into a murky torrent, sweeping away log bridges and anything else in its path; it may be days before the swamps drain sufficiently for the waters to clear. Dege is fed by several tributaries, very similar in form to itself, but smaller and generally shallow except in times of flood. And each of those streams, in turn, has its own tributaries.

3. Sigia and its tributaries

Sigia, a stream joining the Strickland River about a half-hour walk north of Gwaimasi, drains the limestone foothills. This is a very different stream from Dege, though not dissimilar in size. Its waters are sparkling clear, tumbling over a broad bed of cobbles eroded from the hills; this was the stream to which people came when they needed chert for tools. The few deeper pools have clean pebble and sand bottoms, and generally lack the weed-growth and accumulated debris found in Dege. While Sigia, too, can flood rapidly with rain, it does not have the reservoir effect of the swamps and the waters usually fall again within a few hours. The tributaries of Sigia are more closed in, sometimes flowing through patches of sago swamp in their lower reaches, but most - particularly those from the north - show their foothill origins in having wider, stonier beds than streams of the Dege system.

4. <u>Other western streams</u>

Most other streams joining the Strickland from the west are very short, simply cutting through the levee bank from the swamp. Moiyo and its tributary Digu were exceptions, being foothill streams akin to Sigia, but these were well to the north and rarely visited. This is, in fact, a residual category; none of the streams included were important as sources of fish.

I saw little of the streams that entered the Strickland River from the east, beyond their mouths. Judging from local descriptions, however, and from the terrain through which they flowed, it was possible to infer something of their character. Two distinct types can be identified.

5. <u>Eastern swamp streams</u>

All local streams east of the Strickland River rise in the foothills. Those to the south, however, are larger, running through alluvial flats and swamps for much of their length. The streams from Kamu south fall into this category, with Auti, at the southern edge of the local subsistence zone, being the largest.

6. <u>Eastern foothills streams</u>

The streams from Gwi north, on the east bank, are all relatively short, emptying directly from the foothills into the Strickland River. The two tributaries of Auti from which fish were obtained are also effectively foothills streams, and have been included in this last category for analysis.

5.2.3 Fishing techniques

People at Gwaimasi used several different kinds of technology and a wide range of strategies to get fish (Table 9). Definition of techniques for the purpose of analysis,

Table 9 Fishing techniques used within the Gwaimasi area between September 15, 1986 and October 18, 1987.

	PURSUIT	BESETTING	AMBUSHING	TRAPPING	HARVESTING
SPEAR	mobile fish	resting fish			
LINE			tended line	set line	
OTHER	arrow	hand		net	poison

however, poses some problems. The task of procuring fish (or game) has two distinct components: first, the fisher must actually make contact with the prey; then, the prey must be secured. Most classification (as opposed to description) of hunting techniques in studies of human ecology has focussed on the former component, but the people being studied, like Kubo, may be more likely to classify techniques according to the latter component.

Bulmer (1968), for example, discussed techniques of hunting in New Guinea in terms of several broad 'strategies', which included stalking, ambushing, trapping and besetting (see also Healey 1990:92-93). Dwyer and Minnegal (1991a:193-5) formalized this approach, suggesting that all hunting techniques could be reduced to five strategies: (1) active pursuit[9] - where a mobile hunter searches for mobile prey; (2) besetting - where a mobile hunter searches for stationary prey at resting or nesting sites; (3) ambushing - where a stationary hunter waits for mobile prey at feeding sites or tracks; (4) trapping - where a mechanical device is used to replace the hunter at an ambush site; and (5) harvesting - where both hunter and prey are effectively stationary, the hunter collecting small items at known places of aggregation.

No such classification can be definitive, for it draws arbitrary distinctions where reality offers a continuum of possibilities. After all, as Healey (1990:93) remarked, any hunt may "degenerate into a chase when the prey attempts to elude the hunter", whatever

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[9] "Hunting (*sensu stricto*)" in Dwyer & Minnegal (1991a).

the initial strategy. But systematization along these lines does have at least heuristic value. Relative mobility of hunter and prey affects not only the effort expended in a hunt but also the range of choice that the hunter will encounter and even, to some extent, the flexibility to choose.[10]

Kubo, however, did not define fishing techniques in terms of underlying strategies. Rather, they referred to the nature of the technology involved, and the manner in which the fish was secured. Thus, fish were reported as 'entangled' (*habeibo*) by line or net, 'pierced' (*diabo*) by spear or arrow, 'immobilized'[11] (*ubwo*) by poison or hand, and so on.

Categorization of fishing techniques in my records of fishing at Gwaimasi was based on distinctions made by the local people. Since those records relied on reporting by the fishers themselves, this was, perhaps, unavoidable. In as much as my interests lay with the decisions made by those fishers, it was also desirable. But as my knowledge of fishing practices increased it became apparent that a term such as 'line fishing' might subsume more than one strategy; tended and set lines entail quite different investments of time and give different degrees of control over haul size. While the Kubo categories are used for most analyses of choice of fishing technique, therefore, it is important to be aware of the range of options that these categories encompass. The rest of this section, therefore, discusses each of the basic techniques used at Gwaimasi, focussing not only on the equipment used but also the types of strategies employed, the skills entailed, and the flexibility available as to choice of particular tactics and targets.

Two techniques were responsible for most of the catch at Gwaimasi - fishing with spears and with lines. Together, these accounted for more than 94% of the fish obtained

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[10] The optimal prey-choice model, for example, as usually formulated for studies of human ecology (eg. Hawkes *et al.* 1982), is really applicable only to use of the first two strategies since it assumes a hunter patrolling and encountering prey types at random. It is certainly possible to reformulate the models to suit other strategies. Return rates for prey types obtained by different strategies, however, are not directly comparable within a single analysis.

[11] This is probably the best gloss for *ubwo*; 'grabbed and held' could also be used. *So ba ubwo* was the phrase used to describe captures attributed to dogs (= *so*) during a hunt. Note that poison is considered the actor in this context. People who brought in fish obtained by poison were puzzled when we asked who 'immobilized' the fish; clearly the poison had done so, not a person. The relevant question should have been 'who placed the poison in the water?'.

Table 10 Number and weight of fish caught by different techniques within the Gwaimasi area between September 15, 1986 and October 18, 1987.

TECHNIQUE	NUMBER	WEIGHT (kg)
Line	701	295.8
Spear	518	275.1
Other		
Poison	27	18.1
Net	7	7.1
Hand	23	1.5
Arrow[a]	17	9.4
UNKNOWN	85	67.4

[a] The single eel included in this category - weighing 4.3 kg - may have been obtained by 'bow' (see p.154).

within the local subsistence area for which technique of capture is known (Table 10).

1. Spearfishing - *audi ba diabo*

Spearfishing at Gwaimasi entailed getting wet; fish were speared from below the surface of the water, not from above it. Spearfishers - always men - drifted along the surface of streams, or dived in larger pools, to find fish. These they shot using a length (c. 1.4 m) of thick wire fired by a length of rubber, usually from a car inner-tube, tied to one end. Face masks, or goggles, were often used to aid vision underwater, but were not essential.

Despite the emphasis on modern equipment, spearfishing was a traditional technique among Kubo; it was described in the report of one of the earliest government patrols to the area (Patterson 1969).[12] In the past, a hardwood shaft was used, fired by rubber made from the sap of a vine called *dumagai*. The new materials, and particularly

[12] Spearfishing was, apparently, a very localized technique. Patterson (1969) specified that this type of fish-spear was in use along the Cecilia (Boye) and Strickland Rivers, and thought the 'rubber' used sufficiently interesting that he collected specimens for analysis. Beek (1987:93, 113-4) described a similar implement in use among Bedamuni in 1978-79, but declared it to be "essentially new" to those people.

face masks, may have improved the efficiency of the technique, but the skills required would not have changed.

Spearfishing was a very effective technique. It contributed at least 37.6% (n=518) of all fish caught during the survey. Fish of over two kilograms (and up to 8 kg) were regularly speared, and hauls of ten or more fish were not uncommon. It was also a fairly flexible technique, which allowed targeting of particular kinds or sizes of prey. The strategies employed could range from besetting, where people searched for eeltailed catfish hidden beneath leaf litter, to active pursuit of forktailed catfish and small perch that tended to be active during the day. Because of the need to see prey, however, use of this technique was restricted to streams with good visibility.

2. <u>Linefishing</u> - *feseia ba habeibo*

Fishing with baited lines was the single most common technique used at Gwaimasi. Men, women and children were free to use it, the primary constraint being access to the necessary equipment - metal hooks and nylon lines. And, because prey did not need to be seen, linefishing could be used in contexts were spearfishing could not, particularly in the silt-laden Strickland River.

Linefishing was not a traditional technique among Kubo. It was, in fact, unknown 20-30 years ago, when the first patrols reached this area (Hoad 1963)[13], and no attempt has been made since then to manufacture the necessary equipment from locally available materials. Addition of this technique to their repertoire had significantly increased Kubo access to fish; people at Gwaimasi insisted that they had previously had no means of obtaining fish from the Strickland River.

Linefishing contributed more than 50.9% (n=701) of fish caught during the survey. Usually, 'set lines' were used - thrown into the water on the way to some other activity and checked several hours later. These lines were used, in effect, as a form of trap. This, too, was a very effective technique, with the advantage over spearing that little time needed to be invested, but it was much less flexible than spearfishing. Limited control over prey species could be had by selective use of baits.[14] Similarly, some

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[13] Hoad (1963) noted that "fishing hooks were accepted as ornaments until their purpose was explained".

[14] Maunsell *et al.* (1982:84-85) reported that bait used affected relative probability of capture for different species of fish in the Fly River.

control over size of prey could be had by choosing larger hooks and stronger lines. Haul size, however, was still restricted to one fish per line. Potential haul size could be increased by setting more lines but, while several people owned two lines, it is unlikely that anyone had more than three. More seriously, set lines offer no guaranty of returns. Fishing has often been characterized as "a very low-risk strategy... [in that] the probability is low that an individual out fishing will return with no fish at all" (Gragson 1992:435). Set lines, however, often fail to secure a catch. Adding lines may increase the probability of obtaining at least one fish, but provides no more control over the size of the haul produced.

Some control over size of hauls can be obtained by watching lines, clearing them as fish are caught and replacing bait as soon as it is taken - in other words, by switching strategies from trapping to ambushing. Such tending of lines has an obvious cost in terms of time invested, but people at Gwaimasi did occasionally use this strategy. Given the limited number of lines available to individuals, I have assumed that lines were tended if more than two fish were caught during a single episode of linefishing.

Apart from spearfishing and linefishing, the only other important technique used to obtain fish at Gwaimasi was poisoning.

3. Poisoning - *foti ba ubwo*

People at Gwaimasi had access to two types of fish poison, *foti* (from the derris vine) and *yumoti* (from the roots of the *yumo* tree).[15] The principle behind use of each was basically the same: poison that leached out of the bruised vine or root when placed in water stunned fish, causing them to float to the surface where they could be scooped up by hand or with a simple basket. Poisoning trips at Gwaimasi during the survey required only two people, and did not entail any elaborate damming or diversion of streams. We heard reports, however, of far more elaborate poisoning expeditions elsewhere in Kubo territory, akin to those described for Bedamuni (Beek 1987:92) and Etoro (Kelly 1977:38-40).

Poison was only occasionally used to catch fish at Gwaimasi; it was responsible for 2% of the catch (n=27; 2.7% by weight). Poisoning is, in effect, a means of harvesting the fish present in a particular stream or pool. It had the potential to provide large,

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[15] At least three varieties of *foti* and four varieties of *yumo* are recognised.

indiscriminate hauls (at least 20 fish of 4 different species, totalling 11.9 kg, were obtained on one occasion). Because concentration of organic poisons is unpredictable, however, the effectiveness of the technique was highly variable; the fisher had little control over either size or composition of the haul.[16]

Several other techniques were used at Gwaimasi during the survey period, but none contributed much to the catch. I will mention them briefly here, but these minor techniques play little part in the analyses to follow.

4. Net - *neti ba habeibo*

Again, this was not a traditional fishing technique. A scrap of old nylon gill net had been obtained from Waibi, a village further down the river. This was sometimes set up at stream-mouths as a form of trap, with notable lack of success; one fish was considered a good haul. Less than one percent of all fish (n=7) were caught by this means.

5. Hand - *agua ubwo*

Small gudgeons were occasionally caught by hand under rocks in small streams. Less than 13% of all gudgeons (n=23; <2% of the total catch) were caught in this way. Only once during the survey was a larger fish, a forktailed catfish, reported as taken by hand.

6. Arrow - *marai ba diabo*

Men travelling beside streams would sometimes spit, or toss twigs, onto the surface and shoot arrows at small fish that came up to investigate. Only 1.2% of fish in my records (n=17) were obtained in this way but, because skulls of rainbowfish were not kept and brought to us, that value will underestimate the catch by this technique.

7. Bow - *tai ba ubwo*

Eels were sometimes taken by locating them in their holes, then unstringing a bow and using one end to pin the eel until it could be grabbed and killed; a form of besetting.

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[16] Kubo saw this otherwise; they believed that control could be exerted, and frustrated, through a range of magical practices. Poisoning alone, of all the fishing techniques used at Gwaimasi, was governed by explicit ritual and taboos associated with age and reproductive status. While this may be understandable as a response to the unpredictability of returns from poisoning, it may also serve to restrict use of a technique that effectively removes all fish from a stream (see 7.1).

There are no confirmed records of this technique being used within the local subsistence zone. This absence, however, probably reflects problems with translation rather than the actual situation; fish said to have been taken by bow were initially assumed by me to have been shot with an arrow from that bow.

8. Jagging

On one occasion a young girl was observed using a line to jag for small fish in a fast-flowing stretch of Sigia; the hook was tossed onto the surface, allowed to drift briefly, then jerked back. No fish were recorded as caught by this technique, but again the targets were small rainbowfish whose skulls would not have been retained for sale.

Finally, though the fishing techniques used during the survey were diverse, they did not comprise all those of which the people at Gwaimasi were aware. In particular, people described various ways to build fish traps, from simple cone-shaped basket traps placed in small streams to more elaborate arrangements entailing construction of weirs (cf. Beek 1987:92, describing Bedamuni fish traps). None of these were used during my stay at Gwaimasi, though I saw evidence of their use at other villages away from the Strickland River. Such traps may have been effectively replaced, at Gwaimasi, by set-line fishing in the river itself.

Of the fishing techniques used at Gwaimasi during the survey, only one (netting) needed co-operative effort to succeed. The catch from some other techniques might be increased through co-operation; with poisoning, for example, additional fishers perhaps could secure more fish before the poison dispersed. But the primary techniques and tactics used at Gwaimasi were not amenable to co-operative effort. Two people holding a line would not increase the probability of a fish taking the bait, nor were two spears better than one in securing a fish. People did, at times, go spearfishing or linefishing in association with others, but this was not to do with improving efficiency. Rather, it may have been a way of preventing any reduction in efficiency that might result from the uncoordinated activities of others (cf. Ichikawa 1985:46). By travelling in company with others, and keeping track of their movements, an individual could avoid searching locations or setting lines in places that had already been depleted.

Fishing in groups, at Gwaimasi, was largely about coordination, not about co-operation. The effect was to ensure that individuals obtained the returns that would have been possible if no others were fishing. Consequently, in the analyses that follow, I ignore details of foraging group composition, regarding all fishing episodes as independent.

INTERLUDE

Quantitative analysis of behaviour renders the actors themselves anonymous. Gugwi and Sinio, Filifi and Sisigia, are not to be seen in the collations of fishing returns in Chapter 5, yet it was they who caught most of the fish. The anonymity will increase in later chapters; that is a necessary outcome of the analytical stance I have adopted. My concern, in this treatise, is with processes that extend beyond the individual in time and space - with functions of behaviour, not with motives for action. There is a danger of forgetting, however, that those processes exist only in the actions that comprise them. Before proceeding to more detailed analyses of fishing behaviour, then, let the actors briefly take centre stage.

In this interlude, I follow the fishing activities of Gugwi and Sisigia, two of those who lived at Gwaimasi in 1986-87. I map their fishing returns on to records of movement, note activities associated with fishing, or within which fishing may have been embedded, and detail significant events that might have influenced ability or desire to fish. These aspects are combined as a narrative, a chronological account of fishing through the survey. The approach is anecdotal, not analytical; I am concerned here with 'actions', not with patterns of 'behaviour'. The constellation of circumstances that informs a particular decision, and in terms of which individuals may rationalize that decision, tends to be unique. Although that uniqueness is the focus of attention in this interlude I do, in the final section, draw attention to some repetitive themes that run through the narrative.

Gugwi and Sisigia were the most regular and productive fishers among male and female residents of Gwaimasi respectively. I have chosen them as subjects, not because they are representative of the community as a whole, but because of the number and diversity of fishing events in which they engaged. Both were strong characters, and the vicissitudes of their lives through the survey may serve not only to demonstrate the range of circumstances in which people at Gwaimasi fished but also to give a more general sense of life in the community.

The narrative serves, in part, to illustrate issues to be addressed in later chapters. But it has a deeper intent: to remind the reader that the patterns of behaviour which are discussed in subsequent chapters have no intrinsic reality. Those patterns are abstractions from the many unique actions of many real people. And, though the patterns may reveal relationships between aspects of context and of behaviour, they do not describe, nor can they explain, any one of the particular actions from which they have been derived.

GUGWI AND SISIGIA

Gugwi and Sisigia were husband and wife. Theirs was a love match. The marriage had not been arranged through normal channels; they had eloped, and spent some time hiding in the forest to avoid relatives annoyed at the resultant disruption to previous plans. The match was eventually accepted and, with some qualifications, appeared successful. Certainly, the strength of their feelings for each other seemed undiminished after several years of marriage.

Gugwi and Sisigia spent nearly all their time in each other's company; they were apart for only 13% of 386 nights during the survey. Even their daylight hours were usually spent together; on at least 88% of the 209 days that Gugwi and Sisigia were both based at the village they were engaged in related activities in the same general location. These two also tended more often than others to go to bush houses where they could be alone, spending 22% of all nights during the survey together in the bush.

Despite this togetherness Gugwi and Sisigia had no children, a fact that was the only real source of tension between them. Gugwi, at least, very much wanted children. He did have a son - Gawua, aged about 10 in 1986 - from a previous marriage (see Figure 9, in 2.2.2). Gawua, however, appeared to resent his stepmother, and preferred to live with his lineage brothers; he associated directly with his father only when Sisigia was temporarily living elsewhere.

Fishing record

Figure 19 summarizes the fishing returns that Gugwi and Sisigia obtained each week, mapping the catch onto the couple's movements between village, bush and neighbouring communities, while Table 11 provides a daily record of fish caught.

Gugwi and Sisigia were away from the village when the survey started - as, indeed, were most other members of the community. A feast had been planned for September 20, to mark completion of our house, and people had scattered to assemble supplies. Gugwi and Sisigia elected to take a canoe up-river, to gather *kosa* nuts from certain trees to which one of them held a claim. They returned several days later with few nuts - the crop had not yet fallen - but much fish. Four fish had been eaten during their absence (2634 g each in 3.5 days) and another (625 g) was eaten the night of their return, but the rest, smoked, were added to the stockpile for the feast.[1]

The two weeks after the feast were fairly quiet for Gugwi and Sisigia. They did not attend a reciprocal feast held at Nanega, though they shared in the food carried home. Sisigia set a fishing line in the Strickland River on at least one day, but neither she nor her husband moved far from the village through this time. Gugwi spent a few days clearing the area around our house, but then the two turned seriously to completion of their own house in the village. The roof and floor had been in place for some time, and this skeleton structure was already a focus for food-preparation and socializing. Each night, however, Gugwi and Sisigia retreated to a garden house some 500 m away at Daga'agu Hau to sleep, returning to the village at dawn. In the first few days of October the walls of the house were finished and the time to move in approached. But Kubo may not sleep in a new house until certain rituals, which entail the eating of large quantities of meat, have been performed.[2] On October 4, Gugwi and Sisigia, with the youth Dogo, left for an old bush house near the stream Koto, a tributary of Dege. That day and the next the two males speared fish, 25 in all, weighing more than 12 kg. (Gugwi's contribution comprised 19 fish weighing 11,170 g) Nearly 7 kg of this haul (6973 g) were disposed of during that overnight absence, with the remainder carried to the village and shared.

Then again, a quiet time followed. Finishing touches were added to the house, and Sisigia may have processed some sago nearby. Occasionally, she set a line in the

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[1] Reliable attributions for these 'feast fish' could not be obtained, and they are not included in Table 11 or Figure 19. Because Gugwi and Sisigia departed the day before the survey began, only part of the fish they consumed while away (0.75 of 5268 g) is included in analyses.

[2] This concern may have contributed to the decision to hold a feast to mark completion of our house, as well.

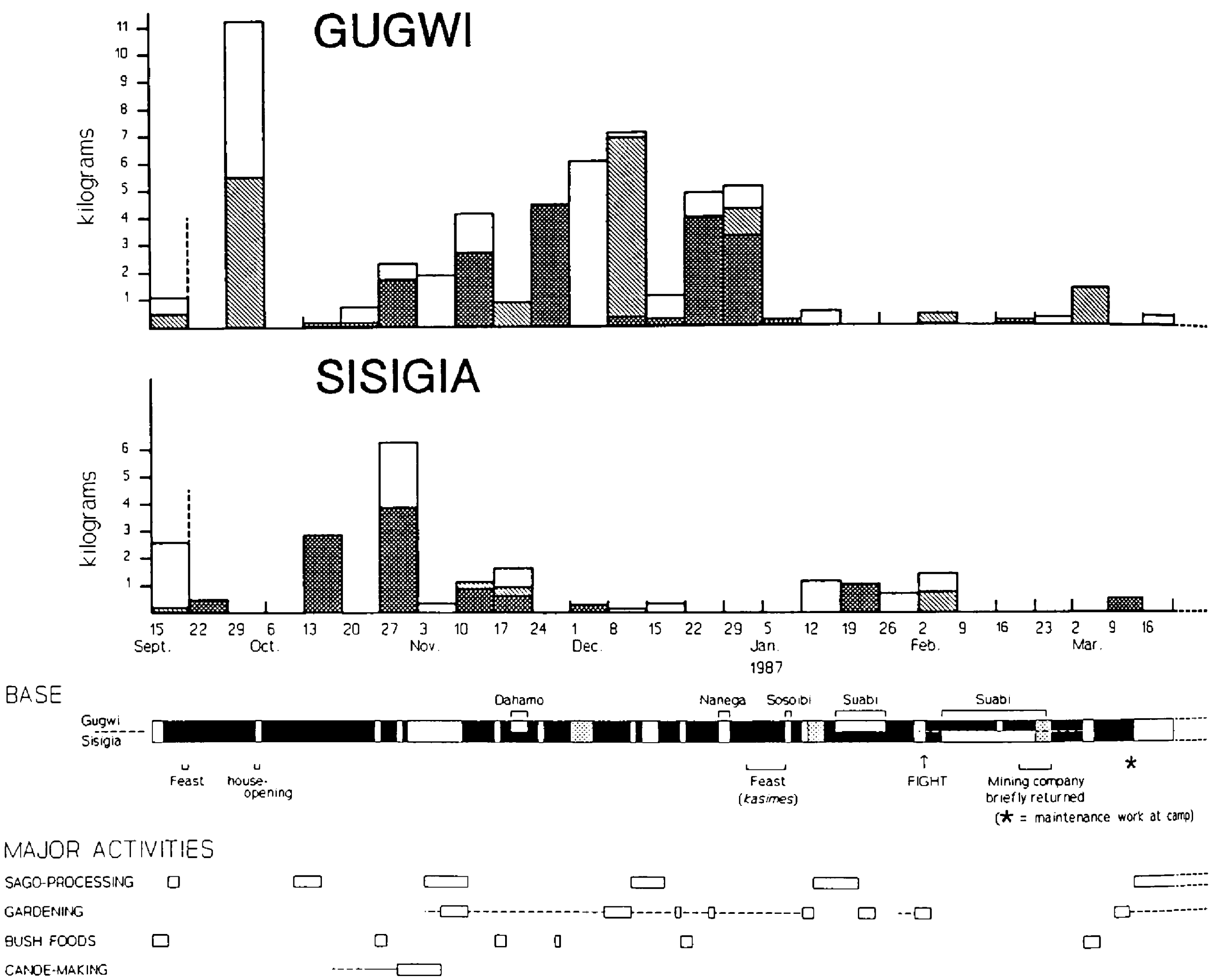

Figure 19 Amount of fish obtained each week by Gugwi and Sisigia, mapped onto other activities and onto movement between village, bush and neighbouring communities.

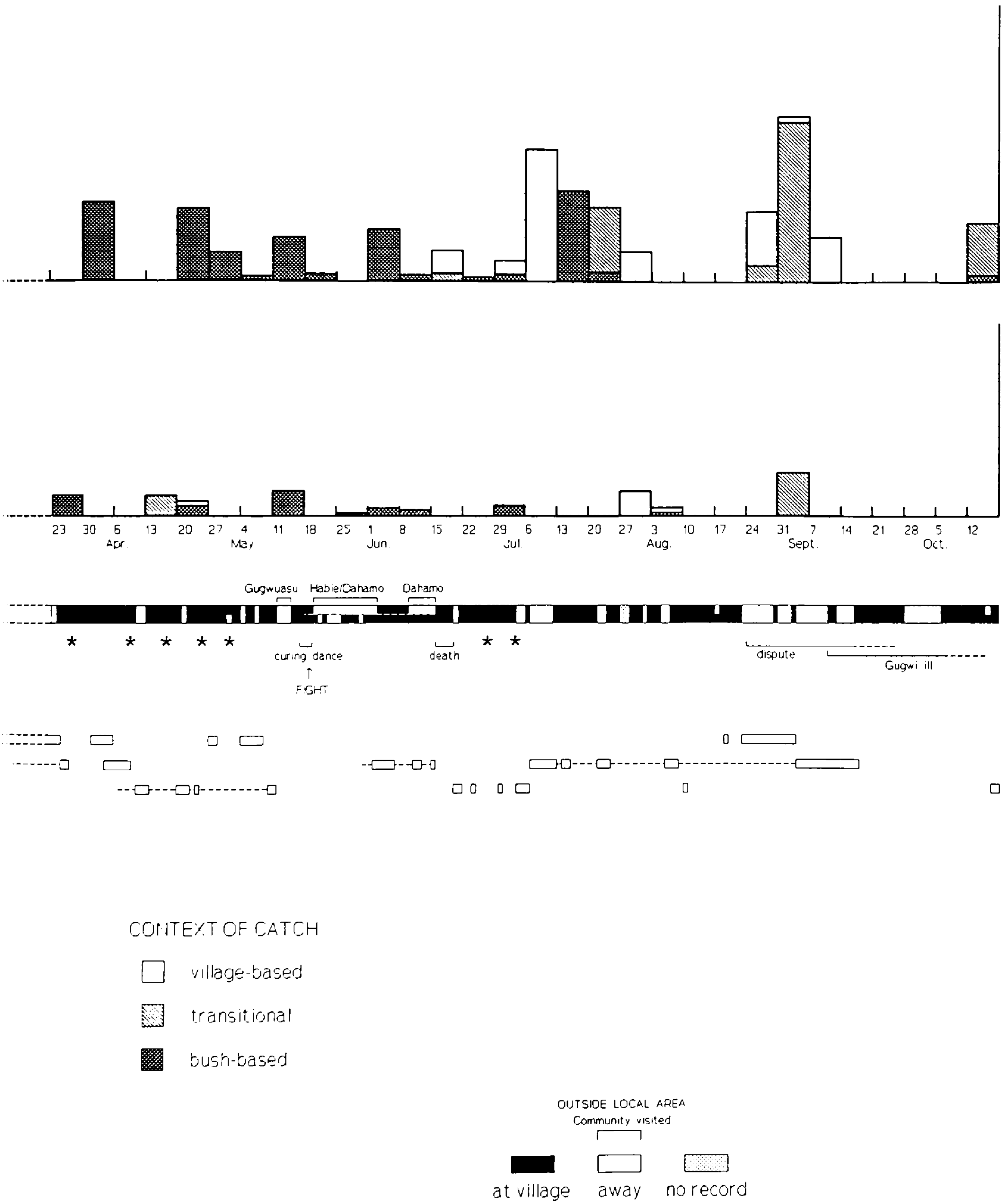
23 30 6 13 20 27 4 11 18 25 1 8 15 22 29 6 13 20 27 3 10 17 24 31 7 14 21 28 5 12
Apr. May Jun. Jul. Aug. Sept. Oct.
Gugwuasu
Habie/Oahamo
Oahamo
curing dance
FIGHT
death
dispute
Gugwi ill
CONTEXT OF CATCH
village-based
transitional
bush-based
OUTSIDE LOCAL AREA
Community visited
at village
away
no record

Table 11 Daily record of fish caught by Gugwi and Sisigia during the survey.

		Village			Trans.		Bush			Fisher	
			N	g	N	g	N	g			Tech.
Sep.	15–17				1	625	3	3951	*	G/S	H
	25	*	1	475						S	H
Oct.	4–5				7	5560	12	5610		G	S
	14	*	1	78						G	S
	15	*	1	435						S	H
	16	*	2	2375						S	H
	24	*	1	174						G	S
	26–27				1	1050	3	556	*	G+S	H+S
	28	*	5	3286						G+S	H
	29	*	4	1072						G+S	H
	30–31						3	1607	*	S	H
Nov.	1–3						5	1775	*	G+S	H
	4–9						3	1532	*	G	H
	10–11				7	224	1	1422	*	G+S	H+[n]
	15	*	3	2735						G+S	H
	16	*	2	860						G	H
	17–18				3	1297	15	603		G+S	H+[n]
	21		1	190						S	H
	22		1	410						S	H
	28	*	15	4441[b]						G	S
Dec.	1–5[a]				1	222	6	6032		G+S	H+S
	10	*	1	382						G	H
	12–13				1	6500			*	G	S
	14–17				1	370	8	1135	*	G/S	H+S
	24	*	1	250						G	H
	25	*	1	305						G	H
	26	*	6	3435						G	S
	27–29				2	1023	4	1723†		G	S
	31	*	5	676						G	H+S
Jan.	1	*	4	2479						G	S
	2	*	1	94						G	H
	11	*	2	209						G	S
	13–16[a]						4	1650		G+S	H
	24		1	506						S	H
	25		1	505						S	H
Feb.	1–3				18	1126	3	1360	*	G+S	H+[n]
	19		1	91						G	H
Mar.	4–6				1	1350	2	210	*	G	S
	14–17		1	480			2	152	*	G+S	H+S
	18–23						2	200	*	G	S
	27	*	1	920						S	H
Apr.	1	*	2	3444						G	S
	11–13				19	849				S	H[n]
	20	*	6	2441						GS	O+S
	21–22						4	142		S	H[n]
	25	*	2	1185						G+S	H

continued on next page...

Table 11 continued...

		Village			Trans.		Bush			Fisher	
			N	g	N	g	N	g			Tech.
May	1	*	1	1250						G	O
	10	*	1	97						G	S
	11	*	6	3046						G+S	O+S
	18	*	1	290						G	H
	29		2	87						S	H^n
Jun.	3		1	342						S	H
	4	*	+	2275[b]						G	S
	8	*	1	264						G	S
	10		1	281						S	H
	-16						2	1033†		G	S
	20-21						3	299	*	G	S
	24	*	2	176						G	S
	29	*	2	460						S	H
	30	*	3	297						G	S
Jul.	4-6						3	579	*	G	S
	7-12						10	4914	*	G	S
	15	*	2	4050						G	S
	20	*	4	353						G	S
	22-24				6	3022				G	S
	27-28[a]						2	2412		G+S	H
Aug.	5-7						3	295	*	S	H^n
	9	*	5	159						S	H^n
	24-30				2	714	5	3265	*	G	S
	31-										
Sep.	-3				7	9039	1	222	*	GS	O+S
	7-10						3	1980	*	G	S
Oct.	14	*	1	10						G	O
	16-17				1	2400				G	S

[a] No residency records; fish have been classified as 'non-village' for analysis but may, in fact, have been caught at the village.

[b] Joint expedition with other males; individual contributions not known so Gugwi's probable haul calculated from known fishing rates. Not included in analyses concerning specific haul sizes.

* under **Village** - indicates episodes when both Gugwi and Sisigia were based at the village.
under **Bush** - indicates episodes when Gugwi and Sisigia were alone together in the bush, or accompanied only by seven-year-old Yasimo.

† indicates that some or all of the catch was obtained while outside the local subsistence zone.

Trans. - Transitional: fish brought back to the village from an absence, or caught on the day of return.

Fisher - G = Gugwi; S = Sisigia; G/S = precise attributions unclear; G+S = both caught fish independently; GS = the two co-operated to catch fish by poison.

Tech. - H = by hook, from the Strickland River; H^n = by hook, not from the Strickland River; S = by spear; O = other - net, poison or arrow.

Strickland overnight, and Gugwi speared one fish in a stream near where he had been collecting banana suckers for a new garden, but fish were not, it seemed of much interest. The two went on another overnight trip to Koto, but this time only three fish were obtained, weighing 556 g in all.

Late in October, activity picked up. Gugwi learned of a *dju* tree adjacent to a new garden that Filifi and Maubo were felling, immediately across the Strickland River from the village. He and Sisigia made several day trips across the river, to check its potential as a canoe and to begin the rough shaping. They took the opportunity to set a few lines each morning and checked these on the way home. When the canoe adze became available for finer work[3] they moved to a small shelter in the new garden to reduce travel time. They stayed 11 nights, Sisigia processing sago to eat while Gugwi, the canoe finished and launched, initiated another garden. Though the garden house was no nearer the river than the village itself, both Gugwi and Sisigia regularly set lines and caught many more fish than was usual when they resided at the village. (Catches for the three weeks after October 27 were 10 and 13 fish for Gugwi and Sisigia respectively, compared to 1 and 3 fish respectively caught in the three weeks before this date.) In addition, on the day she finished processing sago, Sisigia spent some time with a tended line catching seven small gudgeons from a nearby stream.

Once back at the village the couple's fishing effort again declined. Both still set an occasional line, either overnight or while weeding a garden on the banks of the river. They made another trip up-river to the *kosa* trees, again with little success. This time a large party travelled together in canoes. While the men visited nearby bat caves Sisigia tended a line in a stream and caught 15 small gudgeons. She and Gugwi also caught three fish in the Strickland on the way home.

The up-river trip was associated with an expected visit by several people, including Sisigia's clan brother Joshua, from Suabi. As a Seventh Day Adventist, Joshua could not eat catfish, which have no scales, or pig, so two major diving trips were organized to procure scaled fish. Gugwi participated in the second of these; with Joshua and Hegogwa

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[3] This adze was the only one available to several neighbouring communities. It had been borrowed from relatives at Waibi in October 1986, and was used to manufacture at least seven canoes, for people from Wagohai and Gugwuasu as well as Gwaimasi, before it was returned the following May.

he spent the day at Koto, returning with a total of 25 fish weighing nearly 8 kg. His contribution to the catch is estimated at 4441 g.

Some days later, Gugwi and Sisigia visited a new bush house, recently built at Tagu Hau, to search for Mabei's pig which regularly foraged in the area; this sow had recently farrowed and it was time to capture and domesticate the piglets. Another of Sisigia's 'brothers', from Gugwuasu, was already staying at Tagu Hau with his family and with Wafu, the women processing sago while the brother made a canoe. Gugwi took the opportunity to dive in Dege, spearing six fish weighing 6032 g.[4]

When Joshua departed Gugwi and Sisigia again turned their attention to the eastern side of the river. They made several day trips to supplement planting in their new garden, then moved to a shelter near Ia stream to process a sago palm.[5] When Gugwi caught a 6.5 kg eel they brought it to Gwaimasi to share, but then returned to continue the processing. This time the sago palm was not beside the Strickland. Only three fish (720 g) were obtained from the river during the three days the couple were away, supplemented by five small perch (415 g) speared by Gugwi in Ia. Gugwi, at least, still occasionally set lines during the day trips to the garden, both before and after the sago-processing venture, but Sisigia, it seems, had ceased to fish. She may have lost her lines or run out of hooks.

At Gwaimasi everyone's attention now focussed on planning and preparation for *kasimes*, a feast eventually held in early January to which people from several other communities had been invited (see 2.2.6). Large quantities of sago were processed near the bushhouse at Doua, and on December 26 Gugwi and Sisigia, with seven others, went to carry the flour home. The track crossed several streams, and all the males left intending to dive for fish on the way. Most, however, did not fish for long, if at all, for it had rained the previous night and the streams were *agubo*, the water high and turbid. Gugwi was the exception. He stayed behind with Sisigia and dived in a couple of the

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[4] The duration of this visit is unknown. Nor do I know whether the fish were eaten at Tagu Hau or carried back to the village. My partner and I were absent for four nights at this time, staying in our own bush house to the north.

[5] Although Kubo spoke of sago-processing as women's work it was not uncommon for men to assist their wives with breaking up the pith - provided no-one else was around to watch (see 3.1.2). Gugwi, in particular, regularly assisted Sisigia with this task. His contribution was first recognized by us with the realization that Sisigia appeared to be achieving nearly twice the usual rate of sago production per day.

smaller streams, returning two hours after the others with six fish (3435 g).

The next day Gugwi and Sisigia left for the village of Nanega to the west, to give details of the planned timing for the feast. They stayed for two nights, during which Gugwi speared four fish (1723 g) in Mai, a backswamp stream akin to Dege. On the way home he speared two more fish (1023 g) in Sigia. The last few days before *kasimes* were hectic for everyone, with people gathering firewood, special cooking bark and leaves, ferns, bamboo for torches and resin for light, as well as enormous loads of bananas, from all directions. Gugwi speared four small fish (572 g) and some crayfish in Mome one day, when he and Sisigia went to Dege, but he was unsatisfied with this quantity and set a line in the Strickland on his return to the village. The next day he speared another four fish (2479 g) in Fu, near a garden to which he and Sisigia had gone to harvest bananas, and the following day set another line in the Strickland. Sisigia still showed no evidence of fishing.

Kasimes itself, with 43 visitors, two all-night dances and the meat from six pigs to eat, was exhausting and no-one ventured far from the village. A curing ritual, necessitating another all-night dance, and the death (from snakebite) and subsequent funeral of a woman visitor on her way home from the feast, added to the exhaustion. No-one fished.

By January 11, life was returning to normal. Gugwi speared two small fish in Somasio, when he and Sisigia headed west for a few hours away from the village. Two days later, Simo and Gwase returned from a trip to Suabi, and over the next three days Sisigia began to fish again; she caught three fish from the Strickland in that time, while Gugwi caught one. It seems probable that new lines had been brought from Suabi. Sisigia continued to set an occasional line in the river over the following days, both at the village and near a garden she was helping to weed. Gugwi, meanwhile, travelled to Suabi, to fetch his 'brother' Gwase's spouse-to-be. Two days after his return he and Sisigia helped escort an unwilling Mugwa, Gwase's exchange sibling, on the first stage of her journey to her husband-to-be at Suabi.

On February 1, Gugwi and Sisigia again crossed the river. Over the next two days both fished in the Strickland, and on the third Sisigia tended a line in the small foothill stream of Kogu, catching 17 small gudgeons. Their stay was cut short, however, by a quarrel: in January, a son had been born to Sisigia's brother, Sinio; Gugwi had seen the baby during his recent trip to Suabi and was reminded of Sisigia's failure to reproduce. Strong words were spoken, and there may have been more physical expressions of frustration. The two returned separately from across the river, Sisigia immediately retreating to her brother's house. Three days later, she left for Suabi, planning to move in with her relatives there.

Gugwi was devastated; he did not move from the village for the next ten days. Then he took his son Gawua, and Gwuho (with whom he seldom associated), on an overnight trip to Dege in an attempt to ambush a pig. No pig was seen, nor were any fish speared. In the next couple of days he set at least one line in the Strickland. But further developments were interrupted by the long-awaited arrival of a helicopter at 'Basi' - the mining exploration camp established in late 1985 by ESSO at the mouth of Sigia (see 2.1.7c).

The helicopter carried two men sent to repair the camp in anticipation of further survey work. All males at the village immediately applied for, and received, employment and spent the next six days working in the immediate vicinity of the camp. The helicopter travelled to Suabi, bringing back Sinio and Dogo as well as other labourers. Sinio's wife Wafu, with her baby, then decided to walk home to Gwaimasi. Sisigia accompanied her, arriving back at the village on February 23, after an absence of nearly three weeks.

The plans of the mining company changed - indeed the exploration lease itself changed hands from ESSO to City Resources. The company men left, leaving behind some money and, among other things, several cartons of tinned fish and meat. The people of Gwaimasi were delegated to spend each Friday maintaining the helicopter pad, the buildings and their surrounds, and the supplies were to provide food on those occasions (see 3.1.6).

Tension between Sisigia and Gugwi continued after her return. She stayed at her brother's house and, at first, would not speak to her husband. Neither moved far from the village at this time, and no fish were caught. Gradually, however, they made up, and by March 2 Sisigia was back home. Two days later, a large group of people went to Tagu Hau. The intention was to fell sago palms in which to incubate grubs; yet another feast was planned - this time at Gugwuasu in May, with prestations of wild foods as the primary focus - and the grubs, *foi*, were to comprise part of Gwaimasi's contribution. Gugwi and Sisigia accompanied the others, but did not return with them next day. They stayed another night in the bush, and Gugwi speared three fish (1560 g) in Dege.

The next few days were tied up with business meetings; Joshua and others had arrived hoping to encourage Gwaimasi residents to invest earnings from mining-camp work in a trade store to be built at Suabi. This was followed by a spell of weeding nearby gardens. Only one fish was caught in the week, on a line set overnight by Sisigia at the beach near the village. On March 14, Gugwi and Sisigia moved to Tagu Hau to process sago. They stayed nine nights, and in that time Gugwi speared only four fish (362 g) and a small turtle. He had almost certainly shared the sago work with Sisigia. The day of their return two domestic pigs that had been raiding nearby gardens were killed and eaten.

Gardening dominated activities for the next two weeks; the weeding of older gardens and the establishment of a small tuber plot on the west bank of the Strickland near the village. Despite their proximity to the river little fishing was done. Sisigia caught one fish with a line set during a day of maintenance work at the mining camp. A few days later Gugwi speared two fish in Mome, during one of two day trips to Dege probably prospecting for another sago palm to process. In the end a small palm near the new garden was selected; Sisigia, Mabei and Swa, a visitor from Suabi, processed sago while Gugwi continued clearing and planting the tuber garden with Swa's husband Tiami.

With the planned feast at Gugwuasu approaching people began some serious and specific hunting expeditions. Gugwi and Sisigia left to spend two nights in the foothills across the river on April 11. They returned with a large portion of a pig killed by Tiami, who had left earlier to hunt with Filifi and Simo. Their own catch consisted of 19 small gudgeons that Sisigia had caught by line in a small foothills stream. A week or so later they again went fishing, this time to Dege and with somewhat more success; Gugwi speared a fish, and shot several others with bow and arrows, in Fu and its tributary Tosu (2406 g). Another small gudgeon (35 g) for which details were unclear, was probably caught by Sisigia. (At least two of these fish were fed to Sisigia's piglet - a good indication that more than fishing had occupied their time; Kubo restricted the eating of fish for a day or so after sexual intercourse.) The next day news arrived that Filifi, Simo and Tiami, who were still hunting, had killed several pigs, and that people were needed to assist with carrying the smoked meat. Gugwi and Sisigia joined the party and Sisigia again caught a few gudgeons by line in a small stream.

Fires for smoking the pig meat, stored on a rack above the outdoor hearth at Gugwi and Sisigia's house, had to be tended with some care in the following days and the supply of firewood kept up. Sisigia processed a sago palm near the village, and she and Gugwi also twice spent a night at Tagu Hau processing another palm. No fish were obtained on these occasions. In fact, the only fish obtained through this time came from lines and a net set at the mouth of Sigia on two separate days of maintenance work at the mining camp. On May 10, a large group of people travelled to the vicinity of Tagu Hau to harvest the grubs that had been incubating in palms felled six weeks before. Gugwi speared a single fish (97 g) in Tagu that day. The next day, the last before departure for Gugwuasu, he and Sisigia again went fishing hoping to increase their limited contribution to the communal prestation. This time they poisoned fish in Dege, obtaining 2 large catfish (2215 g); Gugwi speared four more fish (832 g) in Tagu.

Gugwi and Sisigia both attended the Gugwuasu feast. With several others they carried large loads of smoked meat for prestation and then returned carrying reciprocal gifts to the Gwaimasi community. Gugwi's younger 'brother' Gwase had not attended the Gugwuasu feast, as he was unable to walk because of a badly inflamed leg. His condition deteriorated during the three days we were at Gugwuasu, and on our return it was decided to summon a spirit medium from Wagohai to perform a seance and curing dance (see Dwyer & Minnegal 1989 for details). Gugwi played a major role in these rituals. (He also set a line in the river during a trip to harvest sweet-potato on the day between the two events.) Sisigia disapproved of Gugwi's involvement, arguing that they were now 'Christians' and that these practices were wrong. The argument escalated into a major quarrel, and again the couple split. This time it was Gugwi who left, travelling for two weeks, visiting relatives among Habiei people to the west, then attending a dance to mark the opening of an airstrip at Dahamo. Sisigia, meantime, went into retreat for a few days at her old garden house at Daga'agu Hau, then began another small garden on the bank of the Strickland. On at least two days she set lines near the garden while she worked.

There was again considerable tension between Gugwi and Sisigia after his return, with Sisigia staying at her brother's house. The day after his return Gugwi responded, with several others, to a call to help secure a large eel in a stream across the river from the village. A few days later he returned from a trip to Dege with a single small fish, which he fed to Sisigia's piglet - evidence of, or a request for, reconciliation. But two days after that he, and most of the other men from Gwaimasi, were off again - this time to Dahamo where they had been told to attend to vote in national elections. (The women were also supposed to go, but decided not to.) Gugwi speared two fish (1033 g) in a stream on the way.

Gugwi and the other men returned the day Damobi died. This old Headubi man usually lived at a bush house near Sosoibi, with his wives and daughter. He had come visiting relatives at Gwaimasi, and developed a severe respiratory infection while waiting to be ferried across the river. Three days later he was dead. Two days of mourning followed, then the burial, and people dispersed to carry news of the death to other communities. Gugwi and Sisigia went to Tagu Hau for the night, to fetch sago, harvest sago grubs, and feed Mabei's pig. Gugwi speared three fish, but again all were fed to Sisigia's piglet; reconciliation was complete.

Over the next couple of weeks Gugwi and Sisigia disappeared to the bush together several times. On two occasions Gugwi speared fish and crayfish. On another, spent across the river, Sisigia set a line in the Strickland. Then they decided to establish another garden, this time not near the river or the village but focussed on a turkey mound on a rise in the backswamps (see Dwyer & Minnegal 1990). They moved to Tagu Hau for two days, spent a night back at the village, then returned to Tagu Hau for another five days. In that time they not only gardened but also wandered the countryside, at least as far as Koto, in search of meat. In the seven days Gugwi speared 13 fish (5492 g) in Dege, of which four were fed to Sisigia's piglet. Additional captures included a pig, a snake, a frog and a jungle fowl. Day trips to the new garden followed. On one of these Gugwi speared two fish (4050 g) in Mome; with a decline in rainfall during July, large fish were becoming easier to procure. After several days back at the village, interrupted by a day trip across the river in search of meat during which Gugwi speared four small fish in I stream, the two returned to Tagu Hau to continue work on their garden. They stayed for three days, and Gugwi speared six fish (3022 g).

With rainfall increasing again at the end of July there was a brief return to linefishing. Both Gugwi and Sisigia set lines in the Strickland on at least one day. Sisigia spent two days processing a sago palm near the village, and both went to Udiadai, near Sigia, to help Mamo fence a garden that had been raided by pigs, but no fish were obtained through this time. Another two-night visit to Tagu Hau followed, again associated with the new garden. Gugwi speared no fish, but Sisigia caught three (295 g) with a line, probably tended, in Dege. Two days after their return to the village Sisigia instigated a day trip across the river in search of meat. Again, only Sisigia caught fish, five gudgeons by tended line in a small foothills stream.

The next two weeks were quiet, with no dominant activity. Two days were spent on maintenance at the mining camp. Another day was spent processing sago. On one night, Gugwi tried again to ambush a pig. But this interlude ended abruptly with a serious dispute between Sisigia and her brother Simo: Sisigia's dog had killed the cassowary chick that Simo had been raising for future sale at Kiunga; he, in anger, had shot the dog - to injure, not kill. The next day loud speeches were made, and eventually a settlement reached whereby each handed the other K20 (see Dwyer & Minnegal 1992b). Feelings were not assuaged, however, and the two families left the village, Gugwi and Sisigia to stay at Tagu Hau and Simo's family to stay at their new house across the river at Hawi Hafi.

Eight days later Gugwi and Sisigia returned, having processed a sago palm. In that time Gugwi had speared seven fish (3079 g) in Dege, of which two, weighing 714 g, were brought back smoked to the village. Their return came the day after a curing dance had been held for Tomasi, the infant son of some Headubi visitors, and was probably timed to avoid that event.

Tension in the community remained high, and Gugwi and Sisigia went back to Tagu Hau for another three days. While there, they again poisoned fish in Dege, obtaining four large catfish (3920 g). All were brought back smoked to the village, together with three of the four fish (6341 g) that Gugwi had speared. Another curing dance was to be held that night, again for the infant Tomasi, and many visitors were at the village. Gugwi stayed well away from the longhouse throughout the performance.

The next day Gugwi and Sisigia resumed work on the garden near Tagu Hau, this time taking Mabei's young daughter Yasimo. Gugwi speared only three fish (1980 g) during the eight days they were away. He was ill when they returned, suffering from an outbreak of influenza that affected almost everyone in the village. Despite this, and probably because of the continuing tension with Simo, Gugwi and Sisigia went back to Tagu Hau after two days. Gugwi's health continued to deteriorate, however, and he did not fish. Five days later he was carried back to the village by his 'brother' Gwase, extremely ill.

Some days later, with no sign of improvement and with Biseiō also deathly ill, a man from Diwosu Hau was called for assistance. Ogisiō was not a spirit medium but could 'see' spirits and signs of their activities. He diagnosed the problem, removed the bamboo slivers that had been inserted into the chests of Guwgi and Biseiō, and advised that they retreat to the bush where the malevolent spirits responsible would find it difficult to relocate them. Sisigia argued that transport to Suabi for Western medicine would be more useful, but in the end Ogisiō's advice was taken. (With almost everyone ill the proposed two-day journey to Suabi may well have been impractical.) Gugwi and Biseiō, with their families and those of Sinio and Mamo for support, retreated to a rough shelter near the stream Yuwena. There they remained for nine days. Neither they, nor anyone else, caught any fish during this time.

By October 6, on return to the village, both men were much improved. They were still weak, however, and Gugwi did little more than sit in the sun for several days. Sisigia, meanwhile, processed sago near the village. By October 11, Gugwi was gaining strength and was frustrated by inactivity. With Dogo, who also had been restricted to the village with a badly inflamed leg, he slowly wandered south. Both used sticks as aids to walking, but were armed to hunt and dive. Dogo speared several fish in Tagu but Gugwi returned empty-handed; he was probably still not fit enough to contemplate a serious diving venture. Three days later he caught his first fish in more than a month, a gudgeon, using three-year-old Okire's toy bow at the washing hole beside the village. Two days after this he left, again with Dogo, for an overnight stay at a shelter near Koto. There he speared his last fish of the survey, a catfish weighing 2400 g.

Discussion

Gugwi and Sisigia caught very different amounts of fish from week to week through the survey. The ways in which, and streams from which, fish were obtained also varied. Some of this variation can probably be traced to changes in weather; the switch from spearing fish to use of lines at the end of July, for example, may have been related to an increase in rainfall at this time. Such extrinsic constraints are the focus of analysis in Chapter 6. Patterns of access to necessary equipment may also have played a part in determining the observed results; the apparent cessation of fishing by Sisigia through December, for example, probably reflected a temporary lack of hooks or lines. There are hints, too, in the very different patterns of returns shown by Sisigia compared to Gugwi, of intrinsic constraints on fishing behaviour; Sisigia speared no fish, and Gugwi did not use lines other than in the Strickland - patterns that can be traced to the different abilities and requirements associated with their personal and social identities. Again, such socially engendered patterning are the focus of separate analysis, in Chapter 7.

Constraints on production, however, whether extrinsic or intrinsic, can not explain why lines were set one day and not the next, why Gugwi was satisfied with two fish one day but caught 15 the next, nor why the stream Fu might be targeted one day and Tagu the next. These are the questions to be addressed here.

Gugwi and Sisigia made their own decisions concerning fishing. Because they spent so much time together, however, each will have made choices in the light of knowledge about the other's fishing activities and allowing for the other's successes. In effect, they can be considered to comprise a single decision-making unit. That interdependence can be seen in the fact that Sisigia was much more likely to fish when Gugwi was elsewhere; she caught fish on only 13 occasions during the 209 days that both she and Gugwi were based at the village, but on 7 of the 32 days that Gugwi was not present ($\chi^2 = 6.86$; $p < 0.01$).

Procurement of fish was rarely the primary goal of a day's activity for Gugwi and Sisigia. The few exceptions all related to ritual or extra-community obligations: a house, newly finished, needed protection from the spirits; visiting relations had to be fed; a contribution was required for an intercommunity feast; a curing dance had to be marked in some manner other than participation. On such occasions Gugwi and Sisigia, but particularly Gugwi, could and did procure large quantities of fish. The goal, it seemed, was to maximize the catch. Streams and techniques were chosen accordingly - spearing in the relatively distant but clearly productive stream Koto in the drier months, poisoning Dege in May and August when the rainfall was greater.

When extra-community obligations were not involved the fishing decisions made were noticeably different. Fishing itself tended to be embedded in other activities; lines might be set while working in a garden near the river, or a short time spent diving in a stream near to where a sago palm was being processed. It seems that, in the absence of those extra-community obligations, fishing strategy shifted from catch maximization to time minimization. As a result, the location of other activities, rather than environmental constraints, largely determined the streams targeted and often the technique used. Set-line fishing, with its minimal time investment, was used where feasible and fishing was restricted to nearby streams though others further afield would have been more productive.

Time minimization is usually associated with a notion of 'limited needs'; the goal is to obtain **adequate** quantities of a resource in as short a time as possible (Hames 1992; Hawkes *et al.* 1985). Definition of this target quantity apparently differed with context for Gugwi and Sisigia, as might be expected given the opening premises of this thesis. In particular, fishing decisions made on days based at the village - where any catch would have to be shared, but other people also could be expected to bring in meat - can be distinguished from those made when Gugwi and Sisigia were alone in the bush.

Table 12 compares the frequency with which Gugwi and Sisigia obtained fish when staying at the village, or returning to the village from elsewhere, and when they were staying in the bush. Gugwi and Sisigia both brought in fish to the village more often than others - on 16% of days and 10% of days respectively, compared to the 9% and 5% of days that was average for resident men and women (see 5.1). Still, this means that even Gugwi caught fish no more than once in every six days. In the context of village life, such infrequency of production will hardly have mattered; on any given day it is likely that another member of the community would also procure meat. There would be little urgency associated with procurement of fish for individual needs.

The ability to rely on the production of others to buffer individual returns also explains the apparent erraticness of Gugwi and Sisigia's fishing when based at the village; they sometimes fished several days in a row, then not at all for more than a week. But the pattern was not, in fact, as erratic as it seemed. Table 13 classifies days that Gugwi and Sisigia were based at the village according to focal activity, and further separates those days according to whether or not fish were caught, and whether or not a canoe was used. Days that the two spent at the village itself, or left only in pursuit of meat, are compared with all other days. Both Gugwi and Sisigia were significantly more likely to fish if some subsistence task other than procurement of meat required them to leave the village ($\chi^2=6.53$, $p<0.02$ and $\chi^2=4.34$, $p<0.05$ respectively). Indeed, the location of those other activities also influenced the probability of fishing. Where they entailed use of a canoe, for example, the probability of fishing was very much higher ($p<0.001$ for both Gugwi and Sisigia).

Table 12 Gugwi and Sisigia - frequency of successful fishing episodes, and average daily production of fish, in different contexts within the Gwaimasi area.

	DAYS					
	all	with fish	Prop. with fish		g/day	
GUGWI						
Village	224	30	0.13	0.16	155	245
Transitional[a]	39	13(6)	0.33		765	
Bush	87	19[b]	0.22		357	
TOTAL	350	55	0.16		273	
SISIGIA						
Village	241	20	0.08	0.10	53	67
Transitional[a]	33	8(5)	0.24		168	
Bush	89	8[b]	0.09		111	
TOTAL	363	33	0.09		73	

[a] Parentheses indicate the number of occasions on which transitional fish were definitely caught on the journey home, rather than being the remains of a larger haul obtained, and partly consumed, in the bush. In the latter cases, the same fishing episode has been counted as both bush-based and transitional.

[b] Minimum. Fish caught over several days in the bush could not be reliably assigned to particular daily hauls. Some hauls will have been conflated in my records.

Fishing, it seems, was not only embedded within other activities but, for Gugwi and Sisigia at least, was usually triggered by those activities. They chose to fish primarily on days where the costs involved, particularly in terms of travel time, were minimal. And they were free to do so because, with production by others buffering variation in daily returns, there was no *a priori* need to obtain fish on any given day.

When Gugwi and Sisigia were alone in the bush, rather than the village, there was no-one else to buffer variation in returns. As might be expected, then, they fished more

Table 13 Gugwi and Sisigia - the relationship between focal activity and fishing behaviour while based at the village.

	Focal activity				Σ
	Village	Hunt/ fish	Garden/ sago	Other or unknown	
GUGWI					
days w. fish	5	7^{1}	10^{5}	8^{6}	30^{12}
w/out fish	123	2^{1}	35^{6}	34^{3}	194^{10}
Σ	128	9^{2}	45^{11}	42^{9}	224^{22}
SISIGIA					
days w. fish	5	3^{1}	6^{1}	6^{3}	20^{5}
w/out fish	119	5^{2}	67^{7}	30^{2}	221^{11}
Σ	124	8^{3}	73^{8}	36^{5}	241^{16}

Superscript - number of days on which canoes were used.

regularly in the bush than at the village (Table 12). Gugwi obtained fish at least every 4.5 days in the bush, compared to every 6.3 days at the village. (The values for Sisigia are distorted by the interdependence of her fishing activities and those of Gugwi; she fished more at the village when Gugwi was away, but was rarely in the bush without Gugwi.) In fact, the values for bush-based fishing will underestimate the real frequency with which fish were obtained. Fish caught over several days in the bush could not reliably be assigned to particular daily hauls. On three occasions people who encountered or visited Gugwi and Sisigia in the bush brought back skulls for them, thus marking separate episodes within an absence but, in most cases, I have allowed a single fishing episode for each absence during which fish were caught. In fact, only once in the 16 occasions that Gugwi and Sisigia stayed more than one night alone together in the bush did they fail to catch fish; Gugwi was seriously ill at the time. (They caught fish on four of the nine occasions that they spent a single night away together.) Certainly, both Gugwi and Sisigia caught more fish per day when in the bush than they caught when in the village (Table 12).

Again, the frequency with which Gugwi and Sisigia brought fish back to the village after absences reveals the importance of costs associated with travel in influencing decisions to fish. The primary bush houses used by Gugwi and Sisigia, one beside Koto, the other at the junction of Tagu with Dege, were close to good fishing locations. As Table 12 shows, both Gugwi and Sisigia were significantly more likely to contribute fish to the village on days that they returned from the bush than on days when they would have had to travel out from the village to fish ($\chi^2 = 9.66$ and 8.04 respectively; $p < 0.01$).

The fishing activities of Gugwi and Sisigia are intricately tied to their personal histories and the vicissitudes of daily life. Yet it is possible to discern, in those activities, some of the factors that, consciously or unconsciously, patterned the decisions made. In particular, there is a clear interplay between the benefits to be gained by procuring fish, and the costs associated with their procurement. The remaining chapters of this thesis explore aspects of that interplay in more detail.

CHAPTER 6

EXTRINSIC CONSTRAINTS ON PRODUCTION

Clear spatial and temporal patterning was evident in the records of fish caught within the Gwaimasi area between September 15, 1986 and October 18, 1987. Different streams contributed very different amounts - and kinds - of fish to the catch. And the contributions from particular streams varied greatly through the survey period. The techniques by which fish were caught also varied both from stream to stream and through the survey, as did the species that dominated the catch. The variation observed does not simply reflect patterns in the distribution and abundance of fish. People at Gwaimasi were selective in their use of resources - in where and how they chose to fish, and in what species they targeted. Their decisions, however, were made against a background of variation in the physical environment. All streams do not contain the same kinds and quantities of fish. And all fish cannot be caught in the same way. These extrinsic factors constrain the material outcome of potential fishing options, and can thus be expected to influence fishing behaviour.

In this chapter I examine the effects of variation in the physical environment - both across space and through time - on the availability and accessibility of fish within the local area associated with Gwaimasi. I then examine the impact of patterns in availability and accessibility on the fishing decisions made by people at Gwaimasi.

6.1 AVAILABILITY AND ACCESSIBILITY

6.1.1 Definitions

The potential utility of any fishing decision depends on both the availability and the accessibility of fish. These two terms, as used in this chapter, refer to different, though not necessarily unrelated, attributes. Each will be affected in different ways by changes in the environment.

Availability of fish refers to the kinds of fish actually present at a fishing location, their sizes and (absolute and relative) abundance. This will vary, in the first instance, with characteristics of the stream in question, such as water quality, depth and rate of flow. These characteristics, however, will be affected by short-term and long-term trends in weather, particularly rainfall. The impact of stream dynamics on fish will thus also affect their availability. Population demography, for example, may vary as a result of movement between streams as water levels change, or of seasonal breeding triggered by such changes.

The sizes and densities of fish present in a stream clearly constrain the amount of fish that can be taken from that stream. But the potential productivity of a resource can be realized only in terms of the means by which people gain access to the resource.

Accessibility of fish refers to the probability that fish which are present in a stream will actually be encountered by a fisher. This will depend, of course, on the technique that is used; spearfishers set about encountering fish in a very different way from linefishers. For any technique, however, accessibility of fish will depend on both characteristics of the stream (not necessarily the same as those affecting availability of fish) and behaviour of the different species within it. Clarity of water, for example, will affect visibility of fish to a diver and of lines to a fish, while different patterns of diurnal activity may affect the likelihood of fish being seen or coming across a baited line. Again, these variables are liable to change in response to short-term and long-term trends in weather, with accessibility of fish affected as a result.

The availability and accessibility of fish within a stream determine the rate at which fish will be encountered, and thus the return rates possible from that location. There is, however, another factor to be considered. Fishing locations themselves may differ in accessibility. Being dispersed in space, the distance to be travelled to reach any stream must be taken into consideration when comparing fishing options. Streams do not move (at least, not on the timescale of this study.) But distance to a fishing location is relative, not absolute. It depends, first, on the place from which it is measured. Much fishing in the Gwaimasi area was embedded within other activities; in such cases the effective distance to a stream must be measured from the primary locus of activity for the day, not from the village. Secondly, distance depends on the unit of measurement. In this case, the crucial variable will have been the time entailed in reaching the stream. The efficiency of travel, and thus the relative distance to fishing locations may be affected by changes in weather conditions.

6.1.2 **Problems of measurement**

Fishing decisions will have been made in the light of patterns in the availability and accessibility of fish. But a problem now arises. Understanding of fish availability and accessibility within the Gwaimasi area must be derived from a single data set which does not, of itself, provide independent measures of either availability or accessibility.

No studies of the distribution, abundance or behaviour of fish in the middle Strickland River and its tributaries have been published. Studies in other, possibly analogous river systems of lowland Papua are also scarce.[1] The best, a study of fish and potential fishing productivity in the Purari River (Haines 1976, 1979a,b; Liem & Haines 1977; papers in Petr 1983) is, as with most such studies, concerned with the possibilities for commercial fishing; it focussed on only a few species, and fewer habitats. Studies in the Fly River (Roberts 1978; Maunsell *et al.* 1982) and in the Laloki River system (Berra *et al.* 1975) were primarily concerned with cataloguing species, rather than with examining the structure of communities. In all cases research has concentrated on the major river channels, with little if any attention paid to backswamp streams and tributaries of the sort from which people at Gwaimasi obtained more than half their fish. Most of the surveys include occasional observations as to stomach contents or reproductive status of specimens but no systematic ecological studies have been undertaken, and the major species obtained at Gwaimasi could still, in 1991, be characterized as 'poorly known' (*Plotosus papuensis*, Allen 1991:66) or 'known thus far' only from a very limited range (*Arius taylori*, Allen 1991:55; see also 5.2.1).

Thus, the only substantive information about availability and accessibility of fish in the Gwaimasi area comes from my own records of local fishing returns.

'Returns of fish' are, of course, the outcome of decisions that were made in response to pre-existing patterns of availability and accessibility. As such, they cannot provide independent measures of either. This is an extension of a problem raised in Section 4.1.3; with access to details of returns only, and not of effort, I argued that only

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[1] More work has been done in the rivers of northern New Guinea, particularly the Sepik (Coates 1985; Allen & Coates 1990; Kailola 1990), but the freshwater fish fauna of the north is very different from that of the south (Allen & Coates 1990:37-41; Allen 1991:12).

limited inferences could be made about the relative utility of different fishing options. Similarly, there is an inherent circularity in any attempt to reconstruct the context of decision-making from its outcome. Patterns of selection cannot be reconstructed from the selected items alone. Indeed, it could be argued that the relevant attributes affecting selection can be recognized only in relation to items that were rejected.

This problem is common to much ecological analysis, particularly in anthropological research, though it is not always recognized or acknowledged. Hawkes *et al.* (1982; see also Hill & Hawkes 1983), for example, relied on catch data in their influential analyses of prey choice among Aché hunter-gatherers. They argued, from that data, that resource types taken by Aché were precisely those which models of optimal prey choice predicted. Because they lacked information about resources that were not taken, however, it remains possible that overall return rates could have been increased by including some of these in the diet; the original conclusion was logically unjustified. This difficulty was acknowledged and addressed several years later (Hill *et al.* 1987:4), but not resolved. The lack of independent ecological data in no way invalidates the explanatory frame used, nor denies the value of the research. It does, however, limit the ways that questions can be addressed and models tested.

The problems implicit in relating selective samples to the population from which they were taken is not restricted to anthropological research. Fisheries ecologists may independently survey biological populations, but scientific surveys are not exempt from the effects of species' differential susceptibility to capture techniques. Allen and Coates (1990:63), for example, reported that their survey of fish in the Sepik River caught **no** specimens of a species of forktailed catfish which comprised 19% of the fish for sale at Angoram market. Another species, which comprised 20% of the market fish, formed 67% of the survey catch (*ibid*:60). Presumably, neither assemblage accurately reflected the composition of the biological population.

But environmental factors do not need to be precisely quantified for their effects on foraging decisions to be apparent. Optimal foraging models predict not just behaviour in given circumstances, but also the circumstances and directions in which that behaviour will change. Trends in environmental conditions - the directions of change - may be describable even when the conditions themselves cannot be accurately documented. Indeed, early optimality models were concerned only with correlations between trends, and not with precise specification of situations. The model of optimal diet breadth, for example, predicted how the number of resource types in the diet should increase or decrease as attributes (abundance or handling time) of high-ranked or low-ranked resources changed (MacArthur & Pianka 1966). Prediction of the actual resources that would be taken in particular conditions was not the aim of this model, though the potential was there in its logic and was formally expressed in later models that dealt with prey choice (eg. Pianka 1978:263-66; Pulliam 1974). The most convincing applications of these more sophisticated models, however, remain those which focus on the effects of change; for example, changes in handling times associated with use of shotguns rather than bow and arrows resulted in predictable shifts in resource choice by Aché (Hill & Hawkes 1983) and the introduction of a new high-return resource to Alyawarra people resulted in predictable shifts in the use of existing resources (O'Connell & Hawkes 1981), while seasonal shifts in distribution and abundance of resources were accompanied by predictable changes in settlement pattern among Athapaskans (Heffley 1981). Such studies do not depend on precise and comprehensive measurement of environmental parameters (though the first two examples given do attempt to provide these), but on identification of relative values for the resources of interest.

It is this last approach that I will take in this and subsequent chapters. I will focus on identifying **relative** values for variables that may influence fishing decisions, whether these be the relative productivity of different streams, the relative distances to be travelled, or the way these values changed, in magnitude or direction, in response to shifting weather patterns. This, in turn, will provide the background for discussion of differences in fishing behaviour at Gwaimasi according to the context of that behaviour.

6.1.3 **Assumptions**

By focussing on change, I am able to call on the considerable literature about scaling and organization of processes in freshwater ecosystems, as distinct from descriptions of particular systems (eg. Davies & Walker 1986; Hynes 1970; Lowe-McConnell 1975, 1987; Regier 1977; Sainsbury 1982; Schindler 1988). Ultimately, however, patterns of variation in the availability and accessibility of fish within the Gwaimasi area still must be inferred from the catch data I recorded. In what follows I make several assumptions.

Differences in the kinds and relative numbers of fish taken by different techniques, from the same stream and in similar weather conditions, reflect differences in the behaviour of fish and thus in relative accessibility of fish to those techniques. In fact, these differences reveal more about the techniques used to procure fish than about the biological assemblages being sampled. To minimize sources of variation I will, as necessary, restrict spatial and temporal comparisons to parts of the catch that were obtained by particular techniques.

Differences in the kinds and relative numbers of fish obtained by a particular technique from different streams, or from a given stream in different weather conditions, indicate real differences in the relative availability of fish. The relationship need not necessarily be straightforward. With linefishing and other non-selective techniques patterns of capture might approximate those of encounter, so that changes in composition of the catch would directly reflect changes in the biological assemblage. With spearfishing, however, another complication must be kept in mind; people can choose to ignore fish they see. The probability that lower ranked items will be taken when encountered, and thus their representation in the catch, will increase as the density of fish in general declines.[2]

Differences in the frequency of captures by a particular technique, where there are no associated changes in the composition of the catch, indicate a difference in the physical accessibility of either fishing locations or of the fish to be found at those locations. Differences in physical accessibility, and thus the potential costs associated with fishing options, may also occur in association with differential availability of fish. In such cases, however, the two effects will be difficult to untangle, and it may be more useful to focus on the combined consequences for relative utility of the options in question.

Differences in the average size of hauls obtained from different streams, or from the same stream in different weather conditions, reflect differences in potential within-patch productivity - the amount of fish that a fisher could expect to encounter, on average, per unit time spent fishing. In any stream this would depend on technique used but, because so much of the fishing at Gwaimasi was embedded in other activities I assume

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[2] The expectation that people will begin to take low-ranked items when encountered as the abundance of higher-ranked items declines, is one of the major predictions of optimal prey choice models (Pyke *et al.* 1977).

that the stream was probably selected first, and appropriate techniques chosen accordingly. In fact, the modal size of hauls from different streams tended to vary much less than the mean size of hauls from those streams; occasional very large hauls from some streams skewed the distributions. It is the possibility of procuring such large hauls, however, that is most relevant here.

6.2 VARIATION IN AVAILABILITY AND ACCESSIBILITY OF FISH

6.2.1 Patterns in space

Streams within the local subsistence zone associated with Gwaimasi can be divided into six geographically distinct systems: (1) the Strickland River; (2) Dege, with its tributaries; (3) Sigia with its tributaries; (4) other western streams; (5) the eastern swamp streams, from Kamu south; and (6) the eastern foothill streams, those from Gwi north together with the two tributaries of Auti (see 5.2.2). These systems differ in terms of the type of country they drain, the clarity, depth and rate of flow of water, the structure of stream beds and channels, and the amount of leaf litter and other debris they contain. Accordingly, we could expect differences in the kinds and quantities of fish found in each system. Certainly, local people thought so. Speaking of a tributary of Dege, for example, one man volunteered that it was a "small water", it didn't have a stony bottom and that big fish went into small streams of this sort.[3] On another occasion, as we planned to go fishing at the mouth of Sigia, two men informed us that there we would catch Gumo and Soi, two species of forktailed catfish; they were right.[4]

Table 14 lists the types of fish, and numbers of each species, known to have been caught in each of the major stream systems during the survey. The assemblages procured were very different. The Strickland River catch, for example, was dominated by four species of forktailed catfish (86% of the catch) that were caught nowhere else. That this assemblage was so different from the others is not surprising; the Strickland's deep, fast-flowing and permanently silt-laden waters were quite unlike any of the other stream systems. But substantial differences are also apparent between those other systems, with

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[3] Tufa, notes from April 1, 1987.

[4] Gugwi and Biseiō, notes from November 11, 1987.

Table 14 Kinds and numbers of fish recorded as obtained from each of the major stream systems in the Gwaimasi area.[a] Numbers for species that comprised more than 25% of the catch from a given system are indicated in bold.

	RIVER	WEST			EAST	
		Dege	Sigia	Other	Swamp	Fthill
FORKTAILED CATFISH						
Arius taylori	**358**	-	-	-	-	-
A. augustus	37	-	-	-	-	-
A. crassilabris	12	-	-	-	-	-
Cochlefelis spatula	24	-	-	-	-	-
A. latirostris	33	5	-	-	**25**	2
A. leptaspis	20	49	5	-	3	-
EELTAILED CATFISH						
Plotosus papuensis	4	**118**	5	-	10	2
Neosilurus equinus	-	36	9	1	4	1
N. sp.	1	1	8	-	-	1
N. ater	-	5	-	1	2	-
Porochilus meraukensis	-	37	-	-	-	1
PERCH						
Pingalla lorentzi	-	**155**	**26**	-	6	11
Hephaestus habbemai	-	47	15	3	12	3
H. fuligininosus	5	-	-	-	1	-
Parambassis gulliveri	4	-	-	-	-	-
GUDGEONS						
Oxyeleotris fimbriata	-	4	-	8	5	**134**
O. herwerdenii	-	-	-	-	1	-
Bostrichthys strigogenys	-	3	-	-	-	-
Mogurnda cingulata (?)	-	-	-	2	-	-
OTHER						
Crenomugil heteocheilus	4	-	-	-	-	-
Nibea sp.	1	-	-	-	-	-
Anguilla spp.	-	1	2	1	2	2
Melanotaeniidae	-	1	2	-	-	1
TOTAL	503	462	72	16	71	158
(number of species)	(12)	(13)	(8)	(6)	(11)	(10)

[a] Records for another 96 fish lacked details as to location of capture.

the catch from each dominated by a different species group. Meaningful comparisons, however, can only be made between assemblages obtained by similar techniques. Table 15 separates the kinds and numbers of fish obtained from different stream systems

(a) by spearfishing and (b) by linefishing. With both techniques, very different assemblages were procured from the different stream systems.

Catfish comprised at least half of the fish obtained by spear in all but the eastern foothill streams (Table 15a). Different species, however, dominated the catch from each system. Catfish obtained from eastern systems were primarily forktailed species, with 90% of those being *Arius latirostris* (*gumo*). In contrast, forktailed catfish comprised only a quarter of the catfish taken from western streams, nearly all of those being *A. leptaspis* (*soi*; 93%). Eeltailed catfish from the Dege system tended to be *Plotosus papuensis* (*aiōdio*; 73% of all eeltails). In the Sigia system, however, two *Neosilurus* species (*twe* and *da*) made up more than three-quarters (77%) of the eeltail catch. Other than catfish, most fish that were obtained by spear comprised two species of perch. Of these, *Pingalla lorenzti* (*tobaga*) dominated the catch in most systems, but *Hephaestus habbemai* (*bō*) were somewhat more common in streams draining swamps. Finally, a third of all fish speared in the eastern foothill streams were *Oxyeleotris fimbriata* (*sa̱*), though only three gudgeons were speared elsewhere.

The species of fish obtained by line tended to differ from those obtained by spear, but again contrasts appear in the composition of the catch from different stream systems (Table 15b). The catch obtained by line from the Strickland River was dominated, as noted before, by forktailed catfish. The catch from the Dege system, in contrast, was dominated by one species of eeltailed catfish, *Porochilus meraukensis* (*aiyō*), that from the Sigia system comprised only a species of perch, *Hephaestus habbemai* (*bō*), and 98% of the catch from eastern bank streams was of the gudgeon *Oxyeleotris fimbriata* (*sa̱*). The differences between these assemblages and those obtained from the same streams by spear can be attributed, at least in part, to differences in the behaviour of fishes that may affect susceptibility to capture by a particular technique. *Pingalla lorentzi* (*tobaga*), for example, sleeps through the day while *Hephaestus habbemai* (*bō*) is active[5]; only 1% of the former (2 of 198) were obtained by linefishing, compared to 40% of the latter (31 of 77). The three species that, together, comprised 94% of the catch by line from streams other than the Strickland River were all small, however, each averaging less than 100g in weight. They may have been usually ignored when encountered by spearfishers.

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[5] Tufa, notes from April 27, 1987.

Table 15 Kinds and numbers of fish recorded as obtained by (a) spearfishing and (b) linefishing, from each of the major stream systems in the Gwaimasi area.[a]

	RIVER	WEST			EAST	
(a) SPEARFISHING		Dege	Sigia	Other	Swamp	Fthill
FORKTAILED CATFISH						
A. latirostris	-	4	-	-	24	2
A. leptaspis	-	48	5	-	3	-
EELTAILED CATFISH						
Plotosus papuensis	-	100	5	-	10	1
Neosilurus equinus	-	31	9	1	4	1
N. sp.	-	-	8	-	-	1
N. ater	-	5	-	1	2	-
Porochilus meraukensis	-	1	-	-	-	-
PERCH						
Pingalla lorentzi	-	139	23	-	6	10
Hephaestus habbemai	-	30	2	1	11	1
H. fuligininosus	-	-	-	-	1	-
GUDGEONS						
Oxyeleotris fimbriata	-	1	-	-	-	8
Bostrichthys strigogenys	-	2	-	-	-	-
OTHER						
Anguilla spp.	-	-	2	1	1	-
(b) LINEFISHING						
FORKTAILED CATFISH						
four river species[b]	429	-	-	-	-	-
A. latirostris	31	1	-	-	1	-
A. leptaspis	18	-	-	-	-	-
EELTAILED CATFISH						
Plotosus papuensis	4	5	-	-	-	-
Neosilurus equinus	-	1	-	-	-	-
N. sp.	1	-	-	-	-	-
Porochilus meraukensis	-	32	-	-	-	1
PERCH						
Pingalla lorentzi	-	2	-	-	-	-
Hephaestus habbemai	-	14	12	2	1	2
H. fuligininosus	5	-	-	-	-	-
Parambassis gulliveri	2	-	-	-	-	-
GUDGEONS						
Oxyeleotris fimbriata	-	-	-	3	5	122
Bostrichthys strigogenys	-	1	-	-	-	-
OTHER						
Nibea sp.	1	-	-	-	-	-
Melanotaeniidae	-	1	-	-	-	-

[a] Records for another 12 fish obtained by spear and 4 fish obtained by line lacked details as to location of capture.

[b] See Table 14 for details of these species.

Table 16 Kinds and numbers of fish recorded as obtained from the main stream of Dege and from its tributaries respectively, by spearfishing and by all other techniques.

	by SPEAR		OTHER[a]	
	Main stream	Tributary	Main stream	Tributary
FORKTAILED CATFISH	45	7	2	-
EELTAILED CATFISH	101	36	18	41
PERCH	93	76	3	23
GUDGEONS	1	2	-	3
OTHER	-	-	-	1
TOTAL (number of species)	240 (9)	121 (8)	23 (7)	68 (10)

[a] Primarily linefishing (57 fish) and poisoning (29 fish).

Stream systems themselves are not homogeneous; average water depth, for example, tends to increase as lower order streams join. I did not always know where along a stream fish had been obtained, but streams within systems were distinguished. The main stream of Dege is as shallow near its source as any tributary, but these upper reaches were comparatively distant relative to other fishing locations. (The source was outside the Gwaimasi subsistence zone.) Along the reaches where people are likely to have fished, water depth and flow volume in Dege were generally greater than in its tributaries, and the fish population could be expected to reflect this. Table 16 gives details of the kinds and numbers of fish known to have been obtained, by spear and by all other techniques, from the main stream of Dege and from its tributaries respectively. The assemblages obtained from the different parts of the system differed not so much in the kinds of fish obtained as in the relative contributions of these to the overall catch. Catfish, particularly forktailed catfish, made up a much higher proportion of the spearfishing catch from Dege itself (61%, with 0.30 of these forktails) than from its tributaries (36%, with only 0.16 of these forktails). The catch from spearfishing in tributaries was dominated by perch (63% of the total, compared with 39% of the catch from Dege). This increased representation of perch in the catch from tributaries probably reflected the lower density of fish in these streams, rather than a major difference in composition of the assemblage; with large species encountered less often, divers were more willing to pursue small fish.

The Strickland River, too, did not provide a homogeneous fishing environment. In particular, where major tributaries joined the river there was an obvious intermingling of comparatively clear water with the silt-laden waters of the river itself. Such confluences may provide concentrations of nutrients, leading to associated differences in fish communities (Hynes 1970; Welcomme 1985). Table 17 provides details of the fish specified as caught at such junctions during the survey. Again, the precise locations of fishing episodes along the Strickland River were not always known. Table 17 distinguishes only those fish which the fisher specifically noted as having been caught at a stream junction. Presumably, some of the fish recorded simply as from the river also came from junctions. For this reason, the catch known to have come from junctions is contrasted with that from the river as a whole (including junctions). As might be expected, the assemblage of fish obtained by linefishing at junctions was more diverse than that obtained from the river as a whole (Shannon-Weaver index of diversity $H'=$ 0.72 and 0.48 respectively[6]). The four species of forktailed catfish that were restricted to the river comprised only 47% of the catch from junctions, compared to 87% of the overall catch from the river. The remaining catch was dominated by species primarily found in side streams. In particular, the other two species of forktailed catfish, *Arius latirostris* and *A. leptaspis* (*gumo* and *soi*), comprised 40% of fish recorded as coming from stream junctions, though less than 11% of the total catch from the river. Of these, the former seems to have been more willing to venture out into the main river. Finally, a few species of fish, though seldom taken, were nearly always captured at major junctions: the bass *Nibea* sp. (*semesi dio*), and two species of large perch, *Hephaestus fuliginosus* and *Parambassis gulliveri* (*togowo* and *awasu*). The mullet *Crenomugil heteocheilus* (*tio*), too, was obtained only at junctions. All four specimens, however, were caught by net, a technique that could not be used in the river itself. Nothing can be inferred about the relative distribution of this species.

Fishing at Gwaimasi, then, occurred within a heterogeneous environment, with geographically distinct patches having quite different assemblages of prey species. The particular fish procured on any occasion will have depended, at least in part, on choice of

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[6] For Shannon-Weaver diversity index, see Kikkawa (1986:50).

Table 17 Kinds and numbers of fish specifically recorded as obtained from places where major tributaries joined the Strickland River, compared to composition of the overall catch from the river.

		by LINE		OTHER[b]
	Total catch	from junctions	other[a]	from junctions
FORKTAILED CATFISH				
four river species	429	26	403	-
A. latirostris	33	9	22	2
A. leptaspis	20	13	5	-
EELTAILED CATFISH	5	1	4	-
PERCH	7	5	2	2
OTHER	1	1	-	4
TOTAL (number of species)	491 (11)	55 (9)	436 (10)	8 (3)

[a] These numbers will include some fish caught at stream junctions but not specifically reported as such.

[b] Primarily gill-netting (7 fish).

fishing location. That choice, however, is likely to have been based not so much on the kinds of fish to be found in a stream as on its potential productivity - the total amount of fish that was likely to be encountered in the stream (and related to this, of course, the amount that was likely to be procured from the stream) per time spent fishing.

Table 18 presents details of the number of occasions on which fish were obtained from each of the major stream systems, and of the average weight and number of fish obtained per episode.[7] Because it is likely that returns from some fishing episodes that

[7] The number of episodes of fishing in some stream systems was small, even when bush-based fishing, as well as village-based fishing, was considered. Those sample sizes are reduced even further when catches obtained in different weather conditions are compared. For this reason, and because distributions tended to be skewed by a few very large hauls, non-parametric statistics have been used in this chapter to compare sizes of fishing hauls. Statistics were calculated using the NPAR1WAY procedure of the SAS data analysis package (SAS Inst. 1988), applying the Mann-Whitney *U* test if there were only two samples and the Kruskal-Wallis test where more than two samples were to be compared.

Table 18 Average size of hauls obtained from each of the major stream systems within the Gwaimasi area.

	RIVER	WEST			EAST	
		Dege	Sigia	Other	Swamp	Fthill
ALL FISHING[a]						
Episodes	297	141	32	11	26	27
av. haul size (g)	965	1573	827	462[b]	2088	723[c]
av. number of fish	1.69	3.33	2.25	1.45	2.77	5.85
av. wt. of fish (g)	571	472	367	317	754	124
VILLAGE-BASED FISHING						
Episodes	221	70	11	6	5	13
av. haul size (g)	767	1513	446	42	3158	760[b]
av. number of fish	1.50	3.07	1.82	1.33	2.80	4.77
av. wt. of fish (g)	511	492	245	32	1128	159

[a] Some episodes that occurred while based at bush houses may have been conflated in reporting, so these numbers may underestimate actual fishing episodes, and overestimate sizes of hauls.

[b,c] These values are distorted by one ([b]) or two ([c]) captures of large eels that together, in each case, weighed more than all other fish obtained from the system combined; average haul size excluding these is less than half that shown.

	ES	D	SR	S	EF	OW
EAST SWAMP STREAMS	.	+	+ + +	+ + +	+ + +	+ + +
DEGE SYSTEM	-	.	+	+ +	+ + +	+ + +
STRICKLAND RIVER	---	-	.	+	+ + +	+ + +
SIGIA SYSTEM	---	--	-	.	+	+ +
EAST FOOTHILL STREAMS	---	---	---	-	.	+
OTHER WEST STREAMS	---	---	---	--	-	.

Results of pairwise comparisons of the sizes of all hauls from different stream systems - Mann Whitney *U* test:

+	$p \leq 0.1$
+ +	$p \leq 0.05$
+ + +	$p \leq 0.005$

occurred during prolonged stays at bush houses have been conflated in my records (see 5.1), Table 18 also provides separate details for village-based fishing episodes. The latter are more accurately documented, but the number of episodes from some stream systems was so low that significant relationships were unlikely to be recognized; thus, analyses have been based on the data for all fishing. In fact, the pattern for both sets of data was consistent. There were significant differences in the sizes of hauls obtained from the different stream systems ($p < 0.0001$; see Table 18 for results of pairwise comparisons). Hauls from streams draining the back swamps, particularly those from eastern swamp streams, were significantly larger, on average, than those from other systems. The Strickland River, in turn, produced hauls that were significantly larger than those from streams draining foothills or from the short streams draining the levee along the western bank of the river.

As might be expected, productivity also varied within stream systems. Table 19 provides details of fishing episodes in different parts of the Strickland River and the Dege system. (Because of the need for more precise and reliable locational information, comparison of returns from different locations within stream systems is restricted to village-based episodes.) Along the Strickland River, productivity seems to have been enhanced at places where major tributaries joined the river; hauls known to have been obtained from junctions were significantly larger, on average, than other hauls obtained from the river. In the Dege system, hauls from the tributaries were significantly smaller, on average, than those from the main stream. In fact, hauls from the main stream of Dege did not differ significantly in size from those obtained in the eastern swamp streams, while those obtained from tributaries were similar in size, on average, to those obtained from the Sigia system.

The hauls compared in Table 18 and Table 19 were obtained by a variety of techniques. Given that each of those techniques was likely to procure a different suite of fish, streams might differ in their effective productivity according to technique used. Table 20 compares average haul sizes obtained by spear and by line in each of the major stream systems. In most streams where both techniques were feasible, and particularly in the two systems that drained swamps, linefishing was much less productive than spearfishing. Only in streams draining the foothills to the east of the river did linefishing regularly produce returns that approximated those from spearfishing. In fact, the productivity of linefishing relative to spearfishing reflected the proportion of large fish in

Table 19 Average size of hauls obtained by village-based fishing from different kinds of locations along the Strickland River and in the Dege system.

	STRICKLAND RIVER[a]		DEGE SYSTEM[b]	
	Junctions	Other	main stream	tributaries
VILLAGE-BASED FISHING				
episodes	32	191	30+5	36+5
av. haul size (g)	973	725	2265	981
	Mann-Whitney *U* test			
	$z=2.84$ $p<0.005$		$z=2.99$ $p<0.003$	
av. number of fish	1.4	1.5	3.67	2.56
av. wt. of fish (g)	692	482	618	384

[a] One episode entailed lines set at both a junction and along the bank some distance away. This has been treated as two distinct episodes.

[b] Six episodes of spearfishing in the Dege system entailed diving in both main stream and tributaries. Five of these could not be used for comparison of haul sizes because, for some of the fish obtained, the precise location of capture was unknown. The other has been treated as two distinct episodes.

the biological assemblage; the catch from the eastern foothill streams was dominated by perch and gudgeons, irrespective of technique used, while spearfishing in the eastern swamp streams produced a greater proportion of the large catfish species, and larger specimens, than obtained from other systems.

Potential fishing locations within the Gwaimasi local subsistence area could thus be ranked, it seems, on the basis of expected within-patch return rates; streams draining the backswamps were likely to produce a greater return for time spent fishing than were those that drained the foothills, with returns from the Strickland River falling between these. And, for each stream system, fishing techniques could also be ranked on the basis of expected returns. But this assumes that patterns of availability and accessibility of fish were constant through time. They were not.

Table 20 Average size of hauls obtained by spearfishing and by linefishing respectively, from different stream systems within the Gwaimasi area.

	RIVER	WEST			EAST	
		Dege	Sigia	Other	Swamp	Fthill
ALL FISHING[a]						
by SPEAR						
episodes	-	118	28	3	21	8
av. haul size (g)	-	1591	894	1532[b]	2166	366
by LINE						
episodes	288	16	3	2	3	14
av. haul size (g)	962	569	253	120	282	356
		Mann-Whitney *U* test				
comparison of sizes of hauls by hook & by spear		z=-3.08 p=0.002	z=-1.50 p=0.13	z=-1.44 p=0.15	z=-2.44 p=0.01	z=0.82 p=0.41
VILLAGE-BASED FISHING						
by SPEAR						
episodes	-	58	10	-	4	4
av. haul size (g)	-	1672	417	-	3585	354
by LINE						
episodes	216	7	1	1	-	5
av. haul size (g)	763	189	131	87	-	360

[a] Some episodes that occurred while based at bush houses may have been conflated in reporting, so these numbers may underestimate actual fishing episodes, and overestimate sizes of hauls.

[b] This value is distorted by capture of a single large eel weighing at least twice as much as all the other fish obtained from the system combined; average haul size excluding that episode is less than half that shown.

6.2.2 **Patterns in time**

Kubo recognised and named recurrent changes in their environment: *hi a*, pitpit time, when the lowland pitpit crop is ready to eat; *hoi sisi a*, rain tumbling time, when clouds move in and with them persistent drizzling rain; *dugaiō a*, okari nut time, when the nuts are ready to harvest; *hame dibi a*, tree leaf time, when leaves fall and cover the ground.[8] The names are descriptive, however, and their use conveyed no sense of an inevitable progression of seasons. The multiple scales at which temporal processes occur within tropical forests (Hoekstra *et al.* 1991; O'Neill 1989; Schindler 1988) preclude any simple schema. While daily, biannual and annual cycles might be identifiable in rainfall and temperature regimes, biological phenomena of significance to local people may operate at even longer time scales; okari nut trees, for example, like many forest tree species, are mast fruiters that produce synchronised crops only every few years. Within the normal lifespan of a Kubo community (3-4 years; see 2.2.6), no fixed calendar could accurately trace the shifting environment or provide a basis for planning future activities.[9] Kubo **observed** changes as they occurred, recognising and naming certain constellations of environmental conditions that were marked by salient features, and responded accordingly.

This tendency to respond to change rather than anticipating it means that fishing behaviour will have been susceptible to influence from both short-term and long-term fluctuations in availability and accessibility of fish.

Fish, like other components of tropical environments, are affected by processes operating at several scales, and Kubo were well aware of these. *Arius leptaspis* (*soi*), *Plotosus papuensis* (*aiōdio*) and *Pingalla lorentzi* (*tobaga*) all reportedly breed during the pitpit season[10] with, presumably, associated changes in physiology and behaviour at that time; *P. papuensis*, for example, guards eggs laid in nests in small tributaries at this time. The fact that no small *Hephaestus fuliginosus* (*togowo*) were caught during the survey, though many small specimens of *H. habbemai* (*bō*) - a closely related species - were taken, suggests that individuals of the former species change their preferred habitat or

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[8] Shaw (1990:39-42) described similar, but not identical, seasons recognized by Samo people to the south of Kubo.

[9] The exception, perhaps, was *hi a* - the only cycle that depended on human activity for its occurrence, necessitating the regular establishment of gardens. The unopened inflorescences of lowland pitpit, a rich food consisting primarily of pollen, were an important ingredient in intercommunity feasts held at this time (cf. Shaw 1975, 1990), feasts which entailed considerable planning. This season was counted, to some extent at least, as a measure of passing years. And yet even *hi a* did not always appear as such. Gwaimasi residents did not plant pitpit gardens in 1986, the first year of their new village. Though some pitpit was grown in mixed gardens, and this produced inflorescences at the appropriate time, the quantity available at any time was small and no pitpit feast was held.

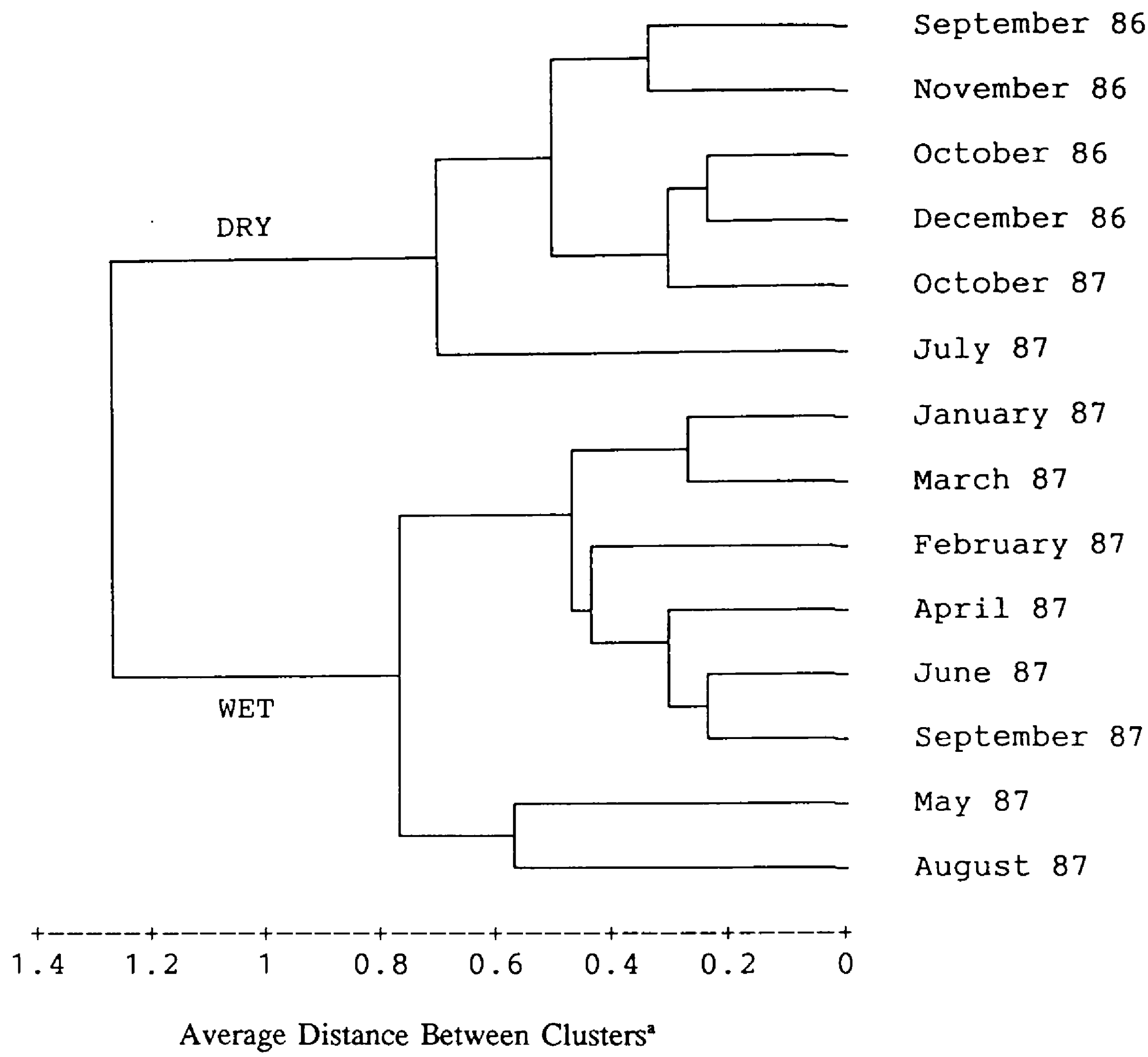
[10] Tufa, notes from April 29, 1987.

behaviour according to stage of life. Again, many fishes are known to be very sensitive to small changes in water level and to move about accordingly; some Kubo people described positioning traps at the mouths of tributaries to take advantage of such movements, catching fish as they returned to larger streams when floodwaters receded. The interplay of these and other factors can lead to 'great fluctuations in fish numbers both seasonally and year to year' in tropical rivers (Welcomme 1979:95), fluctuations that well might affect the relative utility of different fishing options. At the time scale of the study described in this thesis, however, the last of these factors - the effect of variation in water level - is likely to have been most significant in determining changing patterns of fish distribution and abundance through time.

Water levels in streams will be affected by both the overall amount of water entering the system and the intensity and pattern of input. Analysis of rainfall recorded at Gwaimasi in each month of the survey reveals two distinct patterns of weather, defined by three attributes: average daily rainfall, variation in daily falls and the proportion of days with falls of less than 5 mm (Figure 20).[11] Accordingly, I have classified months as either DRY or WET. (The terms are relative; with no month having less than 300 mm of rain it is somewhat inaccurate to refer to any period as 'dry'.) In large part these appear to reflect seasonal shifts, with DRY weather - less than 400 mm of rain in a month, and less than 50% of days having falls greater than 5 mm - from September to December 1986, followed by a shift to widespread and persistent rain in WET months (interrupted by a shorter DRY spell in July) and then a return to DRY weather the following October.

Short-term variation in rainfall may also be important, particularly in systems that respond rapidly to rain. The streams Sigia and Dege, for example, could flood within hours if rain was heavy, and then drain back to normal levels within two or three days. The water level of these stream on a given day, and thus their fishing potential, may be influenced more by the amount of rain that has fallen in recent days than by broad seasonal patterns of rainfall. I have divided each weather type further, therefore, into drier and wetter weeks. The choice of weeks as the scale of analysis was arbitrary. Cutoffs between dry and wet weeks in each broad weather type were primarily selected to ensure approximately equal numbers of weeks in each category but did, in fact, coincide

[11] Average linkages were calculated using the Cluster procedure of the SAS data analysis package (SAS Inst. 1988).



[a] Clustered on:
- average daily rainfall (mm)
- CV for daily rainfall
- proportion of days with rainfall less than 5 mm

Figure 20 Similarity between months in terms of pattern of rainfall.

with disjunctions in the distribution (see Figure 21). DRY weather weeks will be designated as 'DRY-dry' or 'DRY-wet' according to whether rainfall in the week was more or less than 75 mm. WET weather weeks will be designated as 'WET-dry' or 'WET-wet' according to whether rainfall in the week was more or less than 125 mm. (Where a week overlapped months with different weather it has been assigned to the month in which most days fell.)

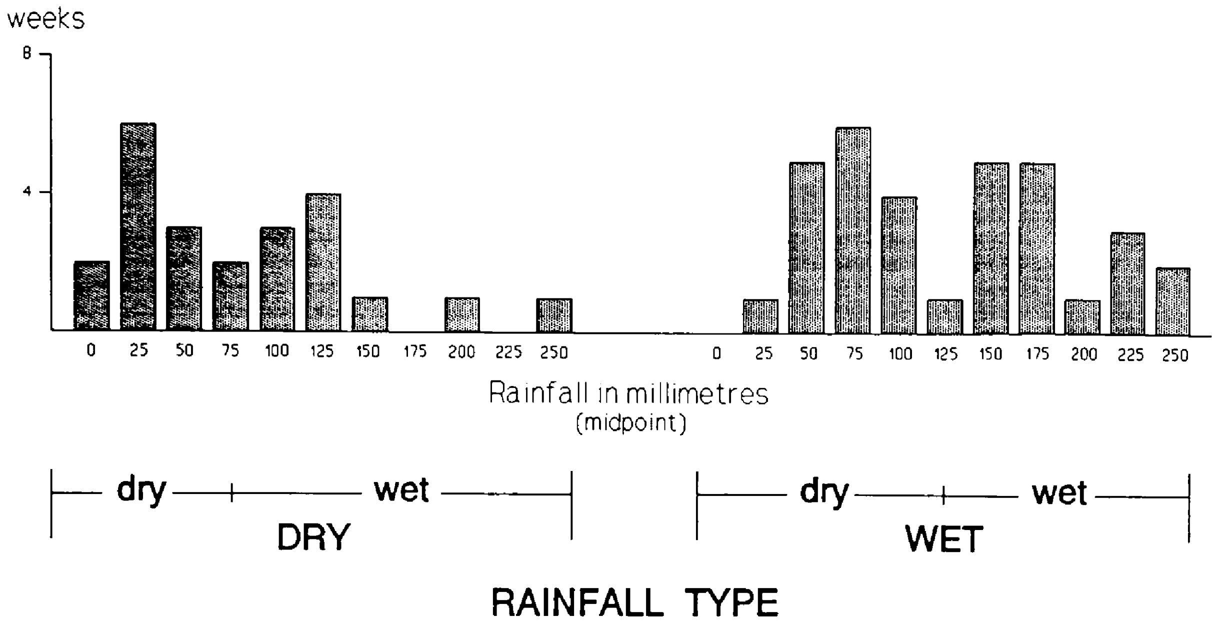


Figure 21 Frequency of weeks with different amounts of rain in DRY and WET weather respectively, indicating the cutoffs selected to distinguish the four different types of rainfall referred to in subsequent analyses.

In summary, four rainfall types are distinguished in the weather experienced at Gwaimasi through the survey period. The different conditions will have affected both water level and characteristics in some or all of the stream systems in the local area and, as a result, the availability and accessibility of fish within those streams. The relevant characteristics are as follows:

DRY weather:

- **DRY-dry** weeks (n = 12) received comparatively little rain, either locally or in the wider region. Water levels in all stream systems were at their lowest levels. Though a few good pools remained, there was little flow in tributaries of streams such as Dege and Sigia. Beaches and rock ledges along the Strickland River were exposed, and visibility in other streams was high.

- **DRY-wet** weeks (n = 11) comprised short spells of heavy rain, within a period of comparatively low rainfall. Local streams - those draining the swamps and foothills - were often flooded, their waters murky and visibility low, but the Strickland River usually was not affected.

WET weather:

- **WET-dry** weeks (n = 18) were short, comparatively dry spells within a period of widespread heavy rain that raised water levels throughout the area. High water levels in the Strickland River usually were not affected by these drier spells, but levels in some local streams fell. The reservoir effect of swamps maintained levels in streams draining them, but rate of flow and turbidity declined, increasing visibility.
- **WET-wet** weeks (n = 16) were characterized by heavy and persistent rain both locally and in the wider region. Water levels in all stream systems were generally high. Beaches and ledges along the Strickland River were often covered, and water in local streams was fast-flowing and turbid.

Note that, as Figure 21 shows, some DRY weeks had as much rain as the wettest of WET weeks and, though no WET weeks were totally without rain, several had falls within the DRY-dry range. Because water takes some time to drain, however, longer term patterns will still have affected those weeks. The four rainfall types, as listed, indicate progressively increasing amounts of water flowing through the area.

As rainfall patterns changed, during the survey, so did the number and kinds of fish caught by people at Gwaimasi. Table 21 summarizes the composition of the catch obtained by village-based fishing in each of the four rainfall types identified above. (Because of the need for fairly precise information as to week of capture, comparison of returns in different rainfall conditions is restricted to those from village-based fishing.) There were marked differences between the kinds of fish caught in DRY weather and WET weather ($\chi^2 = 90.9$; $p < 0.001$), with a shift in emphasis from catfish to the smaller perch and gudgeons in the latter. Short-term patterns of local rainfall also affected the catch; during wetter weather in both DRY and WET weeks there was an increase in the proportion of forktailed catfish and gudgeons relative to eeltailed catfish and perch ($\chi^2 = 31.3$ for DRY weather and 18.9 for WET weather; $p < 0.001$ in each case). The two patterns arose in different ways; the former resulted primarily from changes in the availability of fish, the latter from changes in their accessibility.

The patterns become clearer when effects of variation in the biological assemblages from different streams, or susceptible to capture by different techniques, are removed. Table 22 compares composition of the catch obtained by spearfishing in different rainfall

Table 21 Composition of the catch obtained by village-based fishing in each of the four rainfall types identified.

	PERCENT OF TOTAL CATCH			
	DRY		WET	
	dry	wet	dry	wet
FORKTAILED CATFISH	56	78	34	44
EELTAILED CATFISH	22	8	11	6
PERCH	17	9	36	15
GUDGEONS	4	6	17	32
OTHER	1	-	2	3
Total number caught (number/week)	286 (23.8)	173 (15.7)	126 (7.0)	106 (6.6)

conditions, both from the Gwaimasi area as a whole and from the Dege system alone. In DRY weather catfish comprised 0.65 to 0.73 of speared fish. In WET weather, in contrast, that proportion dropped to less than 0.25, with the much smaller perch and gudgeons dominating hauls ($\chi^2 = 37.8$ for the area as a whole and 42.0 for the Dege system alone; $p < 0.001$ in each case). The different weather types, in fact, affected not only the kinds of fish speared but also the quantities encountered. As Table 23 shows, spearfishing in the Dege system was much more productive during DRY weather than during WET weather; hauls obtained were significantly larger, on average, in the former conditions. The availability of fish in Dege, at least, was clearly affected by seasonal shifts in rainfall, with a greater abundance of fish, particularly of the larger species of catfish, present in DRY weather.[12]

Local rainfall patterns, in contrast to broader seasonal patterns, had little effect on the kinds of fish obtained by spearfishing, or on the sizes of hauls. In both DRY and

[12] Though sample sizes are small there was evidence that the increased availability, during DRY weather, of at least one species of catfish was related to seasonal changes in population structure related to life-history strategies; 19 of 30 *Arius leptaspis* (*soi*) obtained from the Dege system in September to December 1986 or October 1987 weighed less than 500g, compared to only 4 of the 19 obtained at other times ($\chi^2 = 8.35$; $p < 0.005$). The data appear consistent with a pattern of 'seasonal' recruitment.

Table 22 Composition of the catch obtained by village-based spearfishing in each of the four rainfall types identified, from the Gwaimasi area as a whole and from the Dege system alone.

	PROPORTION OF TOTAL CATCH all local area				Dege system			
	DRY		WET		DRY		WET	
	dry	wet	dry	wet	dry	wet	dry	wet
FORKTAILED CATFISH	0.27	0.33	0.10	-	0.25	0.38	0.06	-
EELTAILED CATFISH	0.38	0.37	0.14	0.20	0.41	0.35	0.14	0.14
PERCH	0.34	0.30	0.72	0.80	0.33	0.27	0.76	0.86
GUDGEONS	0.01	-	0.03	-	0.01	-	0.04	-
OTHER	0.01	-	-	-	-	-	-	-
Total number caught (number/week)	128 (10.6)	30 (2.7)	58 (3.2)	15 (0.9)	103 (8.6)	26 (2.4)	50 (2.8)	14 (0.9)

Table 23 Number and frequency of successful village-based spearfishing episodes in different rainfall conditions, and average size of hauls obtained in those conditions, from the Gwaimasi area as a whole and from the Dege system alone.

	VILLAGE-BASED SPEARFISHING EPISODES all local area			Dege system		
	n	no./ 100 days	mean haul (g)	n	no./ 100 days	mean haul (g)
DRY	45	28.0	2015	32	19.9	2289
WET	32	13.4	819	27	11.3	878
			Mann-Whitney U test			
			z=-1.89 p=0.06			z=-2.18 p=0.03
DRY-dry	32	38.1	2278	24	28.6	2387
-wet	13	16.9	1367	8	10.4	1996
WET-dry	23	18.3	884	19	15.1	360
-wet	9	8.0	655	8	7.1	408
			Mann-Whitney U test			
		DRY	z=-0.81 NS		DRY	z=0.11 NS
		WET	z=-1.30 NS		WET	z=-1.04 NS

WET weather, however, the average number of fish caught in wetter weeks was much less than in drier weeks. (The greater variety of fish caught in drier weeks, in fact, simply reflects this greater number of captures.) It seems that, while availability of fish was not affected by short-term changes in water level, such changes had a major effect on accessibility of fish; fish could not be seen to be speared when water was turbid, as was usually the case for some time after rain. People specifically stated, on occasion, that they had not dived for fish (despite perhaps having gone out with the intention of fishing) because a stream was swollen - *agubo*.

In fact, distribution of fish within systems probably was affected by local rainfall, with fish moving into smaller streams in response to rising water levels.[13] Because people could not dive until waters had fallen, this pattern would not be apparent in spearfishing records, especially those from larger streams; fish would have returned to previous locations by the time spearfishing was again possible after rain. Such movements would be of relevance, however, to fishing by means such as traps.

Streams draining the foothills to north and east of Gwaimasi were not affected by local rainfall to the same extent as the Dege system; without the reservoir effect of swamps to sustain flow, water in these streams cleared much more rapidly after rain. Again, because catfish comprised a much smaller proportion of the fish community in the eastern foothill streams, seasonal changes in abundance of these species would have had less effect on the availability of fish within these streams. Despite such differences in the degree to which streams were affected by rainfall conditions (which explain the blurring of patterns seen in the Dege system when examining returns from spearfishing in the area as a whole), all streams that arose in or near the Gwaimasi area showed the kinds of effects identified above - a decline in availability of fish in WET weather relative to DRY weather, and reduced accessibility of fish in wetter weeks of both DRY and WET weather.

Patterns of availability and accessibility of fish in the Strickland River were rather different from those exhibited by other stream systems in the Gwaimasi area. Table 24 compares composition of the catch obtained by linefishing in the Strickland River in different rainfall conditions. *Arius taylori* (*soigia*) dominated the catch at all times,

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[13] Tufa, notes from April 29, 1987.

Table 24 Composition of the catch obtained by village-based linefishing in each of the four rainfall types identified, from the Strickland River as a whole and specified as from places where major tributaries joined the river.

	PROPORTION OF TOTAL CATCH All river				Junctions			
	DRY		WET		DRY		WET	
	dry	wet	dry	wet	dry	wet	dry	wet
FORKTAILED CATFISH								
four river species								
Arius taylori	0.76	0.81	0.82	0.66	0.80	0.17	0.75	0.09
A. augustus	0.10	0.02	0.03	-	-	-	-	-
A. crassilabris	-	0.03	-	0.06	-	-	-	-
Cochlefelis spatula	0.05	0.06	0.03	0.10	-	-	-	0.18
other								
A. latirostris	0.04	0.04	0.05	0.06	-	0.33	0.12	0.18
A. leptaspis	0.04	0.02	-	0.06	0.20	0.50	-	0.27
OTHER	0.02	0.01	0.08	0.06	-	-	0.12	0.27
Total number caught (number/week)	115 (9.6)	123 (11.8)	39 (2.2)	50 (3.1)	15 (1.3)	6 (0.5)	8 (0.4)	11 (0.7)

comprising between 0.66 and 0.82 of all fish obtained by line from the river (including junctions), but there were changes in composition of the remainder of the catch as rainfall conditions changed. In contrast to the pattern described for Dege, however, local rainfall had more effect on the kinds of fish caught in the Strickland River than did broader seasonal shifts in rainfall. As might be expected, this effect was particularly strong near junctions, where local rain drained into the river. Though sample sizes were small, *A. taylori* comprised a much smaller proportion of the catch from stream junctions during wetter weeks of both DRY and WET weather than in drier weeks; only two of the 17 fish obtained from junctions during wetter weeks were *A. taylori*, compared to 18 of 23 fish obtained in drier weeks ($\chi^2=17.3$, $p<0.0001$; $\chi^2=7.3$ and 8.6 for DRY weather and WET weather respectively, $p<0.01$ in each case). Presumably, the increased flow of comparatively clear water into the river after rain - and perhaps the nutrients flushed out by that greater flow - encouraged fish more commonly found in side streams to venture at least to the edge of the river. But local rainfall affected fish within the river itself too. Of the three species of forktailed catfish, other than *A. taylori*, that were confined to the river, *A. augustus* (*owuahia*) were more likely to be caught in drier weeks, the other two species in wetter weeks. Behavioural shifts in response to short-term fluctuations in food supply caused by local rainfall were probably responsible; *A. augustus* is primarily a fish-eater, while the other two species are more omnivorous, *A. crassilabrus* (*okaibo*), in particular, regularly feeding on insects and higher plants (Allen 1991).

The slight differences in composition of the overall catch in DRY weather compared to the catch in WET weather - relatively more non-catfish species in the latter, and relatively fewer *A. augustus* - matched the shifts described above. They, too, presumably reflected the effects of greater rainfall within the local area, rather than the general increase in rainfall throughout the region in these months. It seems that availability of fish in the Strickland River was influenced more by short-term local changes in habitat than by the larger seasonal shifts in water level.[14]

The species most affected by changes in rainfall were all comparatively minor components of the assemblage obtained from the Strickland River as a whole. The overall productivity of linefishing in the river is thus unlikely to have been greatly affected by weather. As Table 25 shows, there was no significant change in the average size of hauls obtained from the river in drier and wetter weeks of either DRY weather or WET weather. Productivity of linefishing did decline in WET weather, however, compared to DRY weather, despite the lack of any significant change in the composition of the catch. But this decline was not general - it was not evident in the sizes of hauls obtained from junctions during the different conditions - suggesting that it reflected a change in the locations where people fished rather than in the availability of fish.

While the dramatic rises in river level that resulted from persistent rain in the mountains during WET months may have had little effect on availability of fish, they had a marked effect on their accessibility. In this case, however, it was fishing locations that became more difficult to access and not the fish themselves. Beaches and rocky ledges - favoured locations for setting lines - were often covered during WET weather. Perhaps more importantly, the stronger current at these times meant that the work entailed in

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[14] Similarly, Gragson (1992:430) reported that "the effect of water type on the spatial distribution of fish throughout Amazonia appears to be less important than generally believed; fish seem to be distributed...largely in response to short term changes in landscape and habitat".

Table 25 Number and frequency of successful village-based linefishing episodes in different rainfall conditions, and average size of hauls obtained in those conditions, from the Strickland River as a whole and specified as from places where major tributaries joined the river.

	VILLAGE-BASED LINEFISHING EPISODES all Strickland River			Junctions		
	n	no./ 100 days	mean haul (g)	n	no./ 100 days	mean haul (g)
DRY	141	87.6	841	11	6.8	1014
WET	75	31.5	617	16	6.7	951
			Mann-Whitney *U* test			
			z=-2.13 p=0.03			z=0.35 NS
DRY-dry	72	85.7	921	7	8.3	1106
-wet	69	89.6	757	4	5.2	852
WET-dry	33	26.2	593	7	5.6	549
-wet	42	37.5	635	9	8.0	1263
			Mann-Whitney *U* test			
		DRY	z=-0.21 NS		DRY	z=-1.04 NS
		WET	z=-0.02 NS		WET	z=-2.12 p=0.03

bringing a canoe upstream was much greater. Travel time to different fishing locations along the river would have increased as a result.

6.3 EFFECTS ON FISHING BEHAVIOUR

Distribution and abundance of fish within the Gwaimasi area, as well as their accessibility by different fishing techniques, reflected water type and level in the different streams, and thus varied both with type of country drained and with patterns of rainfall. If fishing behaviour was influenced by the availability and accessibility of fish we would expect to see noticeable differences in usage of different stream systems in the Gwaimasi area, as well as in patterns of fishing activity in different weather conditions.

6.3.1 **Patterns in space**

People at Gwaimasi fished far more often in some stream systems than in others (Table 26). Their apparent preference for certain fishing locations shows no simple correlation with relative productivity of the streams in question. Eastern swamp streams, for example, produced significantly larger hauls, on average, than either the Strickland River or the Dege system, yet people were at least five times more likely to fish in one of the latter two systems than in the former. Accessibility of fishing locations, however, is likely to have been at least as important a consideration in deciding where to fish as the availability and accessibility of fish at those locations.

Table 26 ranks the major stream systems within the Gwaimasi area according to frequency with which fish were obtained from them, the average haul sizes that could be expected from each, and the average time required to reach them from the village.[15] (To maximize the number of categories, the northern and southern tributaries and the main stream of Dege have been analysed separately.) With distance held constant, there was a clear correlation between the relative productivity of a stream system and the relative frequency with which people chose to fish there. People at Gwaimasi clearly preferred more productive streams. Travel time, however, was also considered in their decisions; with productivity held constant, there was a tendency for frequency of fishing to decline as distance increased. It seems that people would not travel to more distant locations unless the difference in expected within-patch return rates was sufficient to warrant the extra travel time. Thus, people would often bypass the northern tributaries of Dege in order to fish in the main stream, but were much less likely to travel further to fish in the eastern swamp streams.

The influence of travel time on fishing decisions, as shown in Table 26, seems to have been weaker than that of productivity, but this was not necessarily the case. Those calculations assumed that the relative distance to different stream systems was constant,

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[15] Each system, of course, drained a substantial area. I have compared the approximate times required for a round trip to the closest representative fishing location within each system. There was a beach suitable for fishing in the Strickland River only five minutes from the village, while the return trip to eastern swamp streams could take three hours. Crossing the Strickland River added at least half an hour in each direction to any trip.

Table 26 Correlations between the number of occasions on which fish were obtained from different stream systems in the Gwaimasi area, the relative productivity of the systems (indexed as average haul size), and the relative times required to reach them from the village.

		RANK		
	EPISODES	Number of episodes[a] (n)	Size of hauls[a] (s)	Distance from village (d)
STRICKLAND RIVER	297	1	3	1
DEGE - main stream	88	2	1.5	6
- northern tribs.	41	3	5	3.5
- southern tribs.	18	7	5	7
SIGIA SYSTEM	32	4	5	5
OTHER WEST STREAMS	11	8	8	2
EAST SWAMP STREAMS	26	6	1.5	8
EAST FOOTHILL STREAMS	27	5	7	3.5

Kendall partial rank-order correlation coefficient[b]

$T_{ns.d} = 0.611$ $p < 0.025$
$T_{nd.s} = 0.478$ $p < 0.1$

[a] See Table 18.

[b] Significance values are for a one-tailed test; I hypothesised that frequency with which people chose to fish in a stream would increase as productivity increased, and decrease as distance from the village increased.

and measured from the village. Since much fishing was, in fact, village-based this may have been a reasonable approximation, but the actual situation was more complex. People at Gwaimasi often stayed at, and fished from, bush houses that were located an hour's walk or more from the village. These houses were widely scattered; there was, for example, a house near Sigia, another south of Dege, a third in the foothills east of the Strickland River (see 2.1.5). Each differed in its proximity to the major stream systems, and we could expect use made of those systems to vary as a result. People might be more likely to fish in Sigia rather than Dege, despite the difference in productivity, if the former was near their house and the latter an hour and a half away. Even when fishing occurred during day trips from the village, costs of travel to different streams would not always be the same. Much of the village-based fishing at Gwaimasi was embedded within other activities; someone might set a line in the river while clearing a new garden on the levee bank nearby, or take a break from weeding a garden or processing sago in order to dive for fish in a nearby stream. In such cases, distances to streams would presumably be assessed relative to the locus of the primary activity, and not relative to the village.

Table 27 provides a breakdown of the context of successful fishing episodes for each of the six stream systems, again separating records for the northern and southern tributaries of Dege from those for the main stream. Village-based episodes have been distinguished from those that occurred while people were based elsewhere in the local area, or travelling to the village from beyond the area. The former have been further

Table 27 Effect of context on correlations between the relative frequency with which stream systems were used, the relative productivity of the systems (indexed as average haul size), and the relative times required to reach them from the village[a].

	VILLAGE-BASED			OTHER
	discr.[b]	embed.[b]	Σ	
STRICKLAND RIVER	114	107	221	77
DEGE - main stream	18	17	35	54
- northern tribs.	10	26	36	5
- southern tribs.	3	2	5	13
SIGIA SYSTEM	5	6	11	21
OTHER WEST STREAMS	-	6	6	5
EAST SWAMP STREAMS	3	2	5	21
EAST FOOTHILL STREAMS	4	9	13	14
	Kendall partial rank-order correlation coefficient[c]			
$T_{ns.d}$ =	0.601 $p < 0.025$	0.437 $p < 0.1$		0.587 $p < 0.025$
$T_{nd.s}$ =	0.503 $p < 0.05$	0.670 $p < 0.01$		0.224 NS

a See Table 26 for ranking of systems by productivity and distance.

b In this and later tables, 'discr.' refers to discretionary episodes, where fishing was the primary reason for leaving the village; 'embed.' refers to episodes where fishing was embedded in other activities.

c Significance values are for a one-tailed test; I hypothesised that frequency with which people chose to fish in a stream would increase as productivity increased, and decrease as distance from the village increased.

divided into discretionary fishing expeditions, where procurement of fish was known to have been the primary purpose of the trip, and those where fishing was embedded in other activities. (Where the context was not specifically known I have assumed, here and elsewhere in this and other chapters, that fishing was embedded. In fact, I knew the context of all but 32 of the 326 village-based fishing episodes for which location was known.) The significance of relative distance and productivity in determining where people chose to fish differed with context. People leaving the village to fish considered both when making their decisions; the relative frequency of deliberate fishing episodes in each stream system was significantly correlated ($p < 0.05$) both with time required to reach the system and with the average haul size that could be expected from that system. When people were primarily concerned with some other task, however, they paid far less attention to the relative productivity of potential fishing locations. Rather, they tended to fish in the nearest stream. (The strong correlation between distance of a stream system from the village and frequency of embedded fishing within it probably reflects the spatial patterning of other subsistence tasks rather than selective use of fishing locations.) People fishing from other bases in the local area were, not surprisingly, unconcerned about distance of streams from the village. Relative productivity of streams, however, was still an important consideration in choosing where to fish.

Differential availability and accessibility of fish in the Gwaimasi area affected not only where people chose to fish, but also how they fished. Table 28 summarizes, for each of the major stream systems, the proportion of fishing episodes that used spear, lines, and other techniques respectively. People displayed very strong preference for use of one technique over others in most stream systems, but the preferred option was not always the same; nearly all fishing in the Strickland River entailed use of lines, whereas more than 80% of fishing episodes in the Dege and Sigia systems and in the eastern swamp streams used spears. The turbid waters of the Strickland River precluded spearfishing, while other techniques such as netting could only be used at junctions, so it is not surprising to see the dominance of linefishing in the river. Other streams, however, offered a choice of techniques. In those contexts, the dominance of one technique over others reflected people's preference for the technique that offered greatest productivity. Hauls obtained by spearfishing in the Dege and Sigia systems, and in eastern swamp streams were considerably larger, on average, than hauls obtained from the same streams by line (see Table 20). In streams draining the eastern foothills, however, hauls obtained

Table 28 Proportion of fishing episodes that used spear, line and other techniques respectively, in each of the major stream systems within the Gwaimasi area.

	N[a]	RIVER	WEST			EAST	
			Dege	Sigia	Other	Swamp	Fthill
SPEAR	180	-	0.83	0.88	0.27	0.84	0.30
LINE	329	0.98	0.11	0.09	0.18	0.12	0.52
OTHER	35	0.20	0.06	0.03	0.54	0.04	0.19
Episodes with tech. known[b]	544	295	142	32	11	25	27

[a] Includes 12 episodes for which location was unknown - 2 by spear, three by line and 7 by other techniques.

[b] These numbers may exceed the total number of episodes recorded in previous tables because, on a few occasions, more than one technique was used during a single episode; eg. a fish encountered while diving was sometimes taken by hand, rather than speared.

by the two techniques were of similar size, and people showed no marked preference for one technique over the other when fishing in those streams. (Fishing episodes in other streams of the west bank were too few to allow patterns to be recognized either in haul sizes obtained by different techniques or in preference for techniques.)

6.3.2 **Patterns in time**

People at Gwaimasi were much more likely to go fishing in some weather conditions than in others. Table 29 shows the number and frequency of successful village-based fishing episodes in DRY weather and WET weather respectively, and in drier and wetter weeks of each. In DRY weather, there was an average of 9.3 successful fishing episodes every week, but in WET weather this rate dropped to only 3.7 successful episodes per week. Short-term patterns of rainfall, in contrast, seem to have had little influence on the frequency with which people chose to fish, although both availability and accessibility of fish were affected by local rain. But fishing at Gwaimasi was not a unitary phenomenon. Local rainfall, like broader seasonal shifts in weather, did affect the

Table 29 Number and frequency of successful village-based fishing episodes in different rainfall conditions.

	DRY	WET	DRY dry	DRY wet	WET dry	WET wet
Weeks	23	34	12	11	18	16
Number of episodes	214	126	121	93	67	59
Episodes per week	9.3	3.7	10.1	8.5	3.7	3

places where people chose to fish, and the techniques they chose to use.

Table 30 compares the number and frequency of village-based spearfishing episodes in different rainfall conditions, and provides a breakdown of locations where these occurred. Spearfishing was affected both by reduced availability of fish in streams such as Dege during WET weather compared to DRY weather and by reduced accessibility of fish after local heavy rain. People changed their fishing behaviour accordingly. As productivity of streams declined, people went spearfishing less often; there were only 32 village-based spearfishing episodes in 238 days of WET weather, compared to 44 episodes in 161 days of DRY weather ($\chi^2=9.66$; $p<0.01$). They also were less willing to travel to more distant streams in order to spear fish; in DRY weather 34 of 44 village-based spearfishing episodes for which location was known entailed travel beyond the northern tributaries of Dege or the foothill streams of the east bank, compared to only 17 of 38 episodes[16] in WET weather ($\chi^2=9.18$; $p<0.01$). It seems that the returns to be expected from spearfishing in WET weather were not enough to warrant spending much time in travel.

In both DRY and WET weather, people speared fish much less often in the wetter weeks ($\chi^2=7.38$ for DRY weather and $\chi^2=4.66$ for WET weather; $p<0.01$ and $p<0.05$ respectively). In fact, in DRY-wet weather people actually went spearfishing less frequently than in WET-dry weather, though the productivity of streams (judging from

[16] Six episodes in WET weather entailed fishing in both Dege and at least one of its northern tributaries; these have been counted twice.

Table 30 Frequency and location of successful village-based spearfishing episodes in different rainfall conditions.

	DRY	WET	DRY dry	DRY wet	WET dry	WET wet
Days	161	238	84	77	126	112
Number of episodes	44	32	32	12	23	9
Episodes per 100 days	27.3	13.4	38.1	15.6	18.3	8.0
	Episodes per 100 days					
DEGE - main stream	13	5	19	6	9	-
- northern tribs.	4	8	6	3	10	7
- southern tribs.	2	1	4	-	2	-
SIGIA SYSTEM	5	1	6	4	2	-
OTHER WEST STREAMS	-	-	-	-	-	-
EAST SWAMP STREAMS	1	1	1	1	2	-
EAST FOOTHILL STREAMS	2	+	2	1	-	1

haul sizes; see Table 23) was greater during the former period. Flooding in those streams after heavy local rain, however, meant that the fish were simply not accessible by spearing, whatever their abundance. The decline in frequency of spearfishing in these circumstances was not a matter of choice. Note, however, that the reduced abundance of fish in WET weather meant that people were unwilling to travel very far in order to see whether waters had cleared; all village-based spearfishing in WET-wet weeks occurred in the streams closest to the village.

Linefishing in the Strickland River, the other major source of fish for people at Gwaimasi, was affected less by changes in the availability and accessibility of fish themselves than by changing accessibility of fishing locations. Table 31 compares the frequency of successful village-based linefishing episodes in different weather conditions. As beaches and rocky ledges along the river disappeared under rising waters, and as use of canoes became more difficult, people set lines less often; there were only 75 episodes of linefishing in the Strickland river in 238 days of WET weather, compared to 141 episodes in 161 days of DRY weather ($\chi^2=55.7$; $p<0.0001$).

Tactics used in linefishing also changed with rainfall conditions. Table 31 includes

Table 31 Frequency of successful village-based episodes of linefishing in the Strickland River, and of episodes producing different numbers of fish, in different rainfall conditions.

	DRY	WET	DRY dry	DRY wet	WET dry	WET wet
Days	161	238	84	77	126	112
Number of episodes	141	75	72	69	33	42
Episodes per 100 days	87.6	31.5	85.7	89.6	26.2	37.5
Number caught	Episodes per 100 days					
1	57	67	62	52	23	34
2	14	6	8	20	2	3
>2	16	2	15	17	1	1
Number of fish	238	89	115	123	39	50
Fish per 100 days	147.8	37.4	136.9	159.7	31.0	44.6

details of the frequency with which different numbers of fish were obtained by line from the river. Only eight of the 75 episodes of linefishing in the Strickland River in WET weather produced two or more fish, compared to 49 of the 141 episodes that occurred in DRY weather ($\chi^2 = 14.6$; $p < 0.001$). Each bait set can catch only a single fish, so it seems that people at Gwaimasi were more likely to use multiple lines or to tend lines (see 5.2.3) in DRY weather than in WET weather. Because of the additional costs associated with these more intensive fishing tactics, they tended to be used only in locations such as junctions with major tributary streams, where the probability of encountering fish (or, rather, of a fish encountering the line) was comparatively high. People fishing near the village, for example, were less likely to use multiple lines, or to tend lines, than those fishing further afield; only 10 of 85 episodes of linefishing near the village produced two or more fish, compared to 47 of the 131 episodes of linefishing elsewhere ($\chi^2 = 15.4$; $p < 0.001$). As movement along the river became more difficult, however, people were less willing to travel to locations that warranted the use of intensive linefishing tactics.

Local rainfall did not affect the accessibility of fishing locations, and had only slight effects on the availability of fish in the Strickland River. Yet people at Gwaimasi markedly increased the number of lines that they set (though not necessarily the number of linefishing episodes) in wetter weeks of both DRY and WET weather. The shift did not take the same form in each case; in DRY weather, people were more likely to use tended or multiple lines when local rainfall was comparatively high, whereas in WET weather they simply increased their frequency of setting lines. The outcome, however, was the same. During periods of heavier rain, people at Gwaimasi obtained more fish by line from the Strickland River. The reason is to be found not in the river itself but in the effect of heavy rain on other streams. With spearfishing impractical for some time after heavy rain, people who wanted fish turned more to linefishing. The different responses in DRY weather and WET weather simply reflected differences in the accessibility of good fishing locations at the time.

The relative appeal of fishing by other techniques, including the use of lines in streams other than the Strickland River, could have been also affected, directly or indirectly, by rainfall. Table 32 summarizes the number and frequency of successful village-based fishing episodes using a variety of minor techniques in different weather

Table 32 Frequency of successful village-based episodes using minor techniques and strategies (that is, other than spearfishing, or linefishing in the Strickland River), in different rainfall conditions.

	DRY	WET	DRY		WET	
			dry	wet	dry	wet
Days	161	238	84	77	126	112
Number of episodes	21	19	11	10	11	8
Episodes per 100 days	13.0	8.0	13.1	13.0	8.7	7.1
technique used	Episodes per 100 days[a]					
line[b]	3	4	2	4	4	4
hand	6	1	7	5	1	1
arrow	2	1	1	4	2	-
poison	1	+	1	-	1	-
net	1	2	1	-	2	2
misc.	-	+	-	-	-	1[c]

[a] Rounded to the nearest whole number.

[b] In streams other than the Strickland River.

[c] One eel was cornered by several men and killed with a fishing spear.

conditions. The numbers in each case were small, and no significant patterns can be identified. In general, however, the directions of variation are similar to those described above; fishing by these minor techniques declined in frequency in WET weather relative to DRY weather. The exceptions were linefishing in the smaller streams, and netting fish at places where large tributaries joined the Strickland River. Both techniques entailed trapping fish, and thus were not affected by visibility. Episodes were too few, however, to suggest that these techniques were used to compensate for reductions in the fishing potential of other techniques as rainfall increased.

6.4 SUMMARY

People at Gwaimasi were much more likely to fish in some stream systems, and in some weather conditions, than in others. The reasons are to be found in patterns of availability and accessibility of fish within the local area.

Stream systems in the Gwaimasi area differed both in the kinds and quantities of fish that inhabited them and in the accessibility of those fish by various procurement techniques. The Strickland River was influenced primarily by events outside the local area and had the most distinct assemblage of fish species, while its turbid waters and strong current precluded use of all but fairly non-selective trapping and ambushing techniques. Streams that arose in or near the local area all produced the same species of fish, but relative and absolute numbers differed according to the type of country drained; in particular, streams that drained swamps had relatively more large catfish than streams draining foothills or levee bank. Visibility in all these local streams was generally high, and most available fishing techniques could be used in any of them. Differences in the availability of fish, however, meant that the various systems offered very different returns for time spent fishing within them. Swamp streams were much more productive than foothill streams, with returns rates from the Strickland River falling between these.

The distribution and abundance of fish within the Gwaimasi area, however, and their accessibility by different techniques, was not constant. With the shift from DRY weather to WET weather, the large catfish species, in particular, became less common in local streams. Productivity of those streams declined as a result. Short spells of heavy rain in the local area, in both DRY and WET weather, also affected fishing potential in local streams. These streams, being comparatively short, responded rapidly to changes in water input. Flooding, and the associated increase in turbidity, meant that fish could not be seen to be speared for some days after heavy rain. Fish also may have dispersed into smaller streams at these times, as water levels rose, but local rain primarily affected accessibility of fish and not their availability. The productivity of spearfishing, when it was possible, was unaffected.

Increased rainfall in WET weather had little effect on the availability of fish in the Strickland River, but did affect their accessibility; beaches and rock ledges were covered by higher water levels, and the stronger current made use of canoes more difficult. Heavy rain in the local area, in contrast, had little effect on water levels in the river, but the increased flow of comparatively clear water into the river at these times attracted fish to places along the river where major tributaries joined. The productivity of fishing at such locations increased as a result.

People at Gwaimasi were influenced by both relative productivity of stream systems and the relative time required to reach them in deciding where to fish; the frequency with which they chose to fish in a stream increased as within-patch return rates increased and decreased as the distance to be travelled increased. People also showed marked preference for the technique that offered greatest return rates in the chosen location. Accordingly, most fish caught during the survey were obtained either by linefishing in the Strickland River or by spearfishing in Dege and its tributaries.

As availability of fish in local stream systems declined with a shift to WET weather, people became less willing to travel any distance to spear fish. Equally, as travel time to more productive linefishing locations along the Strickland River increased with WET weather, the greater return rates possible at those locations became less attractive. Fishing in general, then, was less productive in WET weather, and people responded by choosing to fish less often.

Local rainfall had a more complex effect on fishing behaviour. Spearfishing was impractical for several days after heavy rain, but the potential for linefishing in the Strickland River was largely unaffected. The relative value of linefishing was thus enhanced at these times. Reflecting this, in both DRY and WET weather, people at Gwaimasi set more lines in wetter weeks than in drier weeks. Some spearfishing did occur in wetter weeks of both DRY and WET weather; productivity of local streams was, after all, unaffected. Because streams had to be monitored to see if waters had cleared, however, distance was a more important consideration than productivity in determining where people speared fish in these conditions.

In summary, availability and accessibility of fish did influence the material outcome that could be expected from alternative fishing options in the Gwaimasi area. The decisions made by people at Gwaimasi reflected this. But the outcome of a fishing trip depends on the abilities of the fisher as much as on the availability of fish. The next chapter considers the ways in which the abilities and requirements of the fisher mediated availability and accessibility of fish.

CHAPTER 7
INTRINSIC CONSTRAINTS
ON PRODUCTION AND CONSUMPTION

Availability and accessibility of fish in the local environment constrained the material outcome that people at Gwaimasi could expect from alternative fishing options. Their behaviour reflected that effect. But such extrinsic constraints on production apply equally to everyone in the community. If these constraints were all that influenced the relative value of different options, the optimal pattern of fishing behaviour would be the same for all. Yet individuals at Gwaimasi differed greatly in the ways they chose to fish, not just in terms of the amounts procured but also in the techniques used, streams visited and species targeted. Those differences must be traced to attributes intrinsic to the fishers themselves.

Not all individuals have the same ability to procure fish; people may differ in their proficiency with available techniques, or in the ease with which they travel. The material outcome to be expected from any fishing option - the amount of fish likely to be procured per unit time - would vary as a result. In addition, individuals may differ in their requirements either for the nutrients contained in fish or for the support from others that sharing fish might bring. In other words, the use that could be made of the outcome of a fishing decision may also vary between fishers. In as much as outcomes, and the use made of outcomes, affects the reproduction of behaviour, the ways that people fished can be expected to reflect such variation in intrinsic abilities and requirements.

In this chapter, I turn from analysis of spatial and temporal variation in fishing behaviour at Gwaimasi to consider variation among individuals in the ways that they fished. That variation is then interpreted in terms of the ways that abilities and requirements are constrained by aspects of the fisher's identity.

The first section of the chapter discusses the social regulation of fishing among Kubo in general, and the constraints on fishing behaviour that applied to all people at Gwaimasi by virtue of their identity as Kubo.

The next section turns to a consideration of variation in individual fishing returns at Gwaimasi, and the way these reflected differences in the constraints affecting specific categories of individuals within the community. Gender-related constraints are discussed first and at most length, an emphasis reflecting both the striking differences in male and female fishing patterns and the extensive literature available addressing such differences. This is followed by analysis of constraints associated with life-history variables - age and initiation, marital status and reproductive status. Finally, I address the effects on fishing behaviour of clan affiliation, a purely structural variable. In each case I begin by describing relevant patterns in the Gwaimasi fishing data. These are then interpreted in the light of both relevant theoretical literature and more general observations of Kubo society.

The last section looks at constraints affecting individuals, rather than categories of people. These are not strictly social constraints - reflecting rather the historical contingencies of heredity and experience - but, as will be seen, the form of Kubo society and ecology encourages the kinds of variation observed.

7.1 GENERAL CONSTRAINTS

The people living at Gwaimasi in 1986-87 were Kubo speakers. Hunter-horticulturalists with an extensive system of gardening, their focus on immediate returns in subsistence (and, arguably, in other aspects of production and exchange) can be expected to have affected their attitudes and practices governing access to resources (Barnard & Woodburn 1991). This section examines constraints on fishing behaviour (or, rather, the absence of constraints) that applied to all people at Gwaimasi, by virtue of their identity as Kubo.

7.1.1 **Fishing rights**

Fisheries have been regarded as "the classic examples of common-property resources" (Chapman 1989:331; see Berkes 1985; Hardin 1968; Feeny *et al.* 1990); the great distances that fish - especially the larger species likely to be of interest to people - may cover in seasonal and developmental movements place them beyond the control of any one individual or group interested in their harvest. Nevertheless, many studies of traditional subsistence fisheries (eg. Carrier 1982; Johannes 1981; McCay 1978; papers in

Cordell 1989; McCay & Acheson 1987), and some larger commercial ones (see especially the series of studies dealing with Maine lobster-fishermen, eg. Acheson 1975), have emphasized the existence and operation of regulatory mechanisms governing tenure and use rights. Indeed, Hardin (1968) argued that sustainable exploitation of common-property resources was impossible without some means of limiting entry.

It was somewhat surprising, therefore, to discover that - with the possible minor exception of poisoning (see below) - Kubo had no general rules governing the right to fish.[1] Fish were treated as a communal resource, freely available to all; unlike pig or cassowary, which always had to be delivered to the owners of the land on which they were killed, fish could be taken and consumed by any passer-by without permission.

The organization of Kubo hunting and fishing rights was similar to that described for Bedamuni (Biami) by Beek (1987:104-7; see 3.1.4). Nominally, all rights to land, and to the natural resources associated with that land, were vested in the clan, with relevant boundaries clearly defined and recognized.[2] Use of that land by others was subject to permission. In fact, as is often the case with systems based on communal ownership, permission would rarely be denied (Williams 1982; but see Beek 1987:17,105). That does not mean that it could be ignored.

In the case of fish, however, and to some extent other small prey species, the need for permission was apparently waived. Having said this, it needs qualification. The lack of constraint applied not to any specific or general type of prey as such (ie., not to 'fish' or to 'small game') but to certain prey obtained by certain means (eg. 'fish caught other than by poison'). Thus ownership of resources is not abrogated; 'fish' may continue, at least nominally, to be regarded as belonging to a clan's territory.

Beek (1987) perceived the relevant boundary between divided and undivided access to resources to lie not in types of prey but in forms of hunting. For Bedamuni, he said, hunting is "practically free as long as it does not involve what could be seen as regular hunting or the taking of large amounts of game in one session" (1987:106). Beek,

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[1] This conflicts with Haines' (1982:282) contention that 'each traditional fishery in [Papua New Guinea] effectively operated under a limited-entry system, with further geographical restrictions within that system'.

[2] In contrast, rights to domestic resources such as tree crops, availability of which entailed investment of labour - however minor - were, by that labour, vested in individuals (cf. Barnard & Woodburn 1991:23).

however, did not offer any rationale as to why these two factors might be significant. One possible interpretation is social. Large hauls can be widely distributed. Where generosity is valued, as Kelly (nd:Ch.2) argued is the case among people of the Strickland-Bosavi area, land-owners may benefit from restricting access to production of large hauls. Kelly, however, was referring only to generosity in the distribution of garnered resources. Ingold (1986a:228), too, saw ownership of resources after harvest in terms of the ability to create distinctions between givers and receivers. I am concerned, here, however, with rights to produce resources in the first place, a matter that raises quite different questions from those associated with rights to consume (cf. Barnard & Woodburn 1991).

Why should people designate some ungarnered resources as subject to restricted access and not others? Ingold has suggested that:

> "The division of the landscape into territorial compartments, far from defining zones of exclusive access to particular holders, actually serves to regulate the exploitation of dispersed resources over a common range ...[It] should be seen as an aspect of practical co-operation ..." (Ingold 1986a:223-224).

Williams (1982), too, interpreted boundaries in terms of management practices. The institution of divided access to a resource, therefore, could be expected to depend on the effects of exploitation on that resource, and particularly on further exploitation of that resource.

Smith (1991b) suggested that the crucial effect of unregulated exploitation lay not in its effect on the resource itself but in its effect on knowledge about that resource. Where a fishing decision by one individual could affect the later options available to another, a premium would be attached to knowing about, if not actually controlling, the decisions made. Several characteristics of fish, and of fishing, in the Kubo area act to minimize the effect that individuals can have on future availability of fish, and thus reduce the call for regulation of access.

Fishing techniques used at Gwaimasi were, in the main, non-intensive. That is, the number of fish removed on any occasion was small compared to the number available. In addition, the mobility of fish - encouraged by great variation (often from one day to the next) in stream conditions in this area - ensured relatively rapid replacement of stock removed. Given the low density of people in this area, and the consequent infrequency of fishing in any one location, no single fishing episode was likely to affect the outcome of future episodes.

Two observations are of relevance here. First, people at Gwaimasi did use one fishing technique that might be termed intensive; they occasionally poisoned fish in smaller streams (see 5.2.3). While results were variable this technique had the potential to remove most fish from at least part of a stream. The rules governing this activity were rigid and constrained, among other things, the frequency with which streams could be poisoned. In general, people should move progressively upstream when poisoning pools, and no stream should be poisoned more than once a year.[3] This may well have made ecological sense; given the potency of poisons used it may have taken a considerable time for the fish population to recover between episodes. But the rule also emphasizes that poisoning a stream effectively restricted future fishing options - at least in relation to outcome that could be expected from a specific stream and technique. The important distinction between poisoning and other fishing techniques lay, I suggest, not in the quantity of meat obtained, as Beek and Kelly supposed, but in this ability to 'alienate' a resource, removing it in its entirety, rather than merely sampling from it (cf. discussion of the importance of 'subtractability' to the idea of common-property resources; Feeny *et al.* 1990:3).

Such ability to alienate others' access to a resource implies that rights to do so, rights that in some sense over-ride those of others, would be perceived as important. Beek (1987:105) reported that among Bedamuni fish obtained by poison were 'subject to formal ownership by the landowning clan' in much the same way as pigs and cassowaries (see also Kelly nd:2.8). The same may well have applied at Gwaimasi though, despite some probing, I elicited no definite statements to this effect. The limited number of occasions where poison was used during the survey did not allow definite patterns regarding identity of fishers to be discerned. In all cases, however, use of poison was reported at the village within a day or so, and the major part of any catch was brought in for general distribution.

The second observation deals with the response at Suabi, where at least 150 Kubo and others had settled around an airstrip opened in 1984, to increased intensity of fishing. Initially, all people living at Suabi had been accorded common access rights to the

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[3] Tufa, notes from October 16, 1987; the constraint was rationalized in terms of allowing new fish time to 'grow large' before reharvesting.

surrounding area in the manner traditionally associated with co-residency. As the community grew to well beyond traditional limits, however, pressure on resources increased. In late 1987 local land-owners sought to divide the previously communal land into individual holdings; among other things (as learned in 1991), each individual or group was to be assigned control over fishing in a particular stretch of river or stream.[4] In this case there was a direct and conscious relationship between increased unco-ordinated use of resources, the associated decline in both quantity and predictability of returns, and the move from an unrestricted to a limited-entry system (cf. Endicott 1991; McGrath *et al.* 1993).

7.1.2 **Fishing taboos**

Subsistence resources, including fisheries, may be managed and sustained not only through systems of tenure and use rights but also by the application of taboos that temporarily or permanently restrict exploitation (Ross 1978; Hames 1987; Johannes 1981, 1982). Whereas access rights prescribe those who may procure resources, taboos proscribe procurement. Kubo, however, imposed few restrictions on procurement or consumption of food resources, including fish.[5]

Kubo declared three species of bird and one lizard to be *toi̱*, taboo to all and never to be eaten, but no species of fish fell into this category; species not obtained during the survey were either scarce, inaccessible, or too small to be of interest. This fits well with Bulmer's more general observation that New Guinean societies are characterized by a "lack of formal traditional restraints on hunting most species of wildlife *as species*. The traditional restraints were mainly on hunting them in certain areas by certain people and at certain times" (Bulmer 1982:71; see also Barth 1975:Ch.18).

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[4] The attempt was strenuously resisted and, though at least some restrictions were operating in November 1991, argument for and against continues. Arguments used against limited entry included the observation that fish do not respect boundaries, and thus overfishing in one territory would continue to impact on others; in other words, it was asserted that access to fish could not be closed simply by limiting access to fishing locations.

[5] Knauft, writing of Gebusi people to the south of Kubo, similarly noted that "there are surprisingly few food taboos, with those that do exist tending to be either temporary or not particularly onerous" and that "there is no belief in sorcery through the use of food" (1985a:17).

In fact, with the one exception discussed above - that no-one should poison any stream that had been poisoned in the previous year - Kubo people imposed few generally applicable constraints on techniques or locations for fishing. Hunting pig and cassowary, or shooting birds from a hide, were, for Kubo, activities that necessitated appropriate ritual observance beforehand, thus restricting the freedom with which they could be undertaken (cf. Marks 1977, 1979). With the exception again of poisoning, no similar requirements applied to fishing.

Traditionally, Kubo clans each had a *toi sa*, a 'forbidden place' to which access was prohibited for all but ritual purposes; the Gumososo *toi sa* was an area of about 0.25 km^2 around the mouth of the stream Sigia, a little north of Gwaimasi, and the Gomososo *toi sa* presumably also lay within the local subsistence zone associated with Gwaimasi. Such reserves may provide refuges for wildlife, allowing survival and recovery of prey species (Bulmer 1982:70; see also Newsome's [1980] interpretation of certain 'increase sites' in Australia), but the two identified would have been inconsequential with regard to fish conservation given their small size and the limited variety of streams encompassed. By 1986, the status of the *toi sa* at Sigia had been compromised by the construction of a mining exploration camp within its bounds (see 2.1.7c). Local people had, with some qualms, assisted in the construction and during the survey displayed no hesitation in entering the site for the purpose of fishing (though they still did not hunt or garden therein). I knew of no other sites which were, or had been, taboo or that were perceived to hold particular threat for people in general.

During 1986-87, then, there were no major, generally applicable socio-cultural constraints acting to restrict fishing behaviour at Gwaimasi. This, however, does not mean that there were no specific constraints, applicable only to certain categories of persons within the community. The next section looks at variation between individuals in the ways that they fished, and interprets these in terms of categorical constraints on fishing behaviour.

7.2 CATEGORICAL CONSTRAINTS

A total of 31 people considered themselves, or were considered by others, to be residents of Gwaimasi for some or all of the survey period (Table 2 in 2.2.2). Some of those 31, however, were not around for long enough, or through an adequate range of

Table 33 Surveyed residents of Gwaimasi - that is, those who were at Gwaimasi or within the local subsistence zone for at least one-third of all days with each of the four rainfall types during the survey.[a]

NAME	AGE[b]	MARITAL STATUS[c]	CHILD BORN IN SURVEY	AFFILIATION[d]
male				
GUGWI	45	M		U
SIMO	40	M		U
BISEIŌ	40	M	+	U
MAMO	35	M	+	D
GWASE	28	U/M		D
FILIFI	25	U		U
SINIO	22	M	+	U
MAUBO	20	U		D
DOGO	15	U		D
GAWUA	10	C		D
female				
GOGO	45	W		D
KOSE	40	M	+	D
SISIGIA	30	M		U
MABEI	25	M	+	U
GOGOI	22	M		U
WAFU	20	M	+	U
BOWA	20	U	+	D
YASOBIDUA	15	M		D
BOUA	10	C		D
YASIMO	7	C		U

[a] Children not yet capable of fishing (n = 2) have been excluded.
[b] Age in years is approximate.
[c] W - widow; M - married; U - unmarried; C - child.
[d] U - Up-gabo; D - Down-gabo; see Section 2.2.5 for details.

weather conditions, for a clear picture of their fishing behaviour to emerge; people present for less than 33% of days in one or more of the four rainfall types identified in Section 6.2.2 have been excluded from analysis. In all, then, I have detailed information on patterns of fishing behaviour for 22 individuals. Two of those were children below the age of five who did not fish, and were probably not yet capable of fishing; I have excluded them from analyses concerning choice of fishing behaviour. All analyses in this and the next section concern the fishing behaviour of the remaining 20 individuals - referred to henceforth as 'surveyed' residents. That sample (Table 33) includes males and

Table 34 Number of successful fishing episodes, and number and weight of fish caught, by surveyed residents of Gwaimasi within the local subsistence zone.

	EPISODES	NUMBER	KG
GUGWI	64	173	95.6
SIMO	37	60	32.6
BISEIŌ	19	50	13.4
MAMO	11	20	17.9
GWASE	24	69	32.3
FILIFI	26	66	38.1
SINIO	31	86	70.9
MAUBO	44	106	58.3
DOGO	32	78	31.7
GAWUA	9	11	3.3
GOGO	6	53	3.9
KOSE	5	7	5.7
SISIGIA	39	117	28.3
MABEI	19	34	7.9
GOGOI	28	46	18.7
WAFU	6	6	1.5
BOWA	11	28	9.1
YASOBIDUA	2	2	0.3
BOUA	8	38	4.1
YASIMO	1	1	+

females of a variety of ages, marital statuses and stages of reproduction.

Apart from the very young children, all long-term residents of Gwaimasi caught at least one fish during the survey period. The amounts caught, however, as shown in Table 34, varied enormously between individuals. Gugwi caught 173 fish weighing a total of 95.6 kg in 13 months (an average of 238 g of fish per day). Yasimo, on the other hand, caught only one fish, of 48 g, in the same time.

Raw numbers, of course, are not directly comparable as indicators of relative fishing behaviour. Gugwi was present, either at the village itself or somewhere in the local subsistence area, for 363 of the 399 days of the survey. Sinio, in contrast, was present for only 267 days. Clearly, Gugwi had much more opportunity to contribute fish to my records. But correcting for available days is not enough; the rainfall conditions affecting those days must also be considered. Most (76%) of Biseiō's absences were during dry months when, as shown in the previous chapter, fishing potential was at its peak. He thus missed considerable opportunity to fish. Sinio's many absences, in contrast, were predominantly (77%) in wet months, when fish were significantly more difficult to obtain, so had less impact on his potential catch. What needs to be compared are the catch per day that could have been expected if all individuals, fishing at their observed rates for different weather conditions, had been present for the entire survey period. Analyses in the rest of this chapter have adjusted individual catch rates, whether recorded as successful episodes, as numbers of fish or as weight of fish, accordingly.[6] No resident was actually present at the village for the entire survey, and comparisons based on the catch that could be expected over that time would exaggerate differences. In comparing individuals, therefore, I have chosen to standardise catches to rates expected per 100 days. Because no long-term resident was present for less than 100 days, the adjusted values are all less than actual records and thus are statistically conservative. (The choice of 100 days as a scale facilitates comparison with the general rates of production discussed in Chapter 6.)

Finally, differential access to fishing locations has to be considered in comparing individual catch rates. While people were based at Gwaimasi this was not a problem (at least in terms of physical access). But people spent, on average, more than a quarter of their available time away from the village, usually at family bush houses. Those houses were widely scattered; Mamo's primary bush house lay beside the stream Sigia, while Gugwi and Biseiõ shared a house beside Dege, Gogo's family had their house near Doua,

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[6] The equation used for calculating these adjustments was:

$$R_a = \frac{\sum_{i=1}^{4} (x_{a_i} / d_{a_i}) D_i}{\sum_{i=1}^{4} D_i}$$

where

R_a	=	adjusted catch rate for individual a
x_{a_i}	=	actual catch during rainfall type i by individual a
d_{a_i}	=	number of days present with rainfall type i for individual a
D_i	=	number of days with rainfall type i in survey

Appendix 5 provides details of the actual catch and residency data from which the adjusted values in Table 35 have been calculated.

a minor tributary of Dege, and Simo's house was across the Strickland River near Duwa, a tributary of Auti (see 2.1.5). The previous chapter showed that these different streams had very different fishing potentials in terms of kinds, numbers and sizes of fish obtained from them. People staying at the different houses, therefore, could be expected to have somewhat different catch rates. The discrepancies could have been further complicated by variation in the size and composition of households and family clusters using each house. The rest of this chapter, therefore, concentrates on analysis of patterns in VILLAGE-based fishing, where both geographical constraints and community organization can be assumed constant for all. Only fish caught on day trips from the village, and days that both began and ended at the village, are included.

Table 35 presents adjusted catch rates for village-based fishing - that is, the number and weight of fish that each long-term resident could have been expected to obtain per 100 days spent at the village, and the number of successful fishing episodes entailed, given his or her observed catch rates in different weather conditions. Despite the adjustments that have been made to remove extraneous sources of variation, variation in productivity between individuals remains high. Some of that variation will reflect different choices made by individuals. Kubo males, in particular, tended to specialise in one or more meat-getting strategies; Gugwi, for example, brought in much fish but almost no pig or cassowary while Mamo, who caught few fish, shot more cassowaries than anyone else in the village (Dwyer & Minnegal 1991a,b; see 7.3 for further discussion).[7] But not all the variation can be attributed to idiosyncrasies of choice. At least some reflects the different social constraints within which individuals had to operate.

Each of the following sections deals with an aspect of social differentiation at Gwaimasi, and with associated patterns of fishing behaviour. In each case, I first analyse fishing records to reveal patterns. Then I seek explanations for those patterns (or their absence) in the different constraints that social identity imposes on abilities and requirements of the fisher.

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[7] Because of this tendency to specialise it is unlikely that fishing returns were normally distributed. Non-parametric statistical tests have thus been used throughout this chapter. For unrelated samples - eg. comparing the catch by individuals in different categories - the Mann-Whitney U test (for two samples) or Kruskal-Wallis test (for >2 samples) is used. The χ^2 test is used where data consist of frequencies - eg. episodes. For related samples - eg. comparing the catch by particular individuals in different seasons - the Wilcoxon signed ranks test (for two samples) or the Friedman χ_r^2 test (for >2 samples) is used.

Table 35 Adjusted catch rates for village-based fishing by surveyed residents of Gwaimasi.

		CATCH PER 100 DAYS[a]	
	EPISODES	NUMBER	KG
GUGWI	15	36	15.8
SIMO	16	19	14.4
BISEIÕ	4	9	2.1
MAMO	2	2	1.3
GWASE	8	20	9.4
FILIFI	6	13	8.5
SINIO	12	35	28.6
MAUBO	11	26	14.5
DOGO	10	21	8.0
GAWUA	4	5	1.6
GOGO	2	17	1.8
KOSE	3	4	3.2
SISIGIA	10	14	6.3
MABEI	7	8	2.4
GOGOI	8	10	3.4
WAFU	3	3	0.6
BOWA	4	11	2.7
YASOBIDUA	2	2	0.4
BOUA	2	2	0.3
YASIMO	-	-	-

[a] Standardised to amounts expected per 100 days if the person concerned had been present for the entire survey fishing at observed rates in each rainfall type; see footnote 6 for details of calculation.

7.2.1 Gender

In small-scale societies like that of Kubo the predominant bases of social differentiation have usually been identified as 'age, gender and personal characteristics' (Kelly nd:Intro.3; see also Barnard & Woodburn 1991:7; Berreman 1981; Cashdan 1980; Flanagan 1989; Woodburn 1982). Of these, gender has received most attention. This section considers the ways in which gender-related differences in fishing behaviour result from, and may contribute to, social differentiation by gender in Kubo society.

Women at Gwaimasi had, on average, significantly lower catch rates for village-

Table 36 Comparison of catch rates from village-based fishing achieved by the 10 male and 10 female surveyed residents of Gwaimasi.

(a) Catch expected per 100 available days (kg)

	NUMBER		KG	
	$\bar{x}$	range	$\bar{x}$	range
MALES (n=10)	18.6	2 - 36	10.4	1.3 - 28.6
FEMALES (n=10)	7.1	0 - 17	2.1	0 - 6.3
	Mann-Whitney U test[a]			
	$z=-2.38$, $p<0.02$		$z=-2.46$, $p<0.02$	

[a] Calculated using the individual catch rates given in Table 35; probabilities are two-tailed.

(b) Number and sizes of hauls and of fish (pooled data)

	NUMBER[a] OF EPISODES	NUMBER PER EPISODE $\bar{x}$	WEIGHT (g) OF FISH $\bar{x}$
MALES	167	2.2	558
FEMALES	77	1.8	302
	$\chi^2=33.2$, df=1, $p<0.0001$	Mann-Whitney U test[b]: $z=-2.37$, $p<0.02$	$z=-6.40$, $p<0.0001$

[a] Standardised to the number of episodes that would have occurred had the person-days available to each gender been no more than those available to the other gender in each rainfall type; see footnote 8 for details of calculation.

[b] Probabilities are two-tailed.

based fishing than did men ($p<0.02$; Table 36a). In fact, the 10 males averaged five times the daily catch rate obtained by the 10 females, while the median catch rate for males (89 g/day) was four times that for females (21 g/day); no female actually achieved the former rate. Table 36b provides a breakdown of the difference in terms of frequency and size of hauls and of fish caught by males and by females.[8] It seems males achieved their higher rates of production by fishing more often, by catching more fish per episode, and by catching larger fish.

Despite the difference in overall productivity the females' hauls included nearly every species caught by males and came from every stream system, if not every stream, that males fished (Table 37a and 37b). There was a considerable difference, however, in the contributions that different species, and different streams, made to the catch of males and females respectively. In particular, females fished far less frequently than men in streams of the backswamps, and caught proportionately fewer of the eeltailed catfish that were mainly found in those streams. On the other hand, females fished comparatively more often in streams of the eastern foothills, and from them contributed nearly all the small gudgeons caught.

There was a marked difference in the fishing techniques used by men and by women. Table 38 presents a breakdown of catch by technique for males and for females, as a percentage of known-technique captures. Males obtained around half of all their fish (49% by number, 51% by weight) by diving with spears. Females caught none by that technique. The absence of spearfishing from the repertoire of techniques used by females

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[8] Where comparisons between categories of individuals are based on pooled data actual catches, whether measured as successful episodes or as number or weight of fish, have been standardized to the catch that would have been expected had fisher-days available to the category in question been no more than those available to any other category. If, for example, men were based at the village for a total of 300 days in DRY-dry weather, and women for only 200 days, then the comparative catch by men would be ⅔ their actual catch - ie. the amount men would have caught in 200 fisher days. The adjusted values which result are not arbitrary, and are statistically conservative.

The equation used for these adjustments was:

$$X_a = \sum_{i=1}^{4} (\sum x_{a_i} / \sum d_{a_i}) d_{i_{min}}$$

where

	X_a	=	adjusted catch for category **a**
	$\sum x_{a_i}$	=	sum of catch during rainfall type i by members of category **a**
	$\sum d_{a_i}$	=	sum of days present with rainfall type i for members of category **a**
	$d_{i_{min}}$	=	minimum number of person-days with rainfall type i for any of the categories.

Table 37 Contribution of different species and streams to the catch from village-based fishing by surveyed male and female residents of Gwaimasi (actual numbers are given).

(a) species composition of catch

SPECIES GROUP	NUMBER CAUGHT	
	MALES	FEMALES
FORKTAILED CATFISH (6)	204 (6)	83 (6)
EELTAILED CATFISH (5)	62 (5)	6 (3+1)
PERCH (4)	80 (2+2)	6 (3+1)
GUDGEONS (4)	10 (3)	62 (2)
EELS (1)	3 (1)	–
OTHERS (3)	3 (2)	1 (1)

Numbers in parentheses indicate number of species represented within each species group in the village-based catch + additional species caught while based elsewhere in the local subsistence zone.

(b) location of successful episodes

STREAM SYSTEM	NUMBER OF EPISODES	
	MALES	FEMALES
STRICKLAND RIVER	105	67
DEGE SYSTEM (10)	51 (9)	8 (6+2)
SIGIA SYSTEM (3)	8 (2+1)	– (+1)
OTHER WEST STREAMS (7)	1 (1+2)	4 (3+1)
EAST SWAMP (4)	2 (1+3)	– (+1)
EAST FOOTHILLS (11)	8 (3+2)	5 (4+5)

Numbers in parentheses indicate number of named streams represented within each stream system in the village-based catch + additional streams fished while based elsewhere in the local subsistence zone.

to catch fish is reflected in greatly reduced frequency of fishing in swamp streams and reduced representation in the catch of species differentially found in those streams. But the absence of spearfishing alone is not sufficient explanation for the differences in male and female catch rates.

The other major fishing technique used at Gwaimasi entailed use of baited lines; it contributed at least 45% of the catch by males and over 90% of that by females. Though

Table 38 Contribution of major fishing techniques to the village-based catch obtained by surveyed male and female residents of Gwaimasi.

	percent of catch where technique reported by		
	LINE	SPEAR	OTHER
by NUMBER			
Males	46	49	5
Females	91	-	9
by WEIGHT			
Males	45	51	4
Females	97	-	3

both males and females used this technique they differed significantly in the catches achieved. Table 39 presents details of catch rates from linefishing in the Strickland River by males and females respectively.[9] The average catch rate for the ten males was still more than twice that for the ten females ($p < 0.1$). As might be expected, given that linefishing allows only limited control over choice of target species within a particular stream, there was no significant difference in the sizes of fish caught by females and males. The difference in catch rates arose because, even with lines, males fished more often than females and caught more fish per successful episode.

While a greater frequency of fishing could simply reflect stronger motivation (which itself would need explanation) the difference in haul sizes obtained by males and females suggests some difference in fishing practices. Either males were setting more lines at a time than females or they were tending their lines more closely. Table 40 presents details of inferred linefishing strategies used by males and females respectively. Males were more likely to tend lines than were females ($p < 0.04$). Males also used multiple set lines relatively more frequently than females, but the difference was not significant. It seems the difference in linefishing catches of males and of females was primarily related to the fact that males were more likely to invest the time required to tend lines.

[9] At least 90%, by weight, of fish caught by line, and 98% of those caught by men using this technique, came from the Strickland River. For comparative purposes, therefore, I have concentrated on this category.

Table 39 Comparison of catch rates from village-based linefishing in the Strickland River achieved by the 10 male and 10 female surveyed residents of Gwaimasi.

(a) Catch expected per 100 available days

	NUMBER		KG	
	$\bar{x}$	range	$\bar{x}$	range
MALES (n=10)	8.6	1 - 20	4.7	0.2 - 12.5
FEMALES (n=10)	3.8	0 - 11	1.8	0 - 5.8
	Mann-Whitney U test[a]			
	z=-1.70 p<0.1		z=-1.63 p=0.1	

[a] For individual catch rates from which these statistics were calculated, see Appendix 5; probabilities are two-tailed.

(b) Number and sizes of hauls and of fish (pooled data)

	NUMBER[a] OF EPISODES	NUMBER PER EPISODE $\bar{x}$	WEIGHT (g) OF FISH $\bar{x}$
MALES	97	1.6	549
FEMALES	58	1.3	489
	χ^2=4.91 df=1 p<0.05	Mann-Whitney U test[b] z=-1.96 p=0.05	z=-0.49 NS

[a] Standardised to the number of episodes that would have occurred had the person-days available to each gender been no more than those available to the other gender in each rainfall type; see footnote 8 for details of calculation.

[b] Probabilities are two-tailed.

Changes in fishing rates with weather conditions reveal another aspect of the difference between male and female fishing behaviour. Table 41 shows male and female catch rates, by number and by weight, for the four rainfall conditions distinguished in the

Table 40 Linefishing strategies used by surveyed male and female residents of Gwaimasi.

	NUMBER OF SUCCESSFUL EPISODES[a]			
	set lines	tended lines[b]	set lines (minimum number) 1	set lines (minimum number) >1
MALE	81	16	63	18
FEMALE	55	3	45	9
	$\chi^2 = 4.42$, df = 1, $p < 0.05$		$\chi^2 = 0.48$, df = 1, NS	

[a] Standardised to the number of episodes that would have occurred had the person-days available to each gender been no more than those available to the other gender in each rainfall type; see footnote 8 for details of calculation.

[b] Defined as episodes in which more than two fish were caught.

previous chapter - effectively drier to wetter.[10] Men's fishing productivity clearly varied with weather. There was a very strong tendency - showing, in fact, in the patterns of all individual males except Biseiō[11] - for the catch from fishing to reduce with increasing rainfall; in the wettest times men were actually obtaining fewer fish on average than were

[10] For comparisons across rainfall conditions, the actual catch by a given category of people has been standardized to the catch that would have been expected had fisher-days available to that category during the rainfall conditions in question been no more than those available to any other category in any of the four rainfall conditions.

The equation used for these adjustments was:

$$X_{a_i} = (\sum x_{a_i} / \sum d_{a_i})\, d_{min}$$

where

X_{a_i}	=	adjusted catch for category **a** in rainfall type *i*
$\sum x_{a_i}$	=	sum of catch during rainfall type *i* by members of category **a**
$\sum d_{a_i}$	=	sum of days present with rainfall type *i* for members of category **a**
d_{min}	=	minimum number of person-days within any one rainfall type for any one category.

[11] See 7.2.2c for the probable explanation of Biseiō's anomalous pattern.

Table 41 Comparison of catch rates from village-based fishing achieved in different rainfall conditions by male and female residents of Gwaimasi.

RAINFALL TYPE	NUMBER[a]		KG[a]	
	Male	Female	Male	Female
DRY-dry	144	28	92.0	10.9
wet	97	29	41.2	10.9
WET-dry	37	16	20.0	4.5
wet	19	28	11.7	6.0
	Friedman χ_r^2 test[b]			
	$\chi_r^2=17.49$ df=3 $p<0.001$	$\chi_r^2=1.77$ df=3 NS	$\chi_r^2=15.87$ df=3 $p<0.01$	$\chi_r^2=3.63$ df=3 NS

[a] Standardized to the amount that would have been obtained in 337 days, the minimum number of person-days either males or females were present for any rainfall type; see footnote 10 for details of calculation.

[b] For individual catch rates in each rainfall type, from which these statistics were calculated, see Appendix 5.

women (though they were still getting more by weight; the fish were larger). Women's fishing, in contrast, showed no such consistent trends in response to changes in weather; catch rates remained much the same throughout.

Much of the drop in male fishing catches with increasing rainfall can be traced to their reliance on spearfishing. The visibility, and hence accessibility, of fish in swamp streams was strongly affected by short-term rainfall patterns, and both frequency of spearfishing episodes and their duration, as measured by mean number of fish speared per episode, reflected this (6.3.2). But linefishing, too, was affected by rainfall. Both males and females show a significant decline in their frequency of linefishing in the Strickland River when monthly rainfall rose above 300 mm ($\chi^2=38.23$, $p<0.001$ for males and $\chi^2=5.90$, $p<0.02$ for females; Table 42). Interestingly, however, the linefishing activity of males dropped significantly more than that of females. Again, this difference can be partly attributed to differences in strategies used by males and females; tended-line fishing, a strategy predominantly used by males, was dropped almost entirely in the wetter months (6.3.2). But males also dropped their frequency of set-line fishing in wetter months significantly more than did females. In fact, male and female rates of set-line

Table 42 Comparison of linefishing strategies used in the Strickland River for village-based fishing by surveyed male and female residents of Gwaimasi, with rainfall below (DRY) and above (WET) 300mm per month.

	EPISODES[a]					
	ALL TYPES		SET LINES	TENDED LINES	SET LINES	
	Male	Female			Male	Female
DRY	73	33	88	18	58	30
WET	15	16	31	1	15	16
	$\chi^2=4.05$ df=1 $p<0.05$		$\chi^2=4.57$ df=1 $p<0.04$		$\chi^2=2.95$ df=1 $p<0.09$	

[a] Standardized to the number of episodes that would have occurred in 725 days, the minimum number of person-days either males or females were present for either rainfall type; see footnote 10 for details of calculation.

fishing were effectively identical in wet months.

Although the catch rate from linefishing by women dropped much less with increased rainfall than that achieved by men the drop was significant. Yet their overall catch rates showed no consistent drop. In fact, as availability of fish from the Strickland declined women increased their use of other techniques; they fished more often, with lines and by hand, in streams other than the Strickland. The catches obtained by these techniques were slight, but men showed no equivalent attempt to compensate for declining production in this way.

In summary, then, women produced small quantities of fish, infrequently, but at a fairly consistent rate through the year. Men, on average, produced much larger quantities, more often, but only if the weather was suitable. What lies behind these differences?

* * * * *

Differences in the subsistence activities of men and women have generated an extensive literature (eg. Burton & White 1984; Chapman 1987; Dahlberg 1981; Ember 1983; Endicott 1981; Hurtado *et al.* 1985; Lee 1979; O'Brien & Tiffany 1984; Schlegel &

Barry 1986; Sillitoe 1985; see Mukhopadhyay & Higgins 1988 for a recent review). Much of that literature has focussed on establishing, and challenging, the generality of patterns in those differences. While details and precise formulations vary, the general conclusion seems to be that men pursue resources or procurement strategies which produce relatively high returns at irregular intervals; women pursue activities that produce smaller returns, more regularly. The difference between male and female fishing behaviour at Gwaimasi outlined above - that men caught larger hauls of fish than women but with less consistency[12] - fits fairly neatly into this pattern.

Most explanations for these gender-related differences in procurement behaviour take one of two forms. The first emphasises the complementarity of the different strategies, and interprets them as a more-or-less sensible division of labour, enabling the integration of spatially and temporarily incompatible activities within the one procurement system or maximising quantity and quality of resources available to the group (eg. Dwyer 1986; Quiatt & Kelso 1985; Kelly nd:2.90). At Gwaimasi, for example, much fishing took place in streams of the back-swamps. Another major subsistence activity - processing sago - also was focussed in those swamps (3.1.2). The two activities were incompatible, the latter requiring a period of concentrated effort at a particular location on land while the former entailed roaming the waterways. Labour was divided accordingly; those who processed sago (women) did not usually fish the backswamps.[13] This is, as it turns out, a major source of the discrepancy in male and female production of fish. But it does not explain that discrepancy.

The implicit or explicit appeal to group-selection (Wynne-Edwards 1962; see discussion in Smith & Winterhalder 1992a:29-32) on which interpretations like the above are based has been strongly criticised (Maynard Smith 1964; Lewontin 1970; but see Boyd & Richerson 1985:Ch.7; Harpending & Rogers 1987; Richerson & Boyd 1992:82-85; Wilson 1983). The primary difficulty that I see, however, lies in explaining why such a

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[12] Fishing was only one component of subsistence, or even of meat-getting, at Gwaimasi. Relative frequency of hauls is thus less significant than relative consistency; resources other than fish were available to fill gaps in the procurement schedule.

[13] Not all backswamps fishing was associated with sago-processing ventures. On several occasions women accompanied their husbands to the backswamps on trips that had the sole purpose of procuring fish. The women still did not fish. Indeed the only occasions when women did fish in the backswamps no males capable of fishing were present.

division of labour should follow gender lines. Why should it always be women who processed sago?

The second set of explanations accepts the logic of a complementary division of labour, as discussed above, but seeks gender-specific constraints that might cause the division to lie where it does. Attention is thus shifted from the product to the producer; men are the ones who fish, it is argued, because something about them means they cannot process sago.[14] Explanations invoking physical constraints, such as strength, speed, or the ability to concentrate on repetitive tasks (eg. Murdock & Provost 1973; Moir & Jessel 1991; see criticisms by Burton *et al.* 1977; Burton & White 1984), can explain statistical differences in behaviour but not absolute distinctions. Ability to bear children has no effect on capacity until actualized, and there is no intrinsic need for child-care to be the domain of one sex or even the parent (see criticism by Halperin [1980:396] of Brown [1970]; also Kelly nd:2.29; cf. Hurtado & Hill 1990; Hurtado *et al.* 1985; Jochim 1988). The relevant difference, it seems, lies not in objectively measured attributes but in socially defined ones - not in sex but in gender; the cultural formulation of gender attributes turns the analogical differences between individuals into digital distinctions between categories (Wilden 1972). Explanations have thus focussed on identification of social constraints that directly or indirectly restrict the targets, the techniques or the locations of subsistence activities according to gender.

There were, at Gwaimasi, no gender-specific restrictions on the types of fish, that could be consumed. Indeed, like other Strickland-Bosavi groups (Knauft 1985a; see footnote 5), Kubo had few permanent restrictions on any foods.[15] Kubo did, however, mark certain social and physiological transitions with temporary status-related restrictions. Because many of these states mark physiological changes that differentially affect women - eg. menstruation, pregnancy, lactation - such restrictions have frequently been interpreted

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[14] Or *vice versa*. In fact, such formulations are almost always expressed in terms of the limited abilities or opportunities of women, not of men. This no doubt reflects western culture's evaluation of gender-segregated tasks; men's options are seen as more desirable than those taken by women (Strathern 1988; Haraway 1989).

[15] In 15 months I encountered only one possible restriction of this sort; Kubo men did not eat, and may not have been permitted to eat, the entrails of pigs.

as gender-specific.[16] Kubo, however, emphasized the social, not the physiological, aspects of these transitions. Thus even temporary status-related restrictions tended to apply equally to men and to women; husbands, for example, were subject to exactly the same taboos as their menstruating, pregnant or lactating wives (see 7.2.2c).[17] The differences in fishing behaviour of males and females at Gwaimasi, therefore, cannot be explained in terms of constraints on the direct benefits to be gained from different decisions.

In addition, there were no gender-specific restrictions on catching any species of fish, or on fishing in particular streams.[18] The catches obtained reflect this; as noted before, the women's haul included nearly all species caught by men (the four exceptions were represented by only 11 specimens of the total 1052 fish caught by surveyed residents within the local subsistence zone) and came from every stream system, if not actually every stream, that men fished.

There were, however, very clear gender-specific differences in access to fishing techniques - differences that ultimately influenced not only the amount of fishing that could be done but also the likelihood of using any particular location and of catching any particular type or size of fish. In particular, women at Gwaimasi did not spear fish and rarely invested the time to tend lines when fishing in the Strickland. I will discuss the two separately.

Spearing was a convenient and flexible technique for procuring fish. The equipment required was fairly simple, and the traditional version of that equipment freely available in the bush. Large hauls could be obtained by spearfishing - more than 12 kg in four hours on at least one occasion - but the method was just as appropriate for catching a

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[16] Restrictions on consumption of food have also often been interpreted as functioning to manipulate physiological states - and thus to manipulate the fertility and fecundity of women (eg. Speth 1990, 1991; Spielmann 1989).

[17] The one exception in relation to fish, in fact, affected not women but recently-initiated men, who could not eat certain fish (see 7.2.2a). The previous initiation had been held two years before our arrival, long enough - though only just - for this restriction to have lapsed, so none of the long-term resident males at Gwaimasi fell into this category.

[18] Again, in 15 months I encountered only one gender-specific prohibition on access to a given location; women were not to visit the caves on Gomososo land from which large numbers of small bats were occasionally harvested.

quick lunchtime snack. Perhaps most importantly, in the country around Gwaimasi one would seldom be more than a few hundred metres from a stream suitable for some diving.

And yet, women did not spear fish. Since the distinction was absolute I must conclude that their failure to do so was a matter of constraint, not of choice - women were, in some way, **unable** to spear fish. And clearly, since women can swim, and do dive with spears for fish elsewhere[19], the constraint was not physical but social.

Beek (1987:52) reported that among Bedamuni the use of 'stabbing' implements was taboo to women; they were, he said, not even to use small pointed sticks to catch spiders. This would certainly have ruled out spearfishing. But Kubo women were not subject to such a rule. Small girls at Gwaimasi, up to at least ten years old, played publicly with bows and arrows, and women freely carried their husbands' hunting equipment if the men were otherwise burdened.

This does not mean that a woman's use of such implements to kill game would have received approval or, more importantly, that a girl would receive encouragement to develop the skills associated with her toy. An indication of the importance of those skills lies in the fact that Gawua, at ten and despite having his own fish-spear, did not succeed in catching a fish by this technique during the survey. (By contrast, even the girl Yasimo, at seven, managed to catch a fish with a baited line.) Play may be an important basis for development of necessary skills (Hames 1992:227-8), but 'participation and emulation' are also necessary (Woodburn 1982:438). Kubo children learned through exposure to the skills of others by accompanying them on expeditions, and by at least some direct advice and instruction.[20]

This requirement for transmission of knowledge provides a mechanism for restricting access to effective use of spearfishing as a technique, but the restriction need not have been conscious, or even expressly imposed by the possessors of the knowledge. Kubo girls were dressed from birth; the need to hide their genitalia from male view was impressed upon them from that time. Thus while men regularly swam and dived naked a

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[19] At Suabi, in November 1991, several Kubo women and girls had their own fish spears and regularly obtained fish by this technique.

[20] On one occasion I watched several men and youths instructing three-year-old Okire in how best to shoot a small mammal with bow and arrows, encouraging him to use for target practice a rat that had been trapped alive.

female who wished to learn from experienced spearfishers - all of whom, at Gwaimasi, were males - would have had to put up with the inconvenience of a dress while swimming and of wet clothes afterwards.

Whatever the precise mechanism - explicit prohibition, denial of tuition, or lack of interest in the light of inhibiting factors - women lacked access to use of a major fishing technique used by men. Consequently they had little access to the larger species of catfish, and limited means of procuring fish from backswamp streams. (Both trapping and linefishing could be used in such streams, but each entails a degree of delay in returns, and cannot be simply substituted for spearing as a procurement strategy.)

In contrast to spearfishing, women were clearly free to use lines to catch fish, and had the knowledge and experience to do so. Yet, with this technique too, women fished less frequently than men, and in different contexts. In this case the reason did not lie in constraints on use of the technique. Rather it lay in constraints on access to the necessary equipment and on opportunities to use that equipment to full effect.

Linefishing was not a traditional technique among Kubo (see 5.2.3b). It was, in fact, unknown 20-30 years before my survey, and no attempt had been made since then to manufacture the necessary equipment from local materials. That equipment - metal hooks and nylon lines - had to be obtained by trade. For much of the previous 30 or so years the source would have been traditional trading networks, but in 1985 a small trade store opened two days walk from Gwaimasi, to capitalize on the money that mining exploration had brought to the region. Most of that money went to men, but a few Gwaimasi women were employed on a project that occurred within the local area, and women shared in the earnings from communal commitments such as maintenance of the mining camp (see 3.1.6; after our arrival women at Gwaimasi also obtained money through sale to us of food and animal skulls.) The very thing that limited women's employment opportunities and thus earning ability, however, also limited their control over spending. For women a two-day journey - or rather, a journey that involved crossing the land of several intervening clans - was a major expedition, even if accompanied by husbands.[21] Most shopping, therefore, was done by males even when it was women's money being spent.

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[21] During the survey, men and youths from Gwaimasi averaged 4.9 trips each (n=52) to the communities of Suabi and Dahamo, the closest at which trade stores were located. Women, in contrast, averaged only 1.3 trips (n=12) to these communities.

The resultant control that men exercised over access to fishing lines was by no means absolute - women definitely owned their lines - but obtaining replacements for lost lines or hooks was often dependent on men's whims. So women generally had fewer lines, and needed to be more careful with the lines they did have.

Relative freedom of movement affected more than just access to equipment; it also restricted access to fishing locations. Though women of Gwaimasi ranged at least as widely as men within the local subsistence zone (cf. Kelly nd:2.18) they had less independence of movement. Women could not just travel at will, or with whomever they chose, and certainly not alone. Consequently, they had less opportunity than men to visit the specific locations where fish were likely to be abundant - places, for example, where larger streams joined the Strickland - and which, because of the higher productivity, might warrant investment of time in tended-line fishing.

To some extent this was an ideological constraint; women were quite capable of travelling as freely as men but were not **supposed** to do so.[22] But there was also a practical component to the constraint. Women did not have access to canoes. Traditionally, Kubo women were prohibited from paddling canoes, with the result that travel to fishing sites across the river was entirely dependent on men.[23] Again, the effect would have been to reduce the viability of tended-line fishing as an option for women. And again, the lack of access to canoes, and thus to fishing strategies, had no relation to the actual capabilities of women versus men.

There is one last point to be made before moving on. At least 90% of women's fishing used a technique that was unknown 30 years before. And nearly 90%, by weight, of the fish women obtained came from the Strickland, a source of fish that was inaccessible 30 years before - too turbid for diving, too fast-flowing for traditional traps. It was possible to catch fish by line in smaller streams but women did so seldom (and men did so even less often). It seems likely that fishing by Kubo women (other than an

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[22] As Kelly (nd:2.29) has argued, the functional explanations usually offered for differences in male and female patterns of movement - "female vulnerability to raiding parties, tending non-pedal children, efforts to control female sexuality and the need to carry heavy loads long distances" - are often not plausible when examined more closely.

[23] In October 1991, Simo volunteered the opinion that the prohibition on women paddling canoes no longer applied, but gave the impression that this was a very recent development. I saw no Gwaimasi women paddling canoes in 1987-87 or in 1991.

occasional gudgeon snatched by hand from under a rock) may itself be a fairly recent phenomenon, and that it took place primarily where there were gaps in the pre-existing pattern of coordinated subsistence activities.[24] Thus, fishing by women had not encroached upon the primary domain of male fishing - the streams that drain the backswamps - despite the potential to do so.

The differences in fishing behaviour of males and females at Gwaimasi can thus be interpreted in terms of social constraints restricting women's access to fishing techniques, technology or locations - in other words, to the **means** of procuring fish.

Implicit in the notion of constraint is the idea of hegemony, of people being actively prevented from doing as they would otherwise choose. The assumption is that women, too, would choose to procure larger, more erratic resources if they were able to do so. But what would women at Gwaimasi have to gain by procuring the sometimes large, but often erratic, hauls of fish that men obtained by spear and heavy lines? Kelly (nd:Ch.2) has argued that the significant difference between these types of hauls and the smaller packages left for women, whatever the actual animals or techniques concerned, lies in their relative potential for wide distribution. The restricted access of Etoro women to hunting of pigs and cassowaries, and to poisoning of fish[25], he argued, effectively precluded them from attainment of prestige through demonstrated generosity; the small items that women obtained were rarely worth sharing beyond the immediate household.

Patterns in the division of labour can thus be seen to correlate not so much with category of organism or size and predictability of haul as with the exchange potential of products. But correlation alone does not indicate causality, and certainly not the direction of causality. Production for exchange need not be intrinsically more valuable than domestic production, and restriction of the former thus necessarily coercive. Recently a third approach to explaining the division of labour by gender has emerged, in which differences in the subsistence behaviour of men and women are interpreted as the product

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[24] See Bowdler (1976) for discussion of a similar process following the pre-historic introduction of linefishing to coastal southeastern Australia.

[25] Note that the activities to which Etoro women have restricted access are also those that Kelly associated with territorial definition of access rights (see p.222 above). The latter concerned control over production, while the current discussion concerns control over consumption. In both cases, however, the crucial interest is seen to lie in the ability to create a distinction between givers and receivers (see also Ingold 1986a:228).

of choice, not of constraint (eg. Jochim 1988; Hawkes 1990). The two genders, it is argued, may have very different goals motivating patterns of subsistence production. While Kelly argued that constraints reflected in the division of labour usually ensured that Etoro women lacked the wherewithal to engage in prestige-producing generosity, he noted (nd:2.38) that even when they had the means to do so - Etoro women did catch the occasional large or medium-sized animal - they did not. Beek (1987:145-53) too, describing patterns in the sharing out of meat among Bedamuni, noted that men and women distributed even similar items in different ways. In both cases women were less likely than men to distribute produce beyond their immediate household, irrespective of the size of the item. It seems that constraints on production were not necessary to prevent women participating in the 'prestige system'.

The possibility thus arises that division of labour by gender reflects different choices made by men and women in the light of their respective patterns of resource-distribution. The social rules which have been interpreted as acting as constraints on production may merely encode the effects of choice. If this is so, then explanations of differences in the subsistence activities of men and women must shift attention from constraints on production to constraints on consumption. Explanations for the different patterns of resource distribution by men and women have usually been sought in structural elements of social systems. Collier and Rosaldo (1981; see also Collier 1988), for example, have suggested that in 'simple' or 'brideservice' societies - of which the Strickland-Bosavi groups are assumed to be instances[26] - the organization of marriage results in gendered obligations of wife and husband to family and group respectively. Thus Collier and Rosaldo (1981:281) note that in these societies women feed their families while men distribute game to group members. Presumably subsistence behaviour will vary according to these different concerns.

But Collier and Rosaldo's argument continues to seek the explanation for behaviour in constraints on action itself, rather than in constraints on the outcome of action. The

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[26] Collier (1988:258) specifically nominated the Etoro as an ethnographic case to which the 'brideservice' model could be applied. Kelly (nd:7.1-74), however, has questioned both the model itself and its applicability in this case. Certainly the notion of 'brideservice' is difficult to reconcile with the description of Kubo marriage practice provided in Chapter 2. But the structure of the model, whatever its general or specific validity, provides a useful illustration in this discussion.

relevant constraint is now seen as lying not on what can be procured but on the use that can be made of the product. There remains the implication that women are structurally excluded from participation in an important domain of social action. This is not necessarily the case. Among both Etoro and Bedamuni the meat that women distribute only within the household is concealed, hidden from public view either actually or by not overtly displaying it. Kelly (nd:37-39) makes the valid point that if there were a structural obligation for women to provision only their households there would be no need for this concealment; the fact that a woman had obtained the meat would automatically mark it as not available for general distribution. It seems that women were subject to the same expectations of generosity as men, and thus could potentially have participated in the prestige system. They chose not to.

Kelly uses the above argument to refute the direction of causality implied in Collier and Rosaldo's model. The problem, however, may not lie in the **direction** of causality but in the presumption that the different goals of men and women were socially defined. A recent paper by Hawkes (1990) suggests an alternative. Hawkes recognized that men generally exploit resources that are more widely distributed, but saw the explanation for this as lying in sex, not in gender. Drawing on the theory of sexual selection as elaborated by Trivers (1972; Bradbury & Anderson 1987) she argued that males would maximize fitness by distributing food widely, thus building networks of obligation, while females would maximise fitness by retaining food within the immediate household (see also various papers in Betzig *et al.* 1988). Women and men thus could be expected to choose different procurement strategies. The organization of Hawkes' argument is very similar to that of Collier and Rosaldo; again, differences in the subsistence behaviour of men and women are interpreted as reflecting different choices made in the light of their respective optimal patterns of resource-distribution. In Hawkes' view, however, the distribution pattern itself is seen as the product of natural selection rather than imposed by aspects of social structure. Despite their superficial similarity, the two models predict rather different developments in the **ideology** of distribution, and thus the behaviour associated with it. In Hawkes' model everyone would prefer all neighbours - male and female - to be generous, and could be expected to penalize those who were not. Only men, however, have anything to gain by being generous themselves. Thus women could be expected to conceal food in the manner on which Kelly commented, in order to avoid being seen as, and penalized for, not sharing.

The different responses of males and females at Gwaimasi to changes in availability and accessibility of fish, as rainfall regimes changed, suggests that these two groups did indeed perceive the benefits to be gained from fishing rather differently.

For women, maximum benefit apparently lay in regular procurement of some relatively small quantity of fish. Little additional benefit was to be obtained by increasing the catch beyond this, so they did not greatly expand their set-line fishing activities as it became feasible to do so. But, on the other hand, if environmental conditions threatened to reduce return rates it was considered worthwhile to put in a bit of extra effort, or to use additional strategies such as linefishing in small streams for gudgeons, in order to maintain production. The slight changes in overall fishing productivity as weather conditions varied reflected changes in frequency of episodes, not in haul sizes.

Men, in contrast, apparently perceived maximum benefit as directly related to the quantity of fish procured. They expanded their fishing activities as environmental conditions permitted, by increasing the frequency of set-line fishing and the frequency and duration of spearfishing trips as well as by adding strategies such as tended-line fishing. In other words, they modified both frequency of fishing episodes and the size of hauls produced as weather conditions changed.

Available data concerning sharing at Gwaimasi are not detailed enough to assess whether these differences in male and female fishing behaviour reflect differences in the extent to which fish was shared. Those data are certainly inadequate for testing whether any differences in extent of sharing was structurally imposed or a matter of choice. That would require information about the consumers of particular fish. Nevertheless, some general observations can be made.

Fish brought back to Gwaimasi, whether caught by men or women, were regularly seen to be handed over to someone else, often someone of another household. Individual fish, however, were not usually subdivided before distribution.[27] The number of fish in a haul, therefore, rather than size or weight of particular fish, determined how widely an individual's catch would be distributed. Since men were more likely than women to obtain two or more fish in any episode, men's hauls were almost certainly shared more

[27] The original recipient might, of course, distribute portions of a fish further after cooking, depending on the availability of other meat in the community.

widely those obtained by women.

It remains possible that, over time, women did share as widely as men, distributing their few fish to different individuals on different occasions. There were five occasions on which a woman caught several fish, and for which rough details of distribution can be inferred from the names of those who later brought me the skulls. In each case, fish were distributed beyond the immediate household, once to at least four, once to three, and twice to two other households. But distribution was not as general as these cases would appear to indicate. Only once were skulls carried by people affiliated to other than the clan group of the fisher, and on that occasion the recipients were children. In fact, children apparently received at least half of all the fish on all five occasions.[28]

The suggestion that women were expected to share, but on a level different from that of sharing by men, is reinforced by an observation that has nothing to do with fish. Women of Gwaimasi occasionally killed large game animals - once even a big cassowary, flushed by a dog and killed by a thrown axe near the garden where the woman was working. In this and other cases the kill was attributed to the dog, not the woman. In analogous examples involving men, however (and dogs played a crucial role in most terrestrial hunting by Kubo), it was the man who received credit. Women may thus effectively have been defined out of the domain of wide-spread public generosity.

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It seems, then, that women at Gwaimasi differed from men both in their ability to procure fish and in the use that they could make of fish. Gender identity imposed constraints both on production and on consumption, and the ways that men and women chose to fish reflected their differing constraints. The relevant differences of ability and of requirements were not innate, being constructed, rather, through the different experiences of men and women respectively. Nonetheless, they can be considered intrinsic to the identity of fishers as Kubo men and women respectively.

Given the very different constraints within which males and females operated, their respective patterns of fishing behaviour cannot be considered comparable - they must be

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[28] This may have been related to the small size of the fish; most were *sa̱*, with an average weight of 35 g, the rest *bo*, averaging 94 g. Beek (1987:148) reported that Bedamuni women, too, distributed their produce mainly to children, but noted that men also were likely to give small items to children.

analysed separately. But in neither case did these constraints of gender **determine** individual behaviour. Within these constraints people still could, and did, do very different amounts of fishing, using different techniques and at different locations. Again, however, at least some of this variation can be traced to other levels of constraint. Gender concerns variation between individuals. But any individual also varies in his or her abilities and requirements through time.

7.2.2 Life-history stages

Age, like gender, has been identified as a major locus of social differentiation in small-scale societies (Barnard & Woodburn 1991; Flanagan 1989). I am concerned, here, not with age as a means of defining relative status of different individuals, but with age as an attribute of individuals themselves.

At first glance, physical age does not appear to have had much effect on fishing behaviour of people at Gwaimasi. Certainly there was no significant correlation between age and village-based fishing rates for either men or women. Nor was there any correlation between age and the proportion of fish that men caught by spear, that either men or women caught by linefishing in the Strickland River, or that women caught by other techniques (Table 43). But this does not mean that some patterning by age did not occur.

Accumulation of years cannot, in itself, affect fishing behaviour. Analyses that purport to discuss the effect of age on hunting performance are concerned with processes of growth and decline through time, rather than age itself; processes such as growth and decline of physical capacities, development of skills or experience, and achievement or loss through time of access to means of production (eg. Dornstreich 1973; Dwyer 1983; Ohtsuka 1990*a*; Ohtsuka & Suzuki 1990). The relevance of these different variables depends on the nature of resources and the means by which they are procured. Among Gadio Enga, for example, young men do most of the hunting, a fact which Dornstreich (1973:279) attributes to their youthful ability to meet demands for 'great physical exertion over short periods'. Much of the hunting in that community, however, entailed pursuit of pigs. Among Etoro, where small to medium animals dominated the catch, endurance was of more importance than strength, and older men hunted more, and more effectively, than younger ones (Dwyer 1983).

Table 43 Surveyed male and female residents of Gwaimasi ranked by age, by frequency and productivity of fishing, and by preference for major fishing techniques.

NAME	AGE	rank	RATE[a] eps	no.	wt	catch by SPEAR[b] rate	prop.
GUGWI	45	1	2	1	2	2	5
SIMO	40	2.5	1	6	4	8.5	9
BISEIŌ	40	2.5	8	8	8	7	4
MAMO	35	4	10	10	10	8.5	3
GWASE	28	5	6	5	5	4	6
FILIFI	25	6	7	7	6	3	1
SINIO	22	7	3	2	1	1	2
MAUBO	20	8	4	3	3	6	8
DOGO	15	9	5	4	7	5	7
GAWUA	10	10	9	9	9	10	10
						catch by LINE from river[b] rate	prop.
GOGO	45	1	8	1	6	6	8
KOSE	40	2	5	6	3	3	6
SISIGIA	30	3	1	2	1	1	5
MABEI	25	4	3	5	5	5	7
GOGOI	22	5	2	4	2	2	2
WAFU	20	6.5	6	7	7	7	1
BOWA	20	6.5	4	3	4	4	3.5
YASOBIDUA	15	8	7	8.5	8	8	3.5
BOUA	10	9	9	8.5	9	9	9
YASIMO	7	10	10	10	10	10	10

[a] Rank based on episodes (eps) and catch (no. and wt) expected per 100 days if each fisher had been present for the entire survey, fishing at observed rates in each rainfall type; see Table 35 and Appendix 5 for details of data.

[b] Based on the weight of fish that fishers would have obtained by the specified technique if each had been present for the entire survey, using techniques at observed rates in each rainfall type; see Appendix 5 for details.

Of the fishing techniques used by Kubo only one - spearfishing - made much in the way of physical demands. Diving did not require strength, or even endurance, so much as healthy lungs, keen eyesight to identify fish against cryptic backgrounds, and a tolerance for the temperature stresses of repeated immersion. Such attributes are unlikely to show major decline until late adulthood (Kawabe 1990, for example, suggested that visual acuity of Gidra people does not greatly decline before the age of 50). There were no males over the age of 50 at Gwaimasi, so the apparent lack of age-related decline in spearfishing may be an artefact of sample size.[29] Linefishing, in itself, made few equivalent demands on either performance or perceptual abilities. The use of canoes to reach prime fishing sites, however, did; both strength and endurance are required to haul a canoe upstream against the flow of the Strickland river. Since muscle strength usually declines steadily from early adulthood (Ohtsuka 1990b:50), it could be expected that young men would be more likely than older ones to engage in tended-line fishing in the Strickland River. This was, indeed, the case. All hauls of more than two fish obtained by men fishing in the Strickland River ($n = 25$) were obtained by those under the age of 30 ($\chi^2 = 36.4$; $p < 0.001$).

Development of skills and accumulation of experience, too, may be of differential importance for different activities. Efficiency in activities entailing search and pursuit are more likely to reflect experience, and thus the effect of age, than those requiring little more than mechanical skill (eg. Ohtsuka 1990*a*; Laughlin 1968). Spearfishing, then, is more likely than linefishing to show increasing efficiency with age. Again, sample size is too small to allow definitive statements but two observations are worth noting. First, Gawua, at 10, speared no fish during the survey though owning a spear and accompanying others on diving trips. Secondly, Dogo, who at 15 was the next youngest and a keen spearfisher, included more eeltailed catfish in his hauls (69% of 35 fish) than was usual for other men[30]; these species are less mobile during the day than the forktailed catfish and perch which other men targeted, and are obtained by besetting rather than active pursuit.

Finally, efficiency of some activities may be significantly improved by addition of equipment that is likely to be accumulated through time. Dwyer (1983), for example, attributed the enhanced hunting efficiency of older Etolo men relative to that of young men at least partly to the former's greater probability of access to a capable hunting dog. Similarly, Ohtsuka (1990*a*) noted that older Gidra men were more likely than young men to have access to a shotgun, with associated higher return rates in hunting. Among Kubo,

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[29] The one individual over the age of 50 for whom I have some data, a man of about 60 who lived three hours' walk to the south of Gwaimasi near Sosoibi (and who died of a respiratory infection in June 1987), did seem to rely on poisoning fish to a greater extent than anyone at Gwaimasi.

[30] Eeltailed catfish comprised, at most, 45% of the catch obtained by any male other than Dogo, and only 36% of the total 505 fish obtained by spear in the local area.

access to diving glasses could be expected to enhance efficiency of spearfishing. There was, however, no age-related difference in access to these glasses at Gwaimasi. Dogs or guns require time to acquire, either in breeding and training or in compiling the means for purchase. Diving glasses, in contrast, were comparatively cheap; the purchase price could be quickly acquired by any man - always provided that paid work was available. The equipment used in linefishing, the lines and hooks themselves, were consumables, and thus unlikely to be accumulated through time.

The passing of years, then, had little effect on the abilities of Kubo men and women to procure fish. But age refers to more than years. In fact, aging may be experienced less in terms of processes of development and decline than as the unfolding through time of sequential states of being.[31] While there may be a necessary order to these life-history transformations - eg. one will be a child before an adult, must be adult before mating and must mate before becoming a parent - the new forms are not necessarily logical outgrowths of the old and may entail quite new structures of expectation and obligation.

The following subsections deal with three of the significant transformations in Kubo life-history - initiation, marriage and reproduction - and discuss the ways in which status-related differences in abilities and requirements affected fishing behaviour at Gwaimasi. Small samples restrict the potential to identify patterns in actual fishing behaviour, but, in each case, differential constraints on production and consumption of fish can be identified and are discussed.

(a) Initiation

Just as gender can be interpreted as a cultural construct based only tenuously on the biological fact of sex, so those interested in age as an organizing principle are often concerned less with the biological fact of development and decline than with the cultural dichotomies that are imposed on that fact. Unlike sex, age is a continuous variable. Onset of menstruation, and later menopause, provide at least two overt markers of development in female lives. For males, however, there are no such unequivocally signalled biological transitions, no intrinsic discontinuities that would allow definition of

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[31] Hill & Kaplan (1988a,b; see also Chisholm 1993) have discussed the tradeoffs between alternative behavioural options which underlie transition between life-history states, and the way that states may constrain each other.

entities around which to structure relationships. In many societies, therefore, age is translated into the socio-cultural construct of initiation - of progressively accumulated (transmitted) knowledge, not years - in much the same way that sex is translated by the social construction of gender. Again, in this way, the analogical process of aging is digitalized into discrete stages that can be identified and marked (eg. Barth 1975; Wilden 1972). Differential application of taboos on foods that people in a given stage can eat, or activities in which they may participate, may act to establish a sense of common identity within age sets, or a sense of differential valuation and perhaps hegemony of some sets over others. Such constraints could certainly be expected to affect foraging decisions.

Kubo, like other groups of the Strickland-Bosavi region (Shaw 1990, Sørum 1982), held only a single initiation.[32] A year or more of casual preparation culminated in three days of ritual at which several young men from different clans, aged between 13 and 20, underwent ordeals, were given final instructions, and were dressed in the ritual finery required for participation as adults in the life of the wider community. Kubo women apparently were not initiated, but this may be understandable in that most were married at or before menarche (see 7.2.2b).[33] Initiation, for Kubo, marked not the progressive accumulation of knowledge but attainment of a new state in life, complete in itself (see Shaw's discussion, 1990:15-17; cf. descriptions of sequential initiation among the Mountain Ok, especially Barth 1975). Thus, the most salient aspect of the process for Kubo was the taking on of the accoutrements of adulthood; initiation was known as *kagia* (= cause to dress; cf. *kandila* as the equivalent term among Samo, Shaw 1990), and initiated men were called *ou kagi*, 'man who has been dressed'.

Kubo marked male initiation with restrictions on food - including fish - that could be eaten (see footnote 17). In particular, new initiates were expected to refrain from eating 'fatty' fish such as the eeltailed catfish *aiõdio*, as well as a range of so-called fatty or high-mucus foods (eg. sago grubs and leaves of the plant aibika (*Hibiscus manihot*). These restrictions, however, marked the transition, not the category created as a result,

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[32] In addition, a number of 'puberty rites' (Allen 1967) were performed for both girls and boys. Piercing of the nasal septum and tattooing the face were performed separately for each individual when considered appropriate.

[33] Shaw (1982, 1990), in contrast, reported that Samo initiated both men and women. It seems, however, that Samo women do not usually marry till their late teens or early 20s (as with Gebusi; Knauft 1985a:169).

and, as with most Kubo restrictions on food, were shortlived. The sense was of some danger to the future well-being of the man and his reproductive success during the liminal state. Thus, though there were community expectations as to the appropriate duration of the taboos, the youths themselves could chose when to resume eating restricted categories of food. Most had abandoned some restrictions within a few months and all within a couple of years. Nevertheless, for a year or more after an initiation was held the new initiates could be expected to display a marked shift of fishing behaviour in response to those taboos; *aiōdio*, the fatty eeltailed catfish specifically mentioned in relation to these restrictions, was a major target of spearfishing (see Table 15 in 6.2.1).

Initiation transformed not only the individual but also relationships between individuals. Among Kubo, the relationship established between co-initiates was very strong; these young men often travelled, hunted and courted together.[34] In effect, then, on initiation men moved out of the family context, with its mix of producers and consumers in any activitiy, into that of bachelor groups comprising only producers. Hunting and fishing practices may well have reflected this changed patterns of association.[35] But this, like the effect of initiation taboos, must remain a matter for speculation. Gawua, little more than a child, was the only uninitiated male among the surveyed residents of Gwaimasi; all other males surveyed had been initiated at least two years before my arrival.

(b) **Marital status**

Some three years after the adulthood signalled by initiation (when treefern had appeared in gardens planted for the ceremony) men were considered ready for the next transformation, that of marriage. Kubo women were usually married at or near the onset

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[34] The four eldest males at Gwaimasi were, in fact, a complete cohort of *samo* (= co-initiate), who had been initiated together about 20 years before.

[35] The other relationship established through initiation, that of *to*, between the initiated youth and his sponsors (male and female) was cemented by a gift of domestic pig at the culmination of the ritual. There did not seem to be any ongoing requirement for the initiate to provide meat to his sponsors in subsequent years, as Shaw (1990:150) described for the *tolo* relationship of Samo. (In fact Shaw stated that, until the initiate marries, the sponsor "is entitled to all meat that the initiate would normally eat himself" [*ibid*]. This was certainly not the case among Kubo.) Unlike Samo, Kubo initiates may have several sponsors, suggesting that the relationship may be comparatively diluted.

of puberty.[36] While gender and age have been suggested as the main idioms of social differentiation in small-scale societies, marriage has been proposed as the source of, and the mechanism for reproducing, that differentiation (Collier 1988; Collier & Rosaldo 1981; Meillassoux 1972; Wood 1987; cf. Kelly nd; Collier and Rosaldo attribute the effect of marriage to underlying relations of material production; Wood, following Turner 1979, prefers to trace it to relations of reproduction, of social production). Certainly marriage can entail the establishment of totally new relationships, and forms of relationship, for the individuals involved. As such it could be expected to result in changed patterns of fishing behaviour.

There were no significant differences in patterns of fishing behaviour for married versus unmarried females. This may be just a reflection, again, of small sample sizes - only three unmarried females were included in the survey. But marriage for a Kubo woman merely entails changing one household, containing both producers and consumers in any activity, for another. The obligations and expectations in the light of which she acts change little in the process. There thus seems no real reason to expect differences in fishing behaviour to result.

More surprisingly, perhaps, there also was no significant difference in the production of fish by unmarried and married males. The top three fishermen, judged by the number of fish caught, were all married but so were two of the three poorest producers. Similarly, while four of the five fishermen who procured the greatest weight of fish were married, so were two of the three who procured least. In fact, however, the great range of productivity within each category suggests a possible explanation for the lack of pattern. Individuals varied greatly in their interest and skills when it came to fishing (see 7.3). If we are to discern the effects of marriage on individual behaviour then this underlying variation must be taken into consideration.

Two male residents of Gwaimasi married during the survey. Table 44 compares the catch rates obtained by Gwase before and after his marriage with those obtained by

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[36] This may explain the absence of formal initiation of women; the two transformations have been effectively collapsed, with women having no state equivalent to that of bachelorhood where they associate primarily with their age-mates.

Table 44 Effect of marriage on Gwase's fishing behaviour: frequency of successful village-based fishing episodes, and number and weight of fish produced, in the period before and after Gwase's marriage on January 30, 1987.

	adjusted catch[a]		catch per 100 days	
	before (47 days)	after (160 days)	before	after
EPISODES				
Gwase	2	11	4.3	6.9
Other males	7.4	8.5	15.7	5.3
NUMBER				
Gwase	5	27	10.6	16.9
Other males	15.9	17.7	33.9	11.1
WEIGHT (kg)				
Gwase	3.3	12.6	7.0	7.9
Other males	9.1	9.9	19.3	6.2

[a] Records for males other than Gwase are standardized to those that would have been obtained in the number of days that Gwase was based at the village in each period. Other males were actually present for 624 person-days before the marriage and for 1070 person-days after the marriage.

other men during the same times.[37] Before his marriage, Gwase fished much less than

[37] When comparing the catch obtained by one individual during part of the survey with the average catch obtained by all others during the same period, actual catches are standardized to the catch that would have been obtained had fisher-days available to those others during the period of interest totalled no more than those available to the focal fisher.

The equation used for these adjustments was:

$$X_{(n-a)_i} = \frac{\sum x_{(n-a)_i}}{\sum d_{(n-a)_i}} d_{a_i}$$

where

$X_{(n-a)_i}$	=	adjusted catch for fishers other than **a** in the period i
$\sum x_{(n-a)_i}$	=	sum of catch actually obtained by fishers other than **a** during the period i
$\sum d_{(n-a)_i}$	=	sum of days that fishers other than **a** were present during period i
d_{a_i}	=	number of days that fisher **a** was present during period i.

To facilitate comparison of rates in different periods, records are also presented as catch per 100 days.

Table 45 Effect of marriage on Tufa's fishing behaviour: frequency of successful village-based fishing episodes, and number and weight of fish produced, in the period before and after Tufa's marriage on August 22, 1987.

	adjusted catch[a]		catch per 100 days	
	before (97 days)	after (29 days)	before	after
EPISODES				
Tufa	4	3	4.1	10.3
Other males	5.4	1.2	5.6	4.2
NUMBER				
Tufa	8	5	8.2	17.2
Other males	11.1	3.2	11.5	10.9
WEIGHT (kg)				
Tufa	3.5	2.3	3.6	8.0
Other males	5.7	2.2	5.8	7.5

[a] Records for males other than Tufa are standardized to those that would have been obtained in the number of days that Tufa was based at the village in each period. Other males were actually present for 1041 person-days before the marriage and for 239 person-days after the marriage.

average for other males. After marriage, however, he increased his fishing activities, at a time when others actually reduced their fishing by two-thirds. Tufa, the other man who married during the survey, was not present consistently enough to be included in the general analyses. His few records, however, reveal the same trends as those of Gwase; his frequency of successful fishing episodes, and the number of fish he procured per day, increased after his marriage in August 1987, though on average they declined for other male fishers (Table 45). It seems that, whatever their initial interest in fishing, men at Gwaimasi increase the rate at which they catch fish when they marry.

The increase in production of fish after marriage does not simply reflect more frequent effort. Table 46 presents a breakdown of catch by technique for married and unmarried males at Gwaimasi, as a percentage of known-technique captures. Unmarried men obtained two-thirds of all their fish (67% by number, 65% by weight) by linefishing in the Strickland River. Married, men, in contrast, obtained more than half of their fish by diving with spears (59% by number and by weight). Marriage, it seems, induced a

Table 46 Contribution of major fishing techniques to the village-based catch obtained by five unmarried and six married males at Gwaimasi.[a]

	percent of catch where technique reported by		
	LINE	SPEAR	OTHER
EPISODES			
Unmarried	77	22	2
Married	49	40	11
by NUMBER			
Unmarried	67	32	1
Married	33	59	8
by WEIGHT			
Unmarried	65	34	1
Married	34	59	7

[a] One surveyed male, Gwase, married during the survey and is thus included in both categories.

change in the ways that men fished, and not only in the amounts of fish that they produced. The greater catch rate achieved by males after marriage can be attributed almost entirely to one thing; they went spearfishing much more often than their unmarried counterparts ($p < 0.01$; Table 47). There was almost no difference in the average size of fish, or of hauls, that the two groups obtained by spearfishing. In contrast, there was no difference in the frequency with which married and unmarried men fished with lines. Unmarried men did, on average, obtain slightly larger hauls when linefishing than did married men, but this probably reflected the relative ages of men in the two categories rather than any preferences associated with marriage; young men were more likely to tend lines (see p.252), irrespective of marital status.[38] Though sample sizes in each case were small, both Gwase and Tufa matched the general shift to a relatively greater emphasis on spearfishing after marriage (Table 48).

Finally, married males at Gwaimasi were far more likely than unmarried males to

[38] The two youngest married men surveyed - Gwase and Sinio - both tended lines on more than one occasion after marriage. The four older men did not do so during the survey.

Table 47 Frequency of village-based fishing, and the average size of hauls and of fish obtained (a) with spears and (b) with lines in the Strickland River, by unmarried and married males surveyed at Gwaimasi (pooled data).

	NUMBER[a] OF EPISODES	NUMBER PER EPISODE $\bar{x}$	WEIGHT (g) OF FISH $\bar{x}$
(a) SPEARFISHING			
Unmarried	13	3.2	568
Married	34	3.3	603
	$\chi^2 = 9.38$ df = 1 $p < 0.01$		
(b) LINEFISHING			
Unmarried	46	1.9	512
Married	46	1.4	591

[a] Standardised to the number of episodes that would have occurred had the person-days available to each category been no more than those available to the other in each rainfall type.

Table 48 Effect of marriage on spearfishing by Gwase and Tufa: frequency of successful village-based spearfishing episodes before and after the marriages of Gwase and Tufa respectively.

	EPISODES per 100 days[a]	
	before	after
Gwase	-	3.8
Other males	3.4	2.7
Tufa	2.1	0.6
Other males	2.3	0.5

[a] Records for males other than Gwase and Tufa are standardized to those that would have been obtained in the number of days that these focal individuals were based at the village in each period.

use techniques other than spear or lines for catching fish; at least 10% of their fish were caught using other techniques (primarily poison), in contrast to less than 1% for unmarried males.

* * * * *

Kubo made little public ceremony of getting married. Shaw (1990:75) traces the moment of transition to the cooking of sago by the woman and its acceptance by the man. Among Kubo, 'true' marriage entailed sexual consummation at a private house in the bush; the future partners were brought there separately, and later returned together as man and wife - the first time they had been alone in each other's company. Though everyone in the village was aware of what was happening the occasion did not warrant public announcement or recognition. Nor was the change in status associated with imposition, or relaxation, of any specific restrictions.

The one possible exception to this generalization concerns, again, use of that anomalous technique, poisoning of fish. Married males were involved with, and probably initiated, every poisoning expedition. Given the unpredictability of this technique, and the associated spiritual and ritual connotations, it is probably not surprising that poisoning was largely the domain of senior males; this was the only technique with such non-secular elements.[39] In each case during the survey, however, a woman or unmarried male assisted in the poisoning operation, and received credit for having done so when skulls from the catch were carried to us. The restriction, in other words, seems to have been on initiation of the event, not on participation (cf. Kelly nd:2.23). And, given the minor quantities of fish that even married males obtained by this technique, the restriction was not economically important.

The major differences in fishing behaviour of married and unmarried males cannot be traced to direct social constraints on fishing activities or the use that could be made of produce.

The affinal relationships created through marriage have often been depicted as relations of obligation (Collier 1988; Collier & Rosaldo 1981), or of coercion (Wood 1987). Certainly, they play a major role in patterning distribution of produce, particularly

[39] Chapman (1987), reported a similar monopolization by senior males of 'religious', as opposed to 'secular', fishing throughout Oceania.

of meat, in many societies (eg. Altman & Peterson 1991; Barnard & Woodburn 1991:18; Beek 1987:159-160; Gibson 1991; Wood 1987). This was not the case at Gwaimasi. Kubo marriage was, in most cases, an arrangement between equals, exchanging equivalent goods (cf. Wood 1987:14; Gregory 1982:65). Such a relationship does not carry within it the seeds of either obligation or coercion; men who had exchanged sisters were often close, and regularly shared both labour and produce (2.2.4), but this was not always the case, and seems to have reflected choice, not a sense of obligation. Meat (as, indeed, all produce) was shared throughout the community, with an emphasis on equality such that, for large game at least, every individual (female and male, adult and child[40]) received a portion of every body part (cf. Speth 1990). The 'symbolic acts of deference' that Wood (1987:13) describes for Kamula - where, within the broader community-wide distribution of meat, affines received specific cuts - did not occur.

But according to Collier and Rosaldo, as well as Wood, the relationship most at issue in marriage is that between a man and his parents-in-law. Even in a system of direct sister-exchange of the sort ideally, and often actually, practiced by Kubo this relationship is **not** one of equals; parents do not receive that which they provide to the husband and, as Gibson (1991:168) noted, 'as soon as goods of fundamentally different type are exchanged, inequality appears'. Thus it is parents-in-law whom the husband must placate, and to whom he remains indebted.

Of the six married men at Gwaimasi during the survey only one, Gwase, the most recently married, had living parents-in-law or, for that matter, any senior affinal kin.[41] Gwase's father-in-law lived at Suabi. It is possible, then, that the structural forms outlined in the analyses of Collier and Rosaldo, or of Wood, did exist in Kubo society (though attenuated by the short life-expectancy in this area, and the concomitant low probability that men, at least would survive to be fathers-in-law).[42] Perhaps the absence,

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[40] Only young children, those less than about eight years old, did not receive individual portions in public distributions.

[41] Gugwi was, in fact, stepfather to Simo's wife Gogoi. But he had given Gogoi in exchange for his own wife. The relationship between the two men was one of equals, of exchange partners.

[42] Gwase did talk of giving meat to his new wife's father, who lived at Suabi, and even set about procuring and drying a large portion of pig for the purpose. (This meat was not obtained through his own hunting efforts but offered by another man, who knew of Gwase's vague intention, in exchange for assistance in building a house). Other

at Gwaimasi, of extra-household obligations resulting from marriage was again an artefact of small sample size. Whatever the explanation, however, such obligations did not influence fishing decisions as reflected in my survey.

Although marriage may not have changed the obligations that informed the subsistence behaviour of men at Gwaimasi it may well have changed their goals. A married man has, by definition, secured a wife. Whether this is considered desirable for control of subsistence production (Collier & Rosaldo 1981), for reproduction of social relationships through children (Wood 1987), or for reproduction of genomes (Hawkes 1991) the married man could be expected to invest effort in maintaining the relationship and its productivity. If so, decisions concerning food production, including fishing, are likely to be made in the light of the need for adequate provisioning of wife and children. An unmarried man, in contrast, needs to be concerned with the establishment of possible relationships, rather than maintenance of a particular one. Decisions concerning food production, again including fishing, would reflect this wider concern.

Following Hawkes' (1991) argument, unmarried men could be expected to be 'showoffs' - to prefer fishing strategies that, though risky, maximize haul size - while married men could be expected to be 'provisioners', more concerned about reliability of returns. The data on village fishing is somewhat ambiguous in this regard. Married men at Gwaimasi did, in fact, fish more regularly than unmarried men, but there was no significant difference in average haul sizes obtained by married and unmarried men respectively. The larger hauls which result from fishing with tended lines may have contributed to the fact that young (and usually unmarried) men were most likely to invest time in use of this technique. But data on all meat-getting by males at Gwaimasi suggest that there was no simple correlation between age or marital status and the choice of 'showoff' or 'provisioner' strategies (Dwyer & Minnegal 1993a).

The differences in frequency of spearfishing by married and unmarried men can be traced primarily to changed patterns of association and consequent patterns of movement. Marriage entailed, for men, a shift from associating with other men to association with women, and the activities of women. One major consequence was that married men spent rather more time in the backswamps than did unmarried men, for the former often

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activities intervened, however, and nothing came of the plan. There was no apparent sense of obligation or duress in his intention.

accompanied their wives to sago-processing. They were thus in the vicinity of good spearfishing streams more often than unmarried men, and may have dived for fish at times when expected returns would not have warranted a special trip to do so. At Gwaimasi, marriage did not affect either a man's ability to use different techniques to fish or, it seems, the use that he could make of fish. By altering the effective environment in which a man operated, however, marriage affected the accessibility of fishing locations and thus the costs associated with fishing.

One further impact on fishing - not of marriage as such but of the sexual activity that marriage legitimized - needs to be mentioned, though it cannot be quantified. I have noted before that Kubo tabooed the eating of fish for some 24 hours after sexual intercourse. On several occasions couples returned from a day in the bush together with a handful of fish which they could not now eat and somewhat shamefacedly were giving away. Reports that fish (except for the skull) had been fed to a pig or a cassowary indicated the same concern, that passion had overtaken an original intention to procure meat. This possibility may well have reduced the frequency with which married men bothered to fish when they travelled to the bush with their wives. If so, the shift to increased fishing activity after marriage revealed in my records probably underestimates the actual extent of changed interests.

(c) Reproductive status

The effects of sexual activity on fishing behaviour were not confined to that of a brief post-coital taboo on eating fish. Four babies were born to long-term residents of Gwaimasi during the survey. In at least two cases the parents displayed marked shifts in fishing behaviour during the pre- and post-natal periods.

Table 49 compares frequency and productivity of fishing by Biseiō before his wife Mabei's pregnancy[43], during that pregnancy, and during the subsequent period of lactation, with average rates for other males during the same times. Biseiō fished more than twice as often, and produced larger hauls, during his wife's pregnancy compared to before it. As a result, he showed a fivefold increase in catch rates during his wife's

[43] In accordance with Kubo perceptions, I have taken pregnancy as dating from four months before birth. This is not meant to imply that Kubo were unaware of earlier physiological changes. Rather, a pregnancy may not have been considered 'established' - and thus worth acknowledging - before about the fifth month.

Table 49 Effect on fishing by Biseiō of his wife Mabei's pregnancy: frequency of successful village-based fishing episodes, and number and weight of fish produced, in the period before Mabei was considered pregnant, during the pregnancy, and after she gave birth.[a]

	adjusted catch[b]			catch per 100 days		
	before (94 days)	pregnant (81 days)	lactating (62 days)	before	pregnant	lactating
EPISODES						
Biseiō	3	6	1	3.2	7.4	1.6
Other males	13.5	5.0	3.5	14.4	6.2	5.6
NUMBER						
Biseiō	3.1	15.6	3	3.3	19.3	4.8
Other males	29.2	8.6	9.2	31.1	10.7	14.8
WEIGHT (kg)						
Biseiō	1.0	4.1	0.1	1.0	5.1	0.2
Other males	16.7	4.4	6.0	17.8	5.4	9.6

[a] The child was born on July 1, 1987; pregnancy is taken as acknowledged from March 1, 1987.

[a] Records for males other than Biseiō are standardized to those that would have been obtained in the number of days that Biseiō was based at the village in each period; see footnote 36 for details of calculation. Other males were actually present for 703 person-days before the pregnancy, 497 person-days during the pregnancy and for 464 person-days after the birth.

pregnancy, at a time when catch rates were, on average, suffering a dramatic decline. Following the birth of her child, however, he virtually ceased to fish, his catch rates dropping to below even his comparatively low pre-pregnancy rate, at a time when other men again increased their fishing activities.

Sinio's wife Wafu was already pregnant when the survey began. Table 50 compares frequency and productivity of fishing by Sinio during that pregnancy, from the birth of Wafu's child to the time six months later when the child's first tooth emerged, and after that event, with average rates for other males during the same times. In this case I have no pre-pregnancy fishing rates to form the basis of comparison, but it is worth noting that Sinio's catch rate during his wife's pregnancy was more than twice the average, and easily the highest overall. Following the birth of her child, this changed

Table 50 Effect on fishing by Sinio of his wife Wafu's pregnancy: frequency of successful village-based fishing episodes, and number and weight of fish produced, in the period when Wafu was pregnant, during early lactation, and after the child cut its first teeth so that weaning was possible.[a]

	adjusted catch[b]			catch per 100 days		
	pregnant (61 days)	lactating (65 days)	weaning (60 days)	pregnant	lactating	weaning
EPISODES						
Sinio	16	1	5	26.2	1.5	8.3
Other males	9.4	4.0	2.7	15.4	6.2	4.5
NUMBER						
Sinio	46.1	1	18	75.5	1.5	30.0
Other males	19.7	6.9	6.9	32.4	10.6	11.5
WEIGHT (kg)						
Sinio	34.0	0.6	19.8	55.8	0.9	33.1
Other males	10.3	3.4	3.0	16.9	5.2	5.0

[a] Wafu's child was born on January 9, 1987; the first tooth is assumed to have erupted six months later, about July 9, 1987.

[a] Records for males other than Sinio are standardized to those that would have been obtained in the number of days that Sinio was based at the village in each period; see footnote 36 for details of calculation. Other males were actually present for 512 person-days before the birth, 785 person-days during early lactation and for 445 person-days after the child cut its first teeth.

dramatically; the catch rates of all males (except Biseiō) declined about this time, but Sinio's dropped significantly more, to less than a fifth of the average. Then, six months later with his child successfully teething, Sinio was fishing again. Though catch rates for other males remained the same Sinio's fishing increased to the extent that he produced six times the average weight of fish obtained by other men.

Two other infants were born during the survey, but neither lived long; one died on the day of birth, the other within a month of birth. Any effects of pregnancy on the expectant father's fishing behaviour, however, should still have been apparent. But Mamo, the father of one of these babies, had the lowest catch rates of all adult males, catching too few fish on too few occasions for significant shifts in fishing rates to be discernible. The father of the fourth child was unknown - at least publicly; the woman concerned was unmarried.

None of the women concerned in these events showed any significant shifts in fishing behaviour in relation to their pregnancies and the subsequent births. Again, however, the numbers of successful fishing episodes recorded for each of these women were too small for significant patterns of change through time to be apparent.

* * * * *

Periods of pregnancy and lactation are generally recognized as stressful, if not actually dangerous. Kubo, like most other human societies (see review in Spielmann 1989), acknowledged this fact by imposing certain restrictions on the behaviour of people at those times. Unlike most societies, however, the restrictions were applied equally to the father as well as to the mother.

Kubo asserted that during pregnancy the expectant couple should not eat terrestrial game killed by others or by a dog; it was believed that if they did so the person or dog responsible for the catch would lose their hunting ability. The couple was thus cut off from general distributions of most large game, including wild pig and cassowary. Some effort was made to compensate them with extra gifts of fish and, in addition, a mechanism existed whereby an expectant couple could eat game shot by an arrow the man had lent to the hunter.[44] Nevertheless, the restriction resulted in a definite decline in the amount of meat received from others. The obvious response was for the couple to obtain more meat themselves. Hunting large game is an uncertain business; without some means of buffering variance in returns, usually through reciprocal sharing with other hunters, it may well not be a viable subsistence strategy (Cashdan 1985; Hames 1990, Hawkes 1992; Kaplan & Hill 1985; Kaplan *et al.* 1990; Winterhalder 1986). Such reciprocal sharing, however, was explicitly ruled out by the restrictions placed on expectant couples. Hunting small game may have been a more reliable source of meat, but efficiency of this activity was largely dependent on use of dogs (cf. Dwyer 1983). Again, use of dogs was

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[44] The notion that an animal is killed by the maker of the instrument of its death, rather than by the one who wields that implement, seems fairly widespread among hunting peoples (eg. Lee 1979). Beek (1987:49) mentions temporary 'lending' of arrows among Bedamuni, and elsewhere in New Guinea, but does not discuss the contexts in which this occurs.

specifically ruled out for expectant couples. It is not surprising, then, that Biseiō, and probably Sinio, turned to fishing to boost the meat available to their families; not only was fishing a comparatively reliable form of meat-getting (see 3.1.4) but also its success was not dependent on assistance from dogs or other people.

The constraints associated with pregnancy, then, could have a major effect on individual fishing behaviour. That effect, however, was indirect; it resulted from a change in the relative benefits to be gained from options other than fishing, rather than any direct prescription to do with fish. In the case of post-partum restrictions, however, the effect on fishing was definitely direct.

Kubo believed that from the time of a child's birth to when the child cut its first tooth at about six months its parents should not eat fish caught at any *hafī*, at any junction of two streams. In this case the danger related not to others but to survival of the child itself; the obvious metaphorical connection was with the flow of breastmilk. But *hafī* is a rather vague term. Where does a junction start and stop? How far from the actual point of intersection do you have to be before the fish are safe to eat? And how large does a tributary have to be before it qualifies as forming a *hafī*? Such ambiguities, arising again from the imposition of a digital proscription on an analogical world, allow some manipulation of food restrictions according to the needs of those affected. With plenty of meat available at Gwaimasi, however, it is hardly surprising that both Biseiō and Sinio virtually ceased to fish after their respective children were born.

When a child cut its first tooth weaning became possible should supply of milk decline, and the worst of the danger for the new infant was past. The restriction on fishing at *hafī* was lifted. Sinio's sudden increase in fishing activity at this stage of his child's life reflects that new freedom. Teething, however, did not mark the end of restrictions associated with childbirth. The last restriction, on eating eels, was not lifted until the child was walking strongly, by which time it was becoming recognized as a person with its own name and social identity. Sinio and Wafu, and Biseiō and Mabei, were all subject to this taboo after the birth of their respective children. Through much of the survey Simo and Gogoi, too, were subject to this taboo in relation to their one-year-old child Sobosio. But the total number of eels caught by anyone during the survey was so low that the effect of this restriction on fishing behaviour is not discernible. It would not have been nutritionally significant.

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Pregnancy and lactation are physiological states that affect only females yet, among Kubo, both men and women are subject to identical taboos in relation to these transformations. Kubo, it seems, are more concerned about the potential implicit in those states, for both males and females, than about the physiological state itself. That potential relates to future social relationships, both with the child and established through the child. Unlike the parenthood that may result, however, 'pregnancy' and 'lactation' (like 'menstruation') are recurrent states, not stages in a developmental process. The temporary restrictions associated with such states are of a different kind from the permanent restrictions that many societies associate with, for example, being female, or being an initiate. The latter signal perceived differences between entities, while the former are perceived as means of controlling processes.[45]

The restrictions that Kubo associated with pregnancy and lactation, may well have provided a sense of control over an essentially uncontrollable phenomenon. The switch from restrictions on terrestrial game to one on aquatic game at the moment of birth may provide a dramatic dichotomy to map onto the event. But function does not explain form, and nor can form explain content. There are other dichotomies available and, while the terrestrial/aquatic shift may have been particularly salient in this high-rainfall environment, the sequence of restrictions could equally have been reversed. In fact, the contrast between pre-natal and post-natal restrictions is not as clean as that implicit in the terms aquatic and terrestrial. 'Fish from *hafi*' and 'game caught by others' do not make a particularly obvious opposition.

More recent studies suggest that the restrictions may also have had a real influence on the process of reproduction (eg. Speth 1990; Spielmann 1989). Most emphasize the deprivation resulting from dietary taboos. Spielmann (1989), for example, noted that reduced dietary intake resulting from restrictions on the types of food that women may eat during pregnancy can result in lowered probability of survival for the foetus, while during lactation it may both lower infant nutritional status and increase time to renewed

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[45] In the same way, Kubo were more concerned about the liminal state of initiation with its potentialities than about the eventual status of initiate; it was process of becoming an initiate that needed to be managed with taboos (7.2.2a).

ovulation.[46] Speth (1990:155-164, 1991), however, has suggested that reduced consumption of certain nutrients, during pregnancy at least, may actually improve health and survival of offspring. In particular, it seems that high maternal protein intake may have detrimental effects on both health of mother and development of the foetus (see also Speth & Spielmann 1983; Noli & Avery 1988).

The effect of the restriction that Kubo placed on expectant parents eating terrestrial game obtained by others was to reduce both overall amounts of protein consumed and effectively remove the possibility of occasional injections of large quantities of protein to the diet. Following Speth's argument, this makes nutritional sense for the woman and her child. But while the expectant father's reproductive fitness might benefit from modification of his wife's diet a change in his own would have no direct impact on health of the child. Why, then, should the restriction apply to the man? The answer may well lie in the changed pattern of behaviour noted above. The taboo motivated, and also excused, an increased emphasis on fishing, with a resultant increase in availability to the expectant mother of regular small parcels of protein replacing the more erratic, but larger, parcels now foregone.

Since it seems that the observed dietary shifts would benefit reproductive success of both the men and the women affected it is difficult to see why they should need to be encoded as a cultural restriction. Two related possibilities arise. Consumption of terrestrial game during pregnancy was perceived as threatening not the couple or their child but others, the others who would normally share with that couple the large game they procure. It is those others, then, who are **seen** to benefit by the restriction. This impression may have motivated the compensatory gifts of fish that were regularly offered, and which further reduced variability in protein intake, in a way that would not have been the case had the pregnant couple merely 'chosen' to change their diet. In addition, the restriction justified a temporary withdrawal from the system of collective action embodied in a general ethos of food-sharing[47] without threatening its underlying structure; in such a system to reject a share might be as challenging as to not offer to share.

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[46] The question of how such practices, apparently favouring a reduced rate of reproduction, would become established in a society is not addressed; but see Hawkes & Charnov (1988).

[47] See Hawkes (1992) for a discussion of sharing as collective action.

The restriction on eating of fish caught at stream junctions which affected Kubo couples after the birth of a child differed from the pre-natal restriction in two important ways. First, ambiguous definition of the tabooed category left it open to manipulation by those supposedly subject to the restriction. Secondly, breaking the taboo threatened only the couple themselves and their child, so that they alone had to take responsibility for any manipulation. There was clearly nothing about fish as such (as there was about large, and thus potentially toxic, parcels of protein in the pre-natal situation) which warranted their exclusion from the diet. In this case, it seems, a quantitative, rather than qualitative, shift in diet was desired. The taboo may have reduced both quantity and regularity of protein or energy intake, while allowing adjustment to prevent too drastic a decline if other resources failed. The associated decline in nutritional status of the woman may have increased birth spacing (eg. Spielmann 1989) and thus, by reducing competition for food, improved survivorship of existing children (Hawkes & Charnov 1988). The application of the taboo to the father, however, cannot be explained in this way. The extension of the taboo to males and, indeed, the encoding of these preferences as taboos in the first place, again can best be understood in terms of the behaviour which resulted. The taboo encouraged, and sanctioned, a shift from regular procurement of small parcels of meat to pursuit of larger game. The effect would have been to rapidly reintegrate the new parents into the sharing system from which they had retreated during the pregnancy.

Whatever the explanation for form and content of Kubo taboos associated with reproductive status - and both functional and structural considerations may have contributed - there can be no doubting their effect on fishing behaviour of affected individuals. The effects can be traced to shifting constraints on the use (nutritional and social) that could be made of fish or other game, rather than to constraints on ability to procure those items.

7.2.3 Clan affiliation

The variables addressed so far, though socially defined, relate to attributes of individuals irrespective of their relationship to particular others. Clan affiliation, in contrast, can be defined only in terms of particular relationships. The community at Gwaimasi comprised two distinct 'clan groups', which I distinguish by the terms Down-gabo and Up-gabo respectively (2.2.5). Each focussed on a sibling set from a particular clan - Gumososo and Gomososo clans respectively - but included affines and dependants of those core individuals. Members of these two groups displayed rather different patterns of fishing behaviour.

Down-gabo males - those affiliated with Gumososo clan - produced less fish per unit time than those from Up-gabo, affiliated with Gomososo. They fished less frequently, caught slightly fewer fish per episode, and caught smaller fish than did Up-gabo males (Table 51).

Table 51 Comparison of catch rates from village-based fishing achieved by five males from each of the two clan groups at Gwaimasi.

(a) Catch expected per 100 available days

	NUMBER		KG	
	$\bar{x}$	range	$\bar{x}$	range
DOWN-GABO (n=5)	14.8	2 - 26	6.9	1.3 - 14.5
UP-GABO (n=5)	22.3	9 - 36	13.9	2.1 - 28.6
	Mann-Whitney *U* test[a]			
	z=-0.73 NS		z=-1.36 $p < 0.2$	

[a] Calculated using the individual catch rates given in Table 35; probabilities are two-tailed.

(b) Number and sizes of hauls and of fish (pooled data)

	NUMBER[a] OF EPISODES	NUMBER PER EPISODE $\bar{x}$	WEIGHT (g) OF FISH $\bar{x}$
DOWN-GABO	65	2.1	485
UP-GABO	92	2.2	604
	$\chi^2=4.64$ df=1 $p < 0.05$		

[a] Standardised to the number of episodes that would have occurred had the person-days available to surveyed males in each clan group been no more than those available to males of the other clan group in each rainfall type; see footnote 8 for details of calculation.

Table 52 Location of successful fishing episodes for village-based fishing by surveyed males from Down-gabo and Up-gabo respectively.

STREAM SYSTEM	EPISODES per 100 days[a]	
	Down-gabo	Up-gabo
STRICKLAND RIVER	23.5	27.1
DEGE SYSTEM	5.6	18.0
SIGIA SYSTEM	2.6	0.9
OTHER WEST STREAMS	-	0.5
EAST SWAMP	-	1.1
EAST FOOTHILLS	0.4	3.8

[a] Standardised to the number of episodes that would have occurred per 100 days had the person-days available to surveyed males in each clan group been no more than those available to males of the other clan group in each rainfall type; see footnote 8 for details of calculation.

Much of the difference can be traced to the streams in which Down-gabo males and Up-gabo males respectively chose to fish. Table 52 presents a breakdown of successful fishing episodes by stream system for the two groups. Down-gabo males fished less frequently than Up-gabo males in the backswamp streams, and did not obtain any fish at all from the eastern swamp streams. In contrast, they fished more often in the stream Sigia, and its tributaries. (Frequency of fishing in the Strickland was about the same for the two groups.) It seems that Down-gabo males ignored the highly productive swamp stream systems in favour of streams which contained smaller, and fewer, fish.

Down-gabo women and Up-gabo women showed no difference in catch rates from fishing. Nor was there any difference in the frequency with which they obtained fish from different stream systems. There was, however, some spatial separation of fishing activities within systems; gudgeons (sa̲) caught by Down-gabo women came from the northern streams within the eastern foothills system, while those caught by Up-gabo women were more likely to have come from southern streams within that system.

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The five Down-gabo males were younger, on average, than the five Up-gabo males, with four of the former unmarried for at least part of the survey compared to only one of the latter. These differences in group composition, however, were not sufficient explanation for the observed differences in fishing behaviour. Age, in particular, had little effect on fishing behaviour at Gwaimasi. Marriage encouraged a shift to spearfishing, but made no predictions as to where that fishing should occur.

The apparent difference in fishing behaviour of males from Down-gabo and Up-gabo reflected the general patterning of their subsistence activities in the landscape. Although any residents of Gwaimasi were nominally free to use any of the natural resources of the surrounding area[48] they did not spread their activities randomly through that area. Down-gabo residents built gardens and processed sago palms to the north and west of the village; Up-gabo residents gardened and processed sago to the south and east (3.1.1-2). Fishing, being so embedded in these other activities, showed a similar separation. The observed differences in fishing behaviour reflected not differential assessment of the benefits to be gained by fishing in particular streams but differences in the costs of travelling to those streams. Both Down-gabo and Up-gabo males were choosing to fish in streams close to their gardens and to places where their wives or sisters were working. The spatial separation of subsistence activities by the two 'clan groups' at Gwaimasi reflected the tendency for people to position their activities near those of close associates, rather than any avoidance of others. While there may have been some impetus for people to orient their movements in the direction of their own clan lands (cf. Beek 1987:106), this does not explain the restricted distribution of activities by Down-gabo residents. Rather, the distribution observed reflected past geographical associations of focal individuals (see 2.3).

To summarize, Down-gabo and Up-gabo residents made fishing decisions in the light of similar requirements, and assessed options according to similar rules. The different patterns of fishing which resulted can be understood only in the context of historically contingent associations with both land and people, associations which, by influencing patterns of movement, affected the ease with which alternative fishing locations could be accessed.

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[48] Many authors writing of the Strickland-Bosavi area have asserted that usage rights to land were conferred by association with residential groups, not clans (Beek 1987:105; Sørum 1980:275; Knauft 1985a:30). Residents of Gwaimasi, too, asserted that anyone in the village was free to use the resources of the local area. On analysing actual behaviour, however, it seems that, among Kubo at least, co-residency did not necessarily negate the need to seek permission before garnering wild resources (Dwyer & Minnegal in press b).

7.3 INDIVIDUAL CONSTRAINTS

The range of variation in the amounts of fish individuals obtained per unit time was less within each of the categories described in the previous section than the overall variation in the community. Apart from the initial gender division, however, the **degree** of variation remained much the same for all categories, with some individuals in each obtaining at least 10 times the catch rates achieved by others, and with catch rates in general well spread through that range. Within the constraints of marital status, reproductive status or clan affiliation it seems that people could, and did, choose to do very different amounts of fishing.

The constraints imposed by social identity patterned change in fishing behaviour, but not the behaviour itself. Sinio and Biseiō, for example, displayed similar patterns of response to changes in reproductive status, with an increased rate of fishing during pregnancy and a dramatically reduced rate during early lactation. At each stage, however, Sinio obtained at least three times the catch rate achieved by Biseiō (allowing for differences in **potential** return rates from fishing at the times concerned). Similarly, Gwase and Tufa both increased their frequency of fishing after they married, but Tufa's catch rates were always much below those achieved by Gwase.

Differences among catch rates achieved by individuals are maintained through changing status. They are also maintained through time (see Table 53[49]). The implication is that the catch rates achieved reflect attributes of the individual, not simply choices made by the individual.

Individual hunters (or fishers) within a community may differ significantly in their ability to procure food (eg. Beek 1987:61,97; Hawkes *et al.* 1985; Hill & Hawkes 1983:171ff; Lee 1979:243; Marks 1976:204; Ohtsuka 1990a; Stearman 1989a). Either as a result of physical attributes or of degree of skill some are likely to be more efficient

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[49] In this case temporal shifts, rather than shifts in response to environmental change, are the focus of attention. Catch rates were calculated for four consecutive three-month blocks, as weight of fish obtained per day based at the village; because ranking was based on internal comparisons within each block no attempt was made to correct for patterns of rainfall through the blocks. Catch rates for Gwase, Sinio and Biseiō - all of whom changed status and thus fishing behaviour through the survey - were not included in calculations of the coefficient of concordance. See Appendix 5 for data.

Table 53 Concordance through time in the relative catch rates achieved by six surveyed male residents of Gwaimasi.[a]

	catch per 100 days (kg)				RANK			
	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	O/D	J/M	A/J	J/S
GUGWI	14.4	13.8	16.5	14.0	3	2	1	1
SIMO	7.3	26.2	9.9	6.9	5	1	2	2
FILIFI	21.6	1.0	-	3.6	2	5	5.5	4
MAUBO	31.1	10.6	2.0	3.1	1	3	4	5
DOGO	8.7	1.7	9.5	3.8	4	4	3	3
GAWUA	4.3	0.3	-	0.8	6	6	5.5	6

Kendall coefficient of concordance

$W = 0.58$
$p < 0.05$

[a] Gwase, Sinio, Biseiō and Mamo all changed status during the survey. Their fishing behaviour could thus be expected to change through the survey and they are not included here.

than others. In some circumstances, at least, the potential differences in production which result may be reinforced by a tendency for more efficient hunters to spend more time hunting (Hawkes *et al.* 1985; Hill *et al.* 1985; Smith 1987b). In other circumstances, where the marginal value of procuring additional meat is limited, or where the opportunity costs associated with hunting are high, time invested in hunting may be expected to decline with efficiency. The Gwaimasi data, however, shows no simple correlation, either positive or negative, between average haul size obtained by an individual male and his frequency of fishing (Figure 22; Table 54). Smith (1987b) also discussed the possibility of a non-linear relationship between efficiency and optimal foraging time, where increasing efficiency at first warrants investment of additional time in foraging but where further increases in efficiency might result in a reduction in time optimally spent foraging. Such a model could fit the Gwaimasi data; residents with the smallest hauls also fished least often, those with average-sized hauls fished most often, and those with the largest haul sizes fished at intermediate frequencies. But again, the pattern is far from clearcut.

The absence of clear relationships reflects the fact that fishing ability was no more

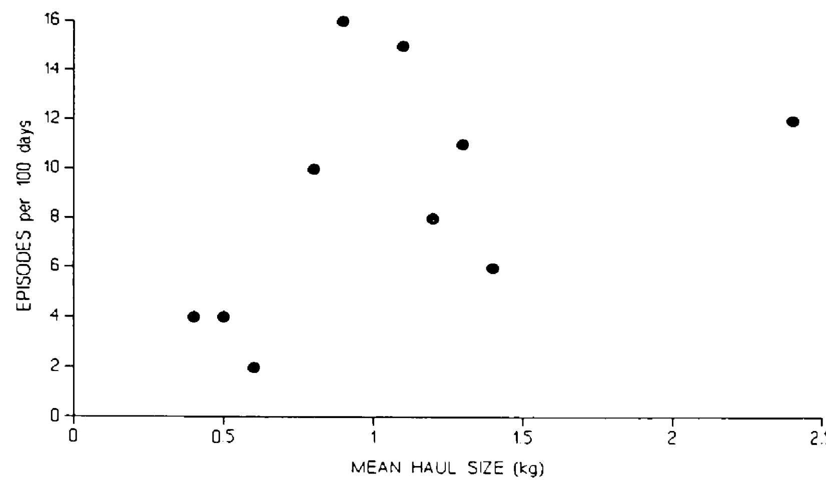

Figure 22 Correlation between the average size of hauls from spearfishing and the frequency with which fish were procured by that technique.

Table 54 Relationship between average size of hauls obtained and the frequency of successful village-based fishing episodes by the surveyed male residents of Gwaimasi.

	HAUL SIZE (kg)	EPISODES[a] per 100 days	RANK haul size	RANK episodes
SINIO	2.4	12	1	3
FILIFI	1.4	6	2	7
MAUBO	1.3	11	3	4
GWASE	1.2	8	4	6
GUGWI	1.1	15	5	2
SIMO	0.9	16	6	1
DOGO	0.8	10	7	5
MAMO	0.6	2	8	10
BISEIÕ	0.5	4	9	8.5
GAWUA	0.4	4	10	8.5

Spearman rank-order correlation coefficient

$r^s = 0.55$
NS

[a] Standardised to number of episodes expected per 100 days if the person concerned had been present for the entire survey fishing at observed rates in each rainfall type; see footnote 6 for details of calculation.

a unitary phenomenon at Gwaimasi than was fishing itself. Kubo used a wide variety of strategies, and associated tactics, for obtaining fish, from hunting and besetting with spear, through trapping and ambushing with lines, to harvesting with poison (5.2.3). Each required its own particular abilities, knowledge and skill. An individual who was skilful at spearing fish might well spend more time at this activity than someone less able. He might be much less skilled at linefishing, however, and spend correspondingly less time engaged in doing so.

Table 55 records the amounts of fish that each male obtained by line and by spear (adjusted to allow for presence in different weather conditions), and ranks individuals according to their productivity with each technique. There was no correlation between ranks; aptitude for one technique did not predispose for or against the other technique. Men who speared most fish per unit time were at best mediocre in their production from linefishing, while the most productive linefishers obtained comparatively little fish by spear.

Table 55 Relative productivity with spears and with lines in village-based fishing by the surveyed male residents of Gwaimasi.

	catch per 100 days (kg)[a]		RANK	
	by SPEAR	by LINE	by SPEAR	by LINE
SINIO	23.9	4.4	1	5
GUGWI	9.4	3.3	2	6
FILIFI	7.8	0.6	3	8.5
GWASE	3.1	6.3	4	3
DOGO	2.1	5.8	5	4
MAUBO	1.8	12.5	6	1
BISEIŌ	1.4	0.6	7	8.5
SIMO	1.0	11.8	8	2
MAMO	1.0	0.2	9	10
GAWUA	-	1.5	10	7

Spearman rank-order correlation coefficient

$r^s = 0.12$
NS

[a] Standardised to amounts expected per 100 days if the person concerned had been present for the entire survey fishing at observed rates in each rainfall type; see footnote 6 for details of calculation.

There was no relationship between the average haul size a man obtained by spear and the frequency with which he went spearfishing. This is not surprising given the extent to which spearfishing tended to be embedded in other activities. There was, however, a significant relationship between average haul size that men obtained by linefishing in the Strickland River, and the frequency with which they did so ($p < 0.02$). This may merely reflect a conflation of two separate fishing strategies - tended-line and set-line fishing; those who chose to tend fishing lines, in addition to setting lines, would have both more episodes of linefishing and larger average hauls. Women, who rarely if ever tended lines, showed no equivalent correlation between productivity and frequency of linefishing.

Kubo males differed not just in the techniques they used, but also in their fishing tactics and targets. Table 56 summarizes the species composition of the catch that each male obtained by spearfishing, and ranks males by the number of fish caught from each of

Table 56 Species composition of the catch from village-based spearfishing by surveyed male residents of Gwaimasi.

	NUMBER per 100 days[a]			RANK	
	CATFISH		PERCH	catfish	perch
	eeltailed	forktailed			
SINIO	10.2	10.8	1.8	1	6
FILIFI	4.5	3.9	2.0	2	5
GUGWI	4.2	1.6	16.5	3	1
DOGO	3.5	1.5	1.0	4	8
GWASE	2.0	1.8	3.4	5	4
MAUBO	1.3	1.0	1.1	6	7
SIMO	0.7	0.7	4.0	7	3
MAMO	1.3	-	-	8	9
BISEIŌ	0.1	0.9	4.4	9	2
GAWUA	-	-	-	-	-
				Spearman rank-order correlation coefficient	
				$r^s = -0.017$ NS	

[a] Standardised to numbers expected per 100 days if the person concerned had been present for the entire survey fishing at observed rates in each rainfall type; see footnote 6 for details of calculation.

the three major species groups. Again, there was no correlation between the ranks; ability to spear perch seems to have been no indication of ability, or inclination, to spear catfish. Perch comprised more than 70% of the fish obtained by Gugwi, Simo and Biseiõ, though the actual productivity of these three men varied enormously. In contrast, Mamo, Filifi, Sinio and Dogo differentially targeted catfish, which comprised more than 80% of the fish each caught. Gugwi and Dogo both obtained more than twice as many eeltailed catfish as forktailed catfish; all other males obtained approximately equal proportions of the two categories of catfish. Though found in the same streams, these categories of fish differ in their behaviour and thus in the tactics required to locate and secure them. Perch are found in quiet pools, the large forktailed catfish in stronger currents. Both perch and forktailed catfish move about during the day, but the large eeltailed catfish tend to rest below snags and leaf litter through the day. Individuals at Gwaimasi, it seems, differed in their preference for diving in different stream conditions, and for actively pursuing fish as opposed to besetting them.

I have argued elsewhere (Dwyer & Minnegal 1991a), that differential specialization on targets and tactics was an integral part of the total Kubo meat-getting system, not just of fishing. Given the low abundance and high diversity of the lowland, tropical rainforest fauna people needed to select a diverse array of prey types. The different behaviours of those potential targets, however, and their patchy distribution, necessitated use of a range of tactics in a variety of environments. Individual specialization meant that, rather than dispersing individual effort across the entire spectrum of tasks, the knowledge and skills of each hunter were developed within a context of particular environments, prey types and technology. Rates of production for each activity would have been enhanced as a result. In a community where all produce is shared, specialization would enhance the overall efficiency of meat procurement; each member would benefit as a result. At Gwaimasi, there were no sanctions, either positive or negative, associated with an individual's productivity as a meat-getter (Dwyer & Minnegal 1991a). Thus, individuals were free to develop their own abilities and interests in the light of opportunities available to them.

Beek (1987:97) reported that by the age of 12 to 13 Bedamuni boys already displayed "marked differences in individual ability and attitude towards hunting and fishing". More importantly, he described how these differences are then enhanced by differential reinforcement by older males; boys good with bow and arrows, for example, might be presented with better equipment than that generally available to those of their age. The young men at Gwaimasi had already clearly diverged in their interests. Dogo displayed most interest in hunting large game, and was regularly invited to accompany older men on hunting excursions. He was more likely to spear fish than to go linefishing, though his relative inexperience as a spearfisher was revealed in his reliance on besetting fish rather than pursuing them in motion (see p.252). Maubo, in contrast, rarely went in pursuit of large game. He procured fish regularly, however, usually by linefishing.

The fishing behaviour of individual Kubo was influenced in multiple ways. Gender, marital and reproductive status and clan affiliation may all have had an impact but these were relative to the particular talents, interests and knowledge of those individuals. Predisposition to these varied manifestations of talent, interest and knowledge may have been acquired relatively early in life, when particular opportunities and associations guide the expression of fishing behaviour and underpin the experience gained. The different abilities acquired as a result of these historical contingencies of heredity and training will have affected the material outcome that individuals could expect from alternative fishing options, and thus the choices that they were likely to prefer.

7.4 SUMMARY AND DISCUSSION

Kubo people did not limit access to fishing locations, or restrict consumption of fish species. This lack of general constraints on procurement of fish, or on the use that could be made of fish, can be understood in terms of the characteristics of fish and of fishing in the area. The fishing techniques available to Kubo (with the exception of poisoning) were non-intensive, and their use would have had little effect on future productivity. Thus, there would have been little to gain by monitoring or controlling the fishing activities of others. As a result, people at Gwaimasi were free to assess fishing options in relation to their own abilities and requirements.

Individuals at Gwaimasi differed greatly in their fishing behaviour through the survey. Productivity differed by as much as two orders of magnitude, but people also differed in the primary techniques used, streams visited and species targeted. The reasons are to be found in attributes of the fishers themselves.

Gender, life-history status and clan affiliation all influenced the ways that people at

Gwaimasi chose to fish. Of these, gender had the clearest effect. Men at Gwaimasi generally fished more often than women, caught more fish per episode and caught larger fish. They used techniques that women did not, spearing fish as well as setting baited lines. Even when linefishing, men were more likely than women to use intensive strategies which offered the potential for large hauls, setting multiple lines or tending lines. This same emphasis appears in the fact that men were much more likely to fish when weather conditions favoured procurement of large hauls. In contrast, while women procured only small quantities of fish, infrequently, they did so at a fairly constant rate through the survey.

Kubo did not differentially restrict either procurement or consumption of fish by gender, so the observed patterns must reflect differential preferences on the part of men and women at Gwaimasi. Those preferences are understandable in terms of the different abilities and requirements of men and women respectively. Differences in access to equipment, experience and information affected the viability and relative efficiency of fishing techniques. Differences in mobility affected time required to reach suitable fishing locations. Together, these constrained the material outcome that could be expected from any fishing decision - the amount of fish likely to be obtained per unit time - and may explain both the relative frequency with which men and women chose to fish, and the different use of techniques and tactics for procuring fish. But differences in ability alone cannot explain the greater sensitivity that men displayed about size of hauls; that is more likely to reflect a difference in the use that could be made of fish. If, as often speculated, men stood to gain more than did women by distributing produce widely, the marginal value of procuring additional fish would decline more slowly for men than it did for women. (Indeed, marginal value may have accelerated before declining; see 1.3.1).

Life-history status affected fishing behaviour in a variety of ways. Development of skills and experience through time, and declining strength and fitness, affected the ability of individuals to procure fish. Initiation, marriage and reproduction affected the use that could be made of fish as much as the ability to procure them. Men increased their frequency of fishing, particularly spearfishing, after marriage, reflecting a change in patterns of association and mobility that altered access to fishing locations. A shift, after marriage, from concern with establishing a variety of relationships to concern with maintenance of a particular relationship, may also have encouraged more frequent fishing, but there was no clear evidence to support the view. Changes in fishing behaviour during pregnancy and early lactation, however, did suggest the importance of social relations in patterning behaviour. Men fished much more often when their wives were pregnant, then effectively ceased to fish for six months or so after the birth, until the child's first tooth erupted. Both patterns are overtly related to restrictions on the consumption of certain foods during these periods. In each case, the restrictions reflect shifts in the relative benefits to be gained by procurement of fish or other game. The form in which the restriction is encoded by the community, however, can best be understood as a way of managing patterns of collective action within the community.

Clan affiliation, too, affected fishing behaviour; men associated with Gumososo clan fished less often and produced smaller hauls than those associated with Gomososo clan. This pattern can be traced to differences between the clan groups in the spatial arrangement of activities other than fishing. The location of gardens and bush houses, which themselves reflected the past geographical associations of focal individuals in the two groups, affected the time required to access alternative fishing locations.

Ultimately, however, individual variation in fishing behaviour crosscut all of the above structural categories. Expression of the constraints that gender, life-history status and clan affiliation imposed on abilities and requirements was itself constrained by the particular talents, interests and knowledge of the individual fishers. Within each category, individuals varied greatly in the amounts of fish produced, the techniques they favoured and the species usually targeted. Moreover, these differences between individuals were maintained through time and despite changing status. Presumably, therefore, they reflected real attributes of the fishers. Differences in personal ability, reflecting not only the contingencies of heredity but also differences in experience and training, meant that the material outcomes which different individuals could expect from any fishing options were unlikely to be the same. Alternative options might well be assessed differently as a result. The absence, among Kubo, of positive or negative sanctions associated with production of meat would have enhanced any tendency toward differentiation of skills.

There is an element of *post hoc* rationalization in the interpretations outlined above. Unlike the approach used in Chapter 6, here I identified patterns of variation in behaviour first, then looked for attributes that might explain the variation. But the arguments rely on more than plausibility. I have suggested in advance the kinds of differences to be expected - differences in the relative costs associated with procurement of resources or in the use that could be made of those resources - and it was to these that I looked in my discussion. Many of the variables considered are intangible, however; it would be difficult, for example, to quantify access to experience or training, or the effect of this on fishing ability. I made no attempt to do so. Nevertheless, in most cases it is clear that people at Gwaimasi were fishing in ways that made sense given the respective constraints to which social categories or individuals were subject. Individuals responded to variation in availability and accessibility of fish in ways that were consistent with those expected of people maximizing the value of their production.

In summary, individual abilities and requirements did influence both the material outcome that could be expected from alternative fishing options at Gwaimasi as well as the use that could be made of those outcomes. The ways that people at Gwaimasi fished reflected that influence. But, just as the outcome of a fishing trip depends on the availability and accessibility of fish as well as the abilities of the fisher, so the use that can be made of the catch depends on the presence and actions of other people as well as the requirements of the fisher. The next chapter considers the way that size of the consumer group mediated the requirements of the fisher and thus the value of alternative fishing options.

CHAPTER 8
EXTRINSIC CONSTRAINTS ON CONSUMPTION

The material outcome to be expected from any fishing decision depends on both the availability of fish and the abilities of the fisher. The fishing behaviour of people at Gwaimasi reflected the influence of both variables. But the value of a potential outcome depends on the use that the fisher could make of it. In the previous chapter I have shown that individuals may differ in their requirements either for the nutrients contained in fish or for the benefits to be gained by distributing fish to others. Again, fishing behaviour at Gwaimasi revealed the effects of this variation. But the use to be made of fish - and thus the probability that a particular outcome will be sought - depends on more than the requirements of the fisher. The interests of others may constrain the benefits that an individual can expect from his or her catch.

The effect that obligation to give to others, and expectation of receiving from others, can have on foraging decisions has been noted before. Beek, for example, has explicitly argued that the "application of hunting and fishing strategies by the individual [Bedamuni] hunter depends not only on the abundance and availability of certain animals, but also on what he or she can do with the catch" (1987:163); thus, a Bedamuni man might not make the effort to pursue a small item that he encountered when children - to whom he would be expected to present the catch - were present, but would do so if alone and thus able to consume the catch himself. Similarly, Wiessner (cited in Hawkes 1992:273) observed that !Kung may assess the probable distribution of their produce, and the chance of receiving food from others, when deciding whether or not to work on a certain day. But such reports usually make no attempt to systematically investigate the effect of constraints on consumption, providing only anecdotal observations. The recognition that value is socially constructed also presumably informed Dwyer's (1985b) assertion that the intended use of game may affect hunting decisions. But, again, Dwyer's one case could not be generalized; his concern was with the motives guiding distribution, rather than with consequences of distribution, and thus did not address the reproduction of behaviour. Evolutionary ecologists, too, have been more concerned with explaining patterns of distribution and consumption than with exploring the implications of those patterns for foraging behaviour. That such implications exist has been acknowledged; Winterhalder (1993:331ff), for example, argued that 'distribution dynamics' and 'consumption dynamics' may constrain optimal patterns of behaviour as much as do the 'production dynamics' which have been the focus of most attention by evolutionary ecologists. I know of no studies, however, that actually address patterns of distribution and consumption as constraints on behaviour rather than as behavioural variables to be explained.

In this chapter I explore the effect that constraints on consumption had on the ways that people at Gwaimasi chose to fish. In particular, I look at the ways that fishing behaviour changed in response to changes in the number of people among whom produce was to be shared. The first section defines the concept of 'resource-sharing group' and identifies the entity - the set of relationships - that, at Gwaimasi, best approximates that definition. Section 2 then discusses the size of the resource-sharing group at Gwaimasi, focussing particularly on the way that the number of consumers which comprise that group varied through the survey. The last section addresses correlations between the number of consumers in the resource-sharing group and patterns of fishing behaviour. Initial analyses focus on variation in actual amounts of fish produced, in order to establish that there was indeed evidence of a declining marginal value for fish at Gwaimasi and that the resultant limit on benefit to be gained from fishing was related to number of consumers. With this basic assumption in place, I turn to analyses of ways in which adjustment of fishing productivity arose in response to changes in size of the resource-sharing group.

8.1 RESOURCE-SHARING GROUPS

8.1.1 Sharing in and sharing out

Residents of Gwaimasi regularly shared the fish they caught. But the recipients of shares were not always the same. And the number of people among whom a particular catch was shared tended to vary with its size. In what sense, then, is it meaningful to speak of a 'resource-sharing group' having anything more than contingent identity?

By resource-sharing group I mean, in the first instance, that group of people who, to use Ingold's (1986a:233) term, share *in* a resource; that is, those who hold collective rights of access to that resource. Members of the resource-sharing group thus can expect to share equally in all produce resulting from appropriation of that resource. (For purposes of analysis this formal definition must be modified to exclude eligible individuals who, on any particular occasion, are absent from the location at which food with a limited 'shelf-life' is distributed and consumed; see 8.1.2.)

This definition contrasts markedly with that offered by E.Smith (1981:40), who defined 'resource-sharing group' as "any group within which a particular resource at a particular time is actually distributed, prior to consumption". Smith, in fact, was describing not the group that shares *in* a resource but the group to which that resource is shared *out*. The two need not be co-incident. As Ingold argued, "ecological considerations determine the extent to which hunters must share *out* the harvested produce in order that everyone should have a share *in* their collective resources" (Ingold 1986a:209). Thus, large hauls of fish may well have been shared out more widely than small ones. And fish may have been shared out to more people during seasons when returns were less predictable. While all members of a resource-sharing group can expect a more-or-less equal share of the available food, they cannot necessarily expect equal shares of the food obtained by each individual (cf. Gibson 1991).

The distinction between sharing in and sharing out is significant, yet it is usually overlooked in the literature. Hawkes, for example, noted that some types of resources procured by Aché of South America were shared more widely than others, irrespective of who obtained them; "While most collected items were more likely to be eaten by a member of the acquirer's family than by someone outside it, [others] were so widely shared that members of the acquirer's nuclear family got no more than other members of the foraging party" (1991:35; see also Kaplan *et al.* 1984; Kaplan & Hill 1985). She then interpreted this description as normative, assuming that the extent to which particular resources would be distributed was fixed, irrespective of quantities produced (though perhaps influenced by attributes such as sex of the producer). A person who concentrated procurement effort on resources that were usually consumed within the nuclear family, she argued, would differentially benefit their household relative to someone who pursued the widely-distributed items.

In contrast, I argue that while the acquirer's family might eat more of his or her own particular produce, that family would not necessarily consume more food than any other member of the resource-sharing group. A household will benefit differentially from the foraging decisions made by its members only if the household itself defines the bounds of the resource-sharing group. Where collective rights of access to resources are held by a larger group - in the Aché case probably the foraging party - any temporal disproportion in production, even of reliable staples, would, I assert, result in redistribution of produce beyond the household.[1] Anything an individual chose to pursue, therefore, would benefit all members of the group, either directly through provision of shares, or indirectly in terms of reduced demand on the produce of others.

In this view the extent to which an individual can expect to benefit from his or her own productive activities, in terms of increased consumption, depends not only on the number of individuals among whom the produce is to be directly and indirectly distributed but also on the amount of food produced by those other individuals. A one kilogram fish may make a considerable difference to the nutritional status of a group of five individuals, if it constitutes the only meat available. If three other fish of the same size have already been caught that day, however, an additional 200 g of meat each may be of little interest to either the acquirer or to other members of the resource-sharing group. Members of a group of twenty, of course, could usefully consume all four fish, and more.

Note that this definition of resource-sharing groups offers no suggestion as how such groups might arise, or how they might vary with circumstance. My concern, here, is to document the effects of such variation, not its causes. Nor am I concerned with the manner in which redistribution of produce within the group might occur. An

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[1] This would explain Hawkes' observation that, among Aché, even the least widely distributed resources were still more often than not consumed by people other than, or in addition to, the producer's immediate family. Several recent papers have commented on the fact that many foods, even plant staples, may be more widely shared than usually assumed (eg. Hames 1990:104). Though the minimal extent of distribution within a resource-sharing group will reflect temporal variance in acquisition, people may well share their produce more widely than strictly required to maintain equality of access by members of the resource-sharing group. As noted in 2.2.6, the frenetic afternoon distribution of the day's produce that characterised sharing of plant foods at Gwaimasi appeared to take no account of differential amounts produced by individuals and concomitant differences in needs. See Marshall-Thomas (1989:211) for another example, again concerning plant foods but this time among !Kung, of identical items being extensively and simultaneously exchanged. Similarly, Ichikawa (1981:63-65) recorded the widespread redistribution of honey obtained by different members of a group of Mbuti pygmies during a single day, noting that 'honey was distributed to ... people who were not short of honey at the moment'.

approximately equal distribution of resources may be achieved via many different routes. The primary requirement would be that, whether organized according to need, or along lines connecting categories of individuals or relationships, patterns of exchange cannot be closed within the bounds of the resource-sharing group.[2] Within this constraint the paths chosen for sharing out food may well reflect attributes of both the product (particularly parcel size) and the producer (eg. age and gender[3]) and it is to an understanding of these choices that much literature on the evolution of sharing is addressed. My concern, however, is not with the particular routes by which food is shared out but with the eventual distribution that results.

To summarize, a resource-sharing group - a group which shares in the produce of all its members - is united by the fact that food obtained by each member directly or indirectly benefits all members. Where the marginal value of food declines with amount procured, food obtained by one member of a resource-sharing group also, directly or indirectly, impinges on the potential benefit to be gained from food produced by all other members. The extent of that impact, however, depends on the size of the group in the first place. Decisions to fish, therefore, should be made in the light of knowledge both of numbers of consumers within the resource-sharing group and of the productive activities of others within that group.

8.1.2 Resource-sharing at Gwaimasi

In Chapter 2 I identified several levels of organization within the general community at Gwaimasi - from household, through family cluster and clan group, to village. At a broader scale, communities, too, were linked in various ways. Each of these levels of organization had a degree of social, biological and economic reality. At

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[2] Note, as a corollary, that the resource-sharing group may be simply an epiphenomenon created by the organization of sharing along particular lines according to associated costs and benefits to individual participants. It would be nonetheless analytically real.

[3] Beek (1987:Ch.5) described the different directions in which Bedamuni males and females, adults and children distributed food items. These differences reflected, and affected, relationships within the society. Though Beek did not comment on the fact, the different orientations also ensured that lines of food distribution did not become closed, and thus would have facilitated equitable distribution of produce among individuals.

each level, people were more likely to share tasks, and produce, with co-members than with others. But, as discussed above, the extent to which, and frequency with which, resources were shared out is no real indication of the bounds of the resource-sharing group. I have suggested before, both in Chapter 2 and again in Chapter 7, that residents of the village held collective rights to each others' produce - that is, that the resource-sharing group was defined by co-residence. But at this stage I need some objective basis for drawing a boundary there. If I am to identify the effective resource-sharing group at Gwaimasi, and thus the appropriate level of analysis for later sections of this chapter, it must be in terms of evidence that the expectations and obligations inherent in collective rights to produce actually influenced the organization of fishing behaviour.

Fishing returns obtained by people at Gwaimasi varied greatly not only between individuals (see Table 34 in 7.2) but also through time. No-one procured fish every day. That variation did not simply reflect attributes of the fish. Admittedly, not all lines set caught fish, and not all diving trips were equally successful - such variation indeed may reflect attributes such as dispersion of fish in space and in time. But much of the variation observed resulted from decisions to fish or not fish in the first place.

Fishing, like all other activities, has opportunity costs. Given that time (and, nowadays, money for equipment) must be distributed among competing interests[4], how might a fisher best schedule his or her fishing activities? It is here that expectations of fish being obtained by others in the resource-sharing group, and obligations to distribute fish among the members of that group, come into play. Where fish has a declining marginal value most benefit for fishing effort will result from obtaining fish when others in the resource-sharing network have not done so.

We can expect, then, that people would offset their fishing efforts relative to that of others in the resource-sharing group. As a result, variation through time in the amount of fish produced per consumer would be considerably less for the resource-sharing group

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[4] This raises a major problem for some of the Aché research alluded to above. The foraging parties described were taken out of context; Aché spent most of their time, and obtained most of their food, gardening at a mission station. Opportunity costs of foraging during expeditions to the forest were thus minimal. Consequently, variation in a hunter's returns through time may well have simply reflected attributes of the prey, not variation in foraging effort. This, of course, was a special situation that was unlikely to have been replicated in the pre-contact situation or to have applied to the overall subsistence system.

as a whole than for its component units.[5]

Table 57 records patterns of variation in the amount of fish produced at Gwaimasi per consumer-day measured at different levels of social organization. Since I am concerned now with variation in amounts available for consumption, not in production as such, the relevant data include not only fish caught while based at the village but also those brought back to the village when returning after an absence. Because fish were usually eaten within a day of capture the potential consumer group for each level was restricted to people who were present at the village on a given day. Individuals may differ, however, in the amount of resources that they need or can use. In particular pre-adolescent children usually eat rather less than adults. My interest in this chapter concerns not numbers of people *per se* but, rather, the potential use-value of resources, and the way this changed as people moved into and out of the community. Thus, in the analyses which follow, actual numbers of residents at Gwaimasi have been converted to represent an equivalent number of adult consumers. Unweaned infants were excluded from analyses, one 2-4 year old child (Okire) was taken as 0.5 consumer units, one 6-8 year old (Yasimo) was taken as 0.7 units and two 9-11 year old children (Gawua and Boua) were each taken as 0.8 units.[6] (All references to 'number of consumers' in the rest of this chapter refer to these adjusted values.) Though people at Gwaimasi did snack through the day most food was eaten in the afternoon and evening; food eaten in the morning was likely to be left over from the previous day's activities. People thus were counted as consumers at the village on a given day if they slept there that night.

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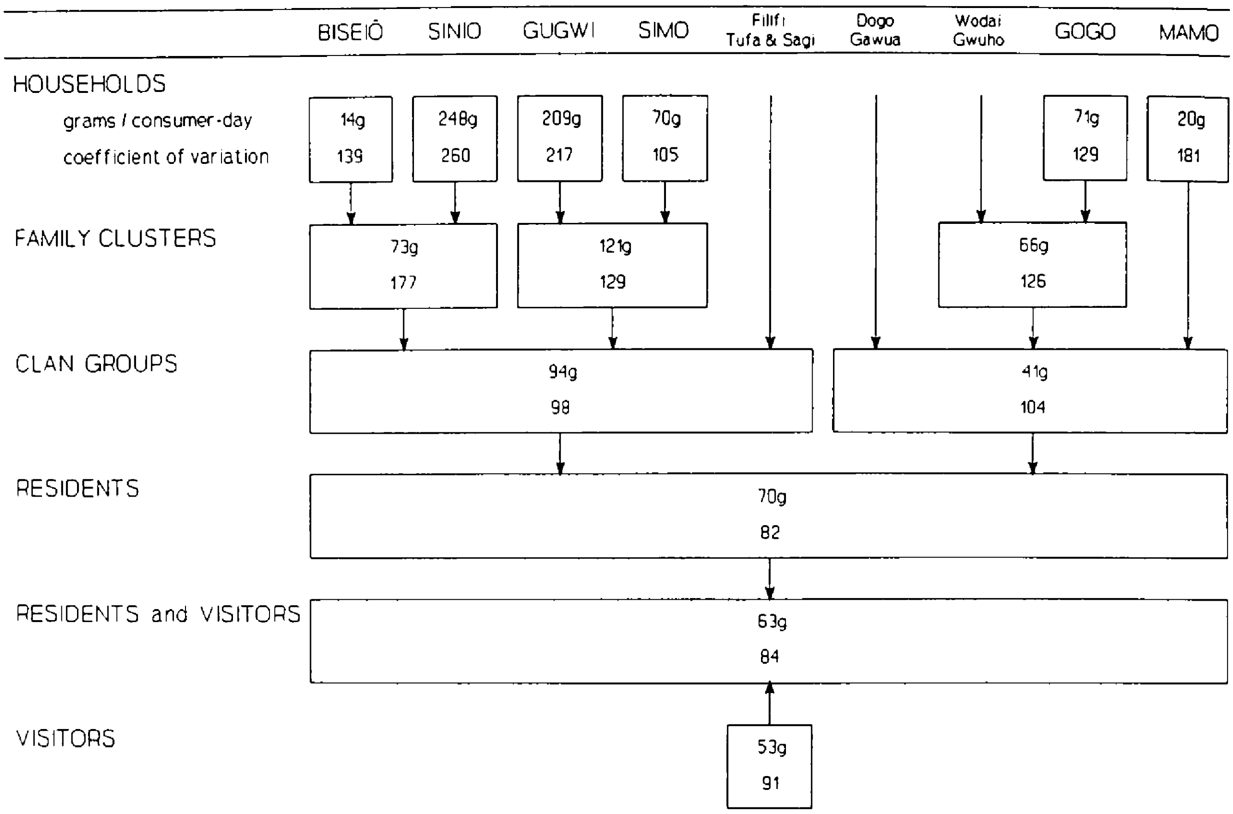
[5] Note that this reverses the usual line of argument concerning the relationship between sharing and asynchrony in returns obtained by different individuals. Sharing will reduce variation in food available for consumption only if such asynchrony exists, and thus has been inferred to be a response to that asynchrony (eg. Kaplan *et al.* 1990:119; Winterhalder 1986; see also other papers in Cashdan 1990). In such interpretations the degree of correlation between returns obtained by different individuals each day is taken as given and, indeed, may be considered crucial to calculations concerning the optimal size of the resource-sharing group (eg. Winterhalder 1990). I am asserting, in contrast, that sharing may encourage a lack of synchrony. As with the more general contrast between environmental and social causality which has motivated this thesis, the two arguments are dialectically, not diametrically, opposed.

[6] Males commonly consume significantly more food than females. Half the women resident at Gwaimasi, however, including four of the five mature women, were pregnant or lactating for some or all of the survey, conditions during which nutritional requirements, and consumption of food, rise markedly (Salfield nd). I therefore have not adjusted consumer values by sex.

Table 57 Patterns of variation in the amount of fish produced per consumer-day[a] by people at Gwaimasi, measured at different levels of social organization; based on fish caught per fortnight from September 22, 1986 to October 18, 1987.



[a] Consumer-days are recorded as the total number of nights that a person slept at Gwaimasi each fortnight. Unweaned infants were excluded from analyses, one 2-4 year old child (Okire) was taken as 0.5 consumer units, one 6-8 year old (Yasimo) was taken as 0.7 units and two 9-11 year old children (Gawua and Boua) were each taken as 0.8 units; comparable adjustments were made for visiting children.

For each two-week block during the survey[7] I calculated the mean weight of fish that members of each household (identified in Table 57 by name of the senior member) obtained while based at the village or brought to the village, relative to the number of

[7] The first week of the 57 weeks in the survey was discarded. Fortnights, rather than weeks or months, were selected as the basis for analysis to minimize the number of missing records or zeros in calculations of variance while maintaining an adequate sample size. No household was totally absent from the village for more than 11% of fortnights (3 of 28) while Sinio's family was absent for more than 26% of weeks (15 of 57). In addition, no family caught fish in less than 44% of their available fortnights; by pooling data to the level of four-week blocks, thus cutting the sample size to 14, this value would have improved only to 50%.

standardized consumer-days that members of that household were present at the village and could have consumed fish. Fortnight to fortnight variability in amount of fish that would have been available to each adult consumer per day if fish were not distributed beyond the household was generally high, with coefficients of variation (CV) ranging from 105% to 260%.

These calculations were repeated for other levels of social integration. (Those individuals who were not members of the primary households are added to the analysis at the level of family cluster or of clan group as appropriate; see Figure 14 in Chapter 2 for relationships.) Variation from fortnight to fortnight in weight of fish obtained per consumer-day by family clusters did not differ greatly from that of the households they comprised, tending to be an average of the component variations. Households in each cluster apparently did not offset their fishing efforts relative to each other. (In fact, given the tendency for households in a cluster to participate in joint activities, their members may often have been in suitable fishing contexts together.) It seems that, for Kubo, the family cluster - rather than the household - may constitute the basic unit of production and reproduction. Of course, in the ideal Kubo marriage arrangement of direct sister-exchange all adults in a family cluster would be genetically related to all children. That is not the case at higher levels of social integration; clan groups, though focussed around a set of closely related individuals, include affines who may be linked only through transitive social relationships. Variation in the amount of fish that each of the two clan groups obtained per consumer-day from fortnight to fortnight was less than that for any family cluster, and even less than that for any of the constituent families. It appears that at this level people may have been adjusting their fishing behaviour in the light of that expected of other family clusters. Variation declined even further at the level of the village, suggesting that the behaviour expected of all other households, not just of those within one's own clan group, was considered when making decisions.

Although visitors (comprising an average of 3.6 consumers per night at the village, compared to an average 13.5 resident consumers) regularly received shares of fish caught by residents, and shared out fish that they themselves caught, incorporating them within the analysis caused no further decline in fortnight to fortnight variation. It seems that residents of Gwaimasi did not consider potential production or consumption of fish by visitors in deciding when and how to fish.

Table 57 also records the actual amount of fish produced per consumer-day during the survey, again measured at each level of social organization. Those values indicate the amount that individuals could expect to receive if fish produced was equitably shared within the component group at each level, but not beyond. Some families caught far more per consumer-day than did others. Even at the level of clan group there were significant differences in the amount of fish produced per consumer. Thus, the benefits to be gained from village-level sharing would seem to have been far from equal. But it must be remembered that fish formed only one part of the Kubo diet, and that some people, such as Mamo, specialized in procuring game other than fish. An analysis of the consequences of equitable sharing of **all** meat, analogous to that in Table 57 (Dwyer & Minnegal 1991a:Table VII[8]), showed grams of meat obtained per consumer-day equilibrating at the level of family cluster, while variability of returns again declined consistently until all village residents were incorporated within the analysis.[9]

In summary, variation in the amount of fish produced per consumer was least when data were pooled at the level of the village. It seems that people were offsetting their fishing efforts relative to those of all other residents at the village, not simply those of family or clan group. The implication is that residents of Gwaimasi could expect to share in the fish caught by all other residents at the village and, of course, were expected to share with those other residents any fish they themselves caught; individual fishing efforts were offset in the light of these expectations and obligations. Potential production and consumption of fish by visitors, however, did not affect the organization of fishing by residents. In other words, rights to share in any fish caught by residents of Gwaimasi appear to have been vested in the set of co-residents (but not visitors) based at the village

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[8] Note that the intent of the analysis in Dwyer & Minnegal (1992a) was rather different from the intent here; that analysis was concerned with identifying an optimal level of distribution, whereas here I am concerned with actual patterns of variation in production. The discussion of patterns thus took a different form.

[9] This decline in variability was not simply an artefact of increasing sample size. A comparable analysis of the consequences of equitable sharing of bananas revealed that both the yield of bananas per consumer and month to month variability in supply equilibrated at the level of clan group, suggesting a rather smaller resource-sharing group for bananas than for meat. This may be related to the fact that bananas, in contrast to meat, can be kept for several days after harvest. Consequently, their marginal value does not decline as steeply, and more kin-preference could be expected in patterns of distribution. On this argument we could expect to find even less co-ordination of effort in sago production, since sago flour can be stored for several months.

that day. This set, its composition varying from day to day as residents moved about and beyond the local subsistence zone, comprised what I have called the resource-sharing group.

My interest, in this chapter, is with the effect on behaviour of changes in the size of the resource-sharing group at Gwaimasi. I will focus on that group only in analysis. All reference to 'number of consumers' in the following sections applies specifically to those in the resource-sharing group; that is, visitors to the village are not included.

8.2 SIZE OF THE RESOURCE-SHARING GROUP AT GWAIMASI

8.2.1 Average size

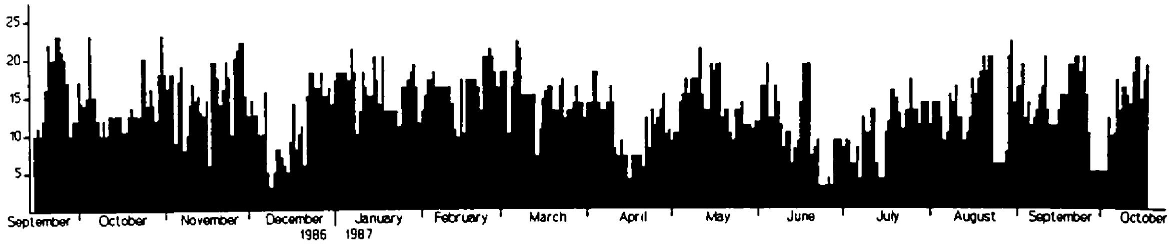
There were, on average, 25 people who regarded themselves, or were regarded by others, as residents of Gwaimasi in any month during the survey (31 separate individuals contributed to that average; see 2.2.2). As noted in the previous section, however, my interest in this chapter concerns not numbers of people *per se* but, rather, the use-value of resources, and the way this changed as people moved into and out of the community. Again, therefore, in the analyses which follow actual numbers of residents at Gwaimasi have been converted to approximate the equivalent number of adult consumers represented (see p.291), and it is this value that is taken as measuring the size of the resource-sharing group.

The **potential** size of the resource-sharing group at Gwaimasi during the survey was, on average, the equivalent of 21.5 adult consumers per day. Not all residents slept at the village each night, however, and thus the actual size of the resource-sharing group on most days was less than this, averaging only 13.5 consumers. More importantly, for the purposes of this chapter, the value varied during the survey from as few as 3.0 to as many as 22.8 consumers.

8.2.2 Variation in size

It was unusual for all residents of Gwaimasi to be based in the village on any day. Some residents, often whole families, would be based at bush houses within the local

(a)



(b)

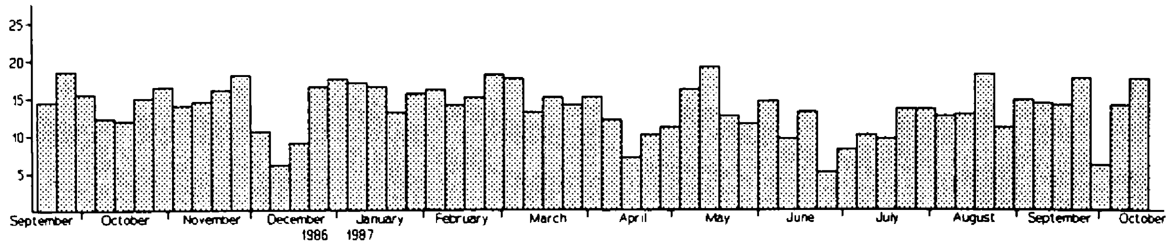


Figure 23 Variation in size of the resource-sharing group at Gwaimasi during the survey, measured as (a) the number of adult-equivalent consumers staying at the village each night, and (b) the average number of consumers per day in each week. (Visitors are not included.)

subsistence zone an hour or more from the village, engaged in subsistence activities or simply in search of privacy. Others might be visiting neighbouring communities or have travelled even further afield. Because households, and to some extent even individuals within households, were essentially autonomous these movements tended to be uncoordinated. The size and composition of the co-resident group based at Gwaimasi, therefore, was continually changing (see Appendix 6).

Figure 23*a* charts the size of the resource-sharing group at Gwaimasi each day during the survey. Day to day variation was great. This raises a problem for analysis. Fish were not always eaten on the day of capture; the number of consumers could rise or fall markedly between time of capture and of consumption. Indeed, although residents usually had a good idea of the planned movements of others, unexpected arrivals or departures might occur while someone was away fishing for the day. Fishing decisions will not have been made in the light of actual numbers of consumers present on the day but on the basis of the number of consumers **expected** to be present. Such expectations presumably reflected trends in the variation of numbers. Therefore, for each week of the survey, I have averaged the number of resident consumers present at Gwaimasi each day (Figure 23*b*), and will take this value as a measure of the expected size of the resource-sharing group, and thus of the potential use-value of resources obtained.

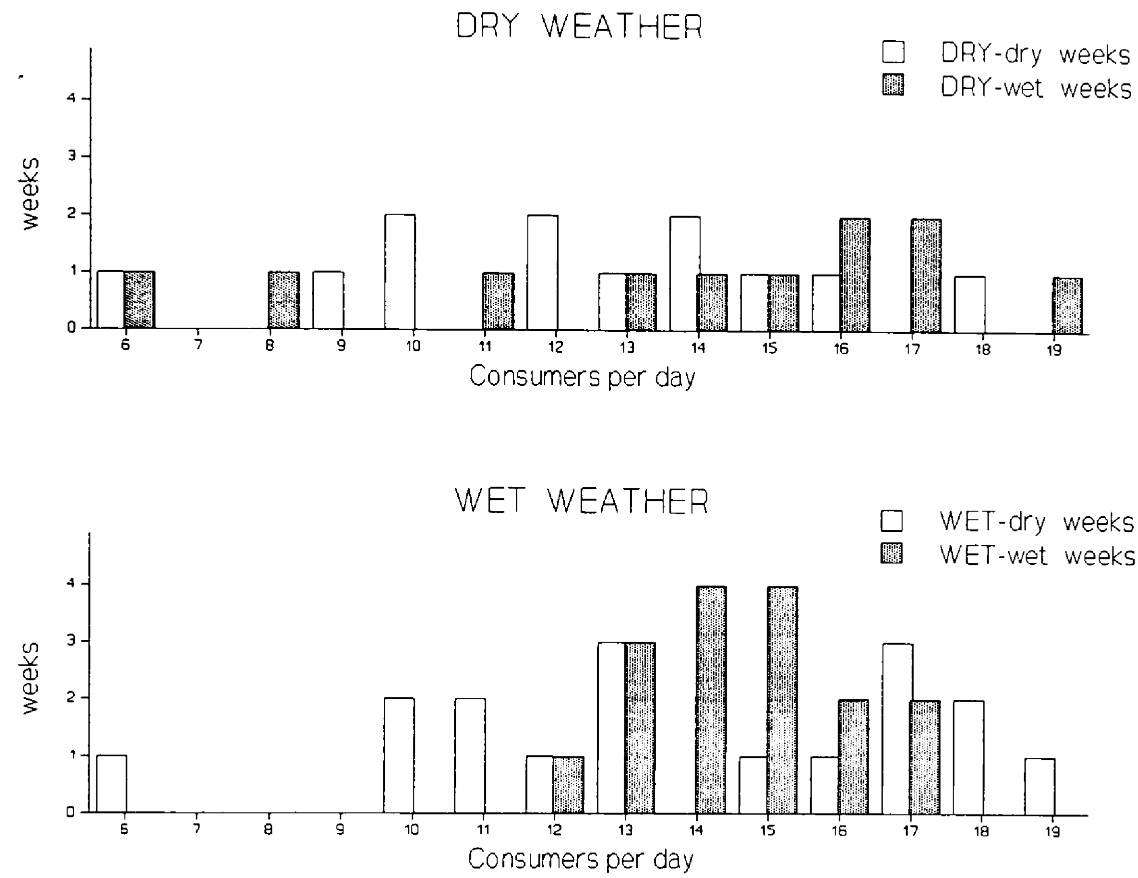


Figure 24 Number of weeks with different sizes of resource-sharing group in each of the four rainfall categories identified in Chapter 6. Number of consumers per day in each week has been rounded to the nearest whole number.

Weeks were chosen as the scale of analysis to allow standardization of patterns relative to variation in constraints on fishing productivity. Availability and accessibility of fish varied greatly during the survey depending on weather conditions - conditions that I have classified according to weekly and monthly patterns of rainfall (6.2.2). In fact, as Figure 24 shows, patterns of movement into and out of the village also were affected by rainfall, in two ways. Comparatively wet weeks in both DRY and WET months increased the probability that people would remain at the village, with median number of resident consumers at Gwaimasi in DRY-wet and WET-wet weeks being 15 and 14.4 respectively, compared to median numbers of 12.5 consumers in both DRY-dry and WET-dry weeks. In addition, the comparatively heavy and persistent rain in WET-wet weeks apparently resulted in a reduction of all movement with people tending to stay were they happened to be; the number of resident consumers at Gwaimasi did not fall below 12 or rise above 17 in Wet-wet weeks, compared to ranges of from 5-6 to 18-19 in other rainfall types.

Records from the different weather conditions are analysed separately when appropriate in the following sections.

8.3 EFFECT ON FISHING BEHAVIOUR

Size of the resource-sharing group at Gwaimasi varied more than threefold in most types of weather during the survey. If, as suggested at the beginning of the thesis and of this chapter, such variation affects the use-value of resources and thus the relative benefits and opportunity costs of procurement decisions, we should expect to see noticeable effects on patterns of fishing behaviour.

Fish eaten by people based at Gwaimasi included not just those caught on day trips from the village but also fish brought in by people who had been staying elsewhere. Indeed, people occasionally travelled to comparatively distant sites, necessitating a night spent in the bush, with the explicit intention of procuring fish to bring back to the village. In such cases decisions concerning haul sizes presumably were made in the light of the number of consumers known (or expected) to be at the village. As noted before, however, unexpected arrivals and departures were not uncommon. Where people were absent for more than two nights their expectations regarding size of the resource-sharing group at the village on their return must be considered suspect. Fish brought back from absences longer than two nights have therefore been disregarded in the following analyses.

Fish brought back from even a short absence may have been caught before the day of return; if smoked, fish can be stored for a few days.[10] I will consider them, however, as a single day's contribution by the fisher concerned.

8.3.1 Overall patterns

Figure 25 plots, for each rainfall type, the amount of fish obtained per fisher-day in each week against the average number of consumers in the resource-sharing group each day that week. For ease of presentation DRY weeks and WET weeks are plotted

[10] Smoked fish did not keep as well as meat from other animals. During the survey, meat from wild pigs, other mammals and birds was smoked and kept for as much as three months before a feast (2.2.6). The fish included in the prestation, however, were all caught no more than two or three days beforehand.

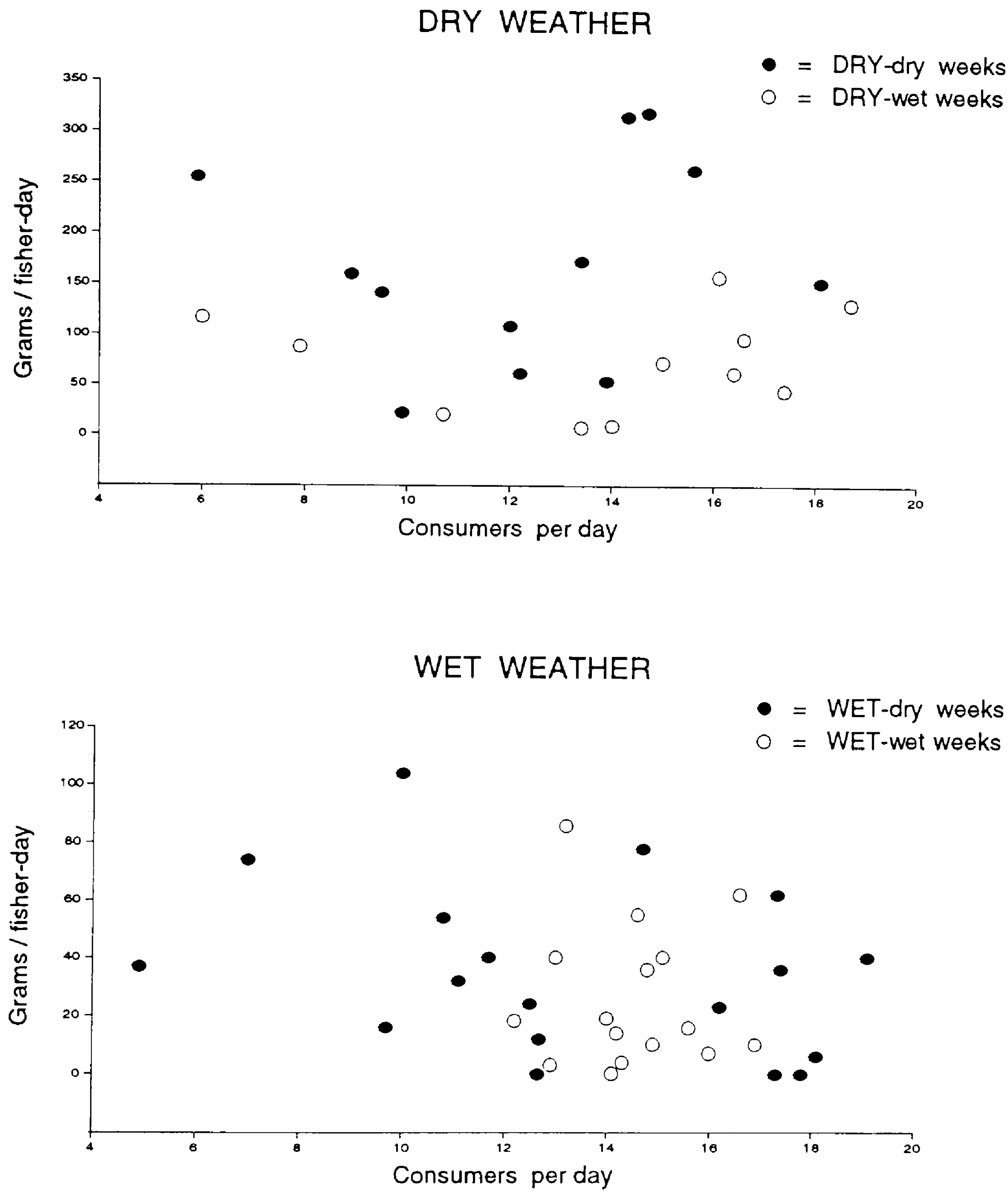


Figure 25 Effect of size of the resource-sharing group on overall production of fish at Gwaimasi: amount of fish produced per fisher-day by residents at Gwaimasi in each week of the survey, relative to average size of the resource-sharing group (number of consumers) at the village on days surveyed in that week. Weeks in DRY months and WET months have been plotted separately, and drier and wetter weeks within those months have been distinguished.

separately. The distributions of points for drier and wetter weeks in dry months show a clear separation; for a given size of the resource-sharing group, less fish was obtained per fisher-day when rainfall was higher. There is no such separation between fishing productivity in drier and wetter weeks of wet months; though size of resource-sharing group varied much less in the latter, amounts of fish procured per fisher-day fall within the range of variation observed for the former and, indeed, span that range. Weeks in these two categories will thus be pooled for subsequent analyses, as WET weeks.

Amounts of fish obtained are well scattered, but in each of the three categories (DRY-dry, DRY-wet and WET) a relationship does appear to exist between size of the resource-sharing group and amount of fish caught per fisher-day. At least some of the variability seen in Figure 25 will reflect stochastic variation in the sizes of fish first encountered - variation over which fishers had only limited control. When average size of the group in any week is rounded to the nearest whole number of consumers per day, and amount obtained per fisher-day averaged for weeks in which size of the group was the same, the observed patterns are clarified (Figure 26). In both drier and wetter weeks of DRY months productivity at first declines and then rises again as size of the resource-sharing group increases ($p < 0.05$ and $p < 0.02$ respectively).[11] In WET weeks there is a consistent fall in productivity as size of resource-sharing group increases ($p < 0.06$).[12]

The patterns of changing productivity outlined above indicate that size of resource-sharing group at Gwaimasi did influence fishing behaviour. Any consistent change in

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[11] One DRY-dry week, November 24-30 1986, has been excluded from this analysis. During that week we employed several residents to build a field station near the stream Sigia. As a result, those people were effectively removed from productive spearfishing areas for three to four days, and obtained less fish than might otherwise have been expected. This was the only survey week in which we employed people to work within the local subsistence zone for more than a few hours.

[12] These and other regressions in this chapter were calculated using the General Linear Model procedure of the SAS data analysis package (SAS Inst. 1988). In each case, I tested both a simple linear model for the relationship between weight of fish obtained and number of consumers (of the form $y = ax + b$) and, where this proved to be not significant, a basic quadratic model (of the form $y = ax^2 + bx + c$). The latter was used merely to test for evidence of significant change in the direction of the relationship as number of consumers increased. The choice of a quadratic equation was made for simplicity of analysis and should not be taken as indicating the expected nature of the relationship; in fact, a succession of linear equations may well have described the relationships more accurately, but sample sizes within the data set preclude more informed analyses.

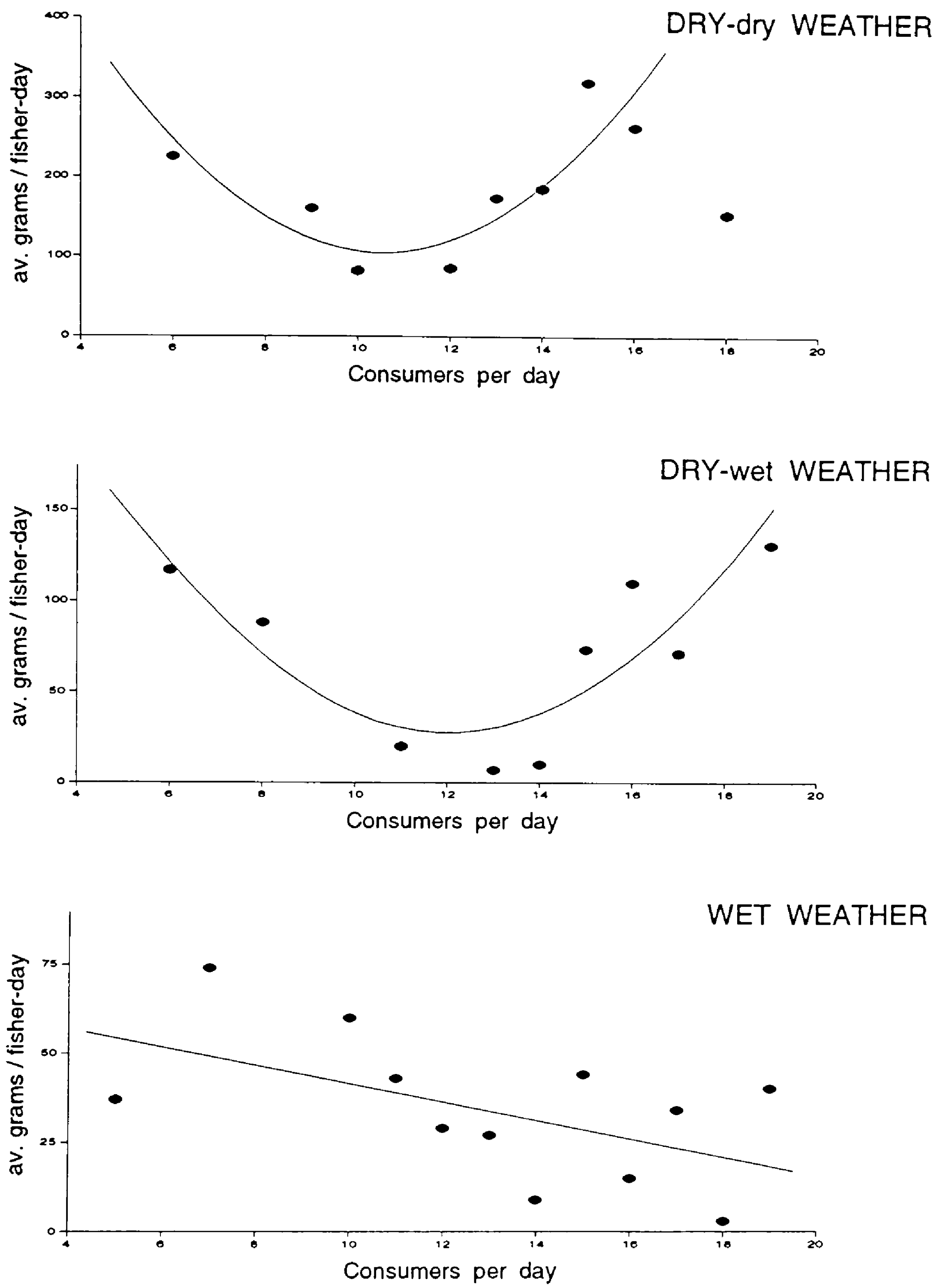

Figure 26 Standardised effect of size of the resource-sharing group on overall production of fish at Gwaimasi: average size of the resource-sharing group at Gwaimasi in any week has been rounded to the nearest whole number of consumers per day, and amount obtained per fisher-day has been averaged for weeks in which size of the group was the same (see Figure 24 for number of weeks in each category). Lines indicate relationships referred to in the text. The DRY-dry week which averaged 18 resident consumers per day has been excluded from analysis; see footnote 10.

fishing productivity (amount produced per fisher-day) must reflect a shift in behaviour entailing, at the least, altered frequency or duration of fishing episodes. But fishing at Gwaimasi was not a unitary phenomenon; several distinct strategies and different tactics contributed to the overall catch. The observed patterns are likely to be composed of several, perhaps contradictory, relationships affecting the marginal value of choosing a given fishing technique, location or type of fish. The apparent complexity of DRY season patterns, where productivity first declines and then rises again with increasing group size, supports this view.

The potential relationship between size of resource-sharing group and the marginal value of a foraging decision is linear. Increasing the size of the resource-sharing group can only increase the potential use-value of produce; it cannot cause the value to decline (see 1.3). But foraging options do not exist in isolation. Because there remains a limit to the potential value of each option, an increase in the benefit to be gained from one option may result in a decline in the **relative** value of another. Since it is changes in relative value that affect optimal foraging behaviour we can argue that (a) increased investment in a given strategy - as indicated by an increase in the amount procured with the strategy per fisher-day - reflects an increase in the marginal value to be expected from that strategy, while (b) any decline in investment reflects an increase in the value of some other strategy.

In the following sections I discuss the major fishing strategies employed at Gwaimasi - spearfishing and linefishing - and the relationships that could be expected, in the light of discussion in previous chapters, between changing size of the resource-sharing group at Gwaimasi and relative value of the strategy as a fishing option. These then provide the context for discussion of patterns revealed by analysis.

8.3.2 **Changes in fishing behaviour**

(a) **Spearfishing**

Gwaimasi men speared fish in streams that drained the backswamps and foothills of the local subsistence zone. All these streams were at least a half-hour walk from the village. Because suitable diving locations were patchily distributed, even within streams, much of the cost of spearfishing lay in travel time. Consequently, the longer a fisher spent actually diving, and thus the larger the haul obtained, the greater the overall efficiency of the technique. Any limit to the amount of fish that could be used would thus directly constrain the utility of spearfishing as a strategy for procuring meat. As size of the resource-sharing group increased, and with it the marginal value of procuring additional meat, spearfishing could be expected to increase in value. Whether, and when, this increase in efficiency translated into increased production would have depended, of course, on the comparative efficiency of spearfishing relative to other fishing or hunting strategies.

Spearfishing was the most flexible of the fishing strategies available to people at Gwaimasi, and the one that offered most control over production. Apart from modifying the frequency with which they fished, and the duration of particular episodes, spearfishers had a choice of various fishing locations with very different return rates and could be selective about types of fish to target once encountered. In addition, since only men fished with spears, the options available to individual fishers would have been basically similar, with the primary sources of variation being individual skill.[13] We could thus expect comparatively clear patterns of change in spearfishing behaviour as size of the resource-sharing group at Gwaimasi changed.

There were significant correlations between the average amount of fish men obtained each day by spearfishing and the average number of consumers at Gwaimasi. The shapes of the relationships in the three rainfall types, however, differed markedly both from each other and from the overall patterns described above.

DRY-dry weather:

In DRY-dry weather, water draining the swamps ran clear and, with water-levels low, fish concentrated in larger streams. Returns for time spent in the water spearing fish were high, in comparison to other meat-getting strategies. With few fish in smaller streams, however, distances to suitable diving locations may have been greater at these times than others.

If the resource-sharing group, and the amount it could consume, were small, travel time would become an important consideration in determining whether or not to go

[13] Though both marriage and reproductive status affected the costs and benefits associated with alternative fishing options (7.2), the effect was minor compared to the variation in abilities of those within the different categories.

spearfishing. Spearfishing episodes that did occur are likely to bave been embedded within other tasks which placed people near suitable diving streams and thus reduced costs. Otherwise, options such as linefishing (see below) would have been preferred.

As size of the resource-sharing group increased, and with it the benefits to be gained from procuring additional meat, the comparatively high within-patch return rates mean that the efficiency of spearfishing increased rapidly. With travel time declining as a proportion of costs associated with this activity the frequency of spearfishing could be expected to increase, as would the distance people were prepared to travel to do so.

The pattern of spearfishing behaviour seen at Gwaimasi in DRY-dry weeks matches these expectations well. No spearfishing occurred during the two weeks with lowest number of consumers. When there were more than nine consumers per day, however, men did occasionally spear fish. Indeed, they steadily increased the average amount of fish each speared per day as number of consumers increased further (Figure 27*a*; $p < 0.05$).

This increased production was achieved in several ways. Men fished more often (Figure 27*b*; $p < 0.05$). They also tended to produce larger hauls, catching more fish in an episode (Figure 27*c*; $p < 0.02$) rather than targeting larger fish. These changes, however, reflected more fundamental behavioural shifts.

Table 58 gives a breakdown of context and location of spearfishing trips in DRY-dry weather, relative to average number of consumers present at the village each day in the week concerned. Discretionary fishing expeditions, where procurement of fish was known to be the primary purpose of the trip, have been distinguished from occasions where fishing was embedded in other activities.[14] As potential benefits increased, men were more likely to undertake specific fishing trips, rather than waiting till other activities placed them near a suitable stream. This allowed for greater choice of fishing locations, and both the streams visited and the species of fish caught reflect this. When numbers of consumers were low men occasionally dived in the small tributaries of Dege nearest the village as well as in Dege itself, but travelled no further afield. Dege dominated fishing

[14] Where context was not specifically known I have assumed, in this and subsequent sections, that fishing was embedded. In fact, I knew the context of all spearfishing episodes that occurred in DRY-dry weather, 10 of 12 in DRY-wet weather and 25 of 30 in WET weather.

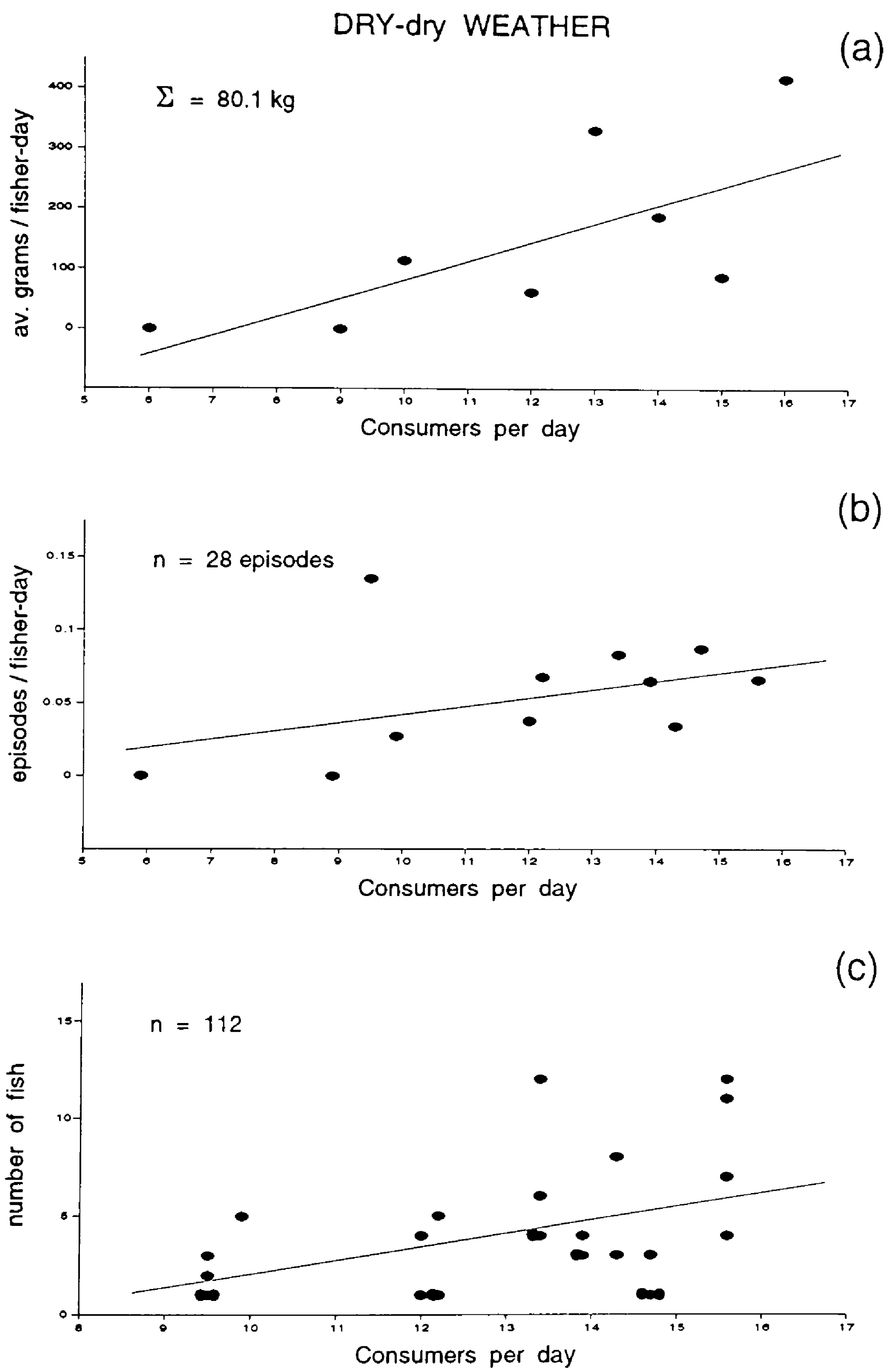

Figure 27 Effect of size of the resource-sharing group on spearfishing in DRY-dry weeks: (*a*) amount of fish produced per fisher-day averaged for weeks with similar number of consumers per day, (*b*) number of episodes per fisher-day in each week, and (*c*) number of fish actually obtained in each episode, relative to average size of the resource-sharing group (consumers per day) at the village. (Note that episodes in the one week when number of consumers averaged 18 have been excluded; see footnote 10 for details.)

Table 58 Context and location of successful spearfishing episodes in DRY-dry weather, relative to average size of the resource-sharing group (consumers per day) in the weeks when those episodes occurred.

CONSUMERS /DAY	CONTEXT[a]		LOCATION				
			Dege System			Eastern Swamp	Other
	embed.	discr.	north	main stream	south		
6	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-
10	6	-	2	3	-	-	1
12	5	-	1	4	-	-	-
13	3	1	-	3	-	-	1
14	2	3	1	2	-	2	-
15	1	3	-	3	-	1	-
16	-	4	-	2	1	-	1

[a] In this and later tables, 'discr.' refers to discretionary episodes, where fishing was the primary reason for leaving the village; 'embed.' refers to episodes where fishing was embedded in other activities.

episodes when numbers were between 12 and 14, but above that number men began to travel to the eastern swamp streams as well. The one visit to Koto, a major tributary of Dege but well to the south, occurred in the week when number of consumers was greatest.

Table 59 provides a breakdown of the types of fish speared in DRY-dry weather relative to average number of consumers present at the village. When the resource-sharing group was small (≤ 12) catches were dominated by one species of forktailed catfish, with perch the next largest category. As number of consumers increased, composition of the catch changed. Eeltailed catfish increased in importance and, when number of consumers reached 14, another species of forktailed catfish began to be caught. The latter change reflects the shift to occasionally fishing in streams of the eastern swamps, where *gumo* (*Arius latirostris*) were apparently far more common (see 6.2.1). The changing importance of eeltailed catfish, however, was evident even within returns from the main stream of Dege; only four of 20 fish speared in Dege when size of the resource-sharing group was less than 13 were eeltailed catfish, compared to 18 eeltailed catfish among 29 fish speared in Dege when number of consumers equalled or exceeded

Table 59 Species composition of the catch from spearfishing in DRY-dry weather relative to average size of the resource-sharing group (consumers per day) in the weeks when those fish were caught.

CONSUMERS /DAY	NUMBER OF FISH CAUGHT				
	Eeltail catfish	Forktail catfish *gumo*	Forktail catfish *soi*	Perch	Other
6	-	-	-	-	-
9	-	-	-	-	-
10	4	-	5	4	-
12	2	-	7	3	-
13	13	-	5	8	-
14	6	7	6	1	1
15	4	2	-	1	-
16	19	2	6	6	1

15 ($\chi^2=8.47$; $p<0.01$). Presumably, as the benefit to be gained from large hauls increased, people were willing to travel further to particular locations along Dege, perhaps pools where large fish such as *aiōdio* (*Plotosus papuensis*) were more likely to be found and within-patch return rates were correspondingly greater.

Individuals at Gwaimasi favoured different spearfishing tactics according to their particular skills and experience (see 7.3). Both the species likely to be caught, and the haul sizes likely to be produced varied as a result. As number of consumers at the village changed, and with it the relative value of different spearfishing strategies, we could expect that individuals would assess their options differently. In other words, we could expect that the identity of those doing the spearfishing would change as size of the resource-sharing group increased. In fact, Filifi and Sinio were responsible for nine of the 13 successful spearfishing episodes that occurred when size of the resource-sharing group equalled or exceeded 14, but only three of the 15 episodes for which number of consumers was less than this ($\chi^2=6.89$; $p<0.01$).

<u>DRY-wet</u> weather:

In DRY-wet weather short spells of heavy rain flooded streams draining swamps and foothills, dramatically reducing visibility and thus the accessibility of fish to spearing. On many days it was simply not possible to catch fish by this technique, and the amount procured in any week can be expected to reflect this. The actual availability of fish within streams was not markedly affected by local rainfall; when it was possible to spear fish, within-patch return rates were similar to those in DRY-dry weeks. The need to monitor condition of streams, however, would have reduced the overall efficiency of spearfishing in this weather.

But the effect of local rainfall on spearfishing efficiency was not the same for all streams. Small streams, such as the northern tributaries of Dege, cleared more quickly that larger streams after rain, while the relative proximity of many of these streams to the village meant that the costs of monitoring their condition would have been minimal. Accessibility of fish in such streams would thus have been little affected by the weather, while the tendency for fish to move into small streams of this sort when it rained may actually have increased their productivity relative to that of DRY-dry weather. Admittedly, the hauls usually obtained from the tributaries of Dege close to the village were small, even in the best conditions. When there were few people to be fed, however, spearfishing in such streams could be among the more efficient ways of meeting requirements.

The comparatively low within-patch return rates for spearfishing in small streams means that efficiency would have increased only slowly as more time was invested in pursuit of larger hauls. As the amount of meat that could be used increased, with size of the resource-sharing group, strategies that required greater minimal time investment but which offered larger returns of meat per unit time (eg. pig hunting), might well have increased in value more rapidly. If the relative value of spearfishing was low enough this strategy might well be dropped from the repertoire of subsistence activities at higher group sizes. But the potential efficiency of spearfishing - especially in the larger, more distant streams with high within-patch return rates - would continue to increase as the benefits to be obtained from procurement of additional meat increased. With even larger numbers of consumers, for whom the amount that could be used exceeds that likely to be produced by any one activity, we could expect that spearfishing might again appear worthwhile.

Again, the pattern of spearfishing behaviour seen at Gwaimasi in DRY-wet weeks matches these expectations. Some spearfishing occurred when the resource-sharing group was very small - up to eight consumers. At intermediate group sizes, from 11 to 14 consumers, no fish were speared. As number of consumers reached 15, however, men

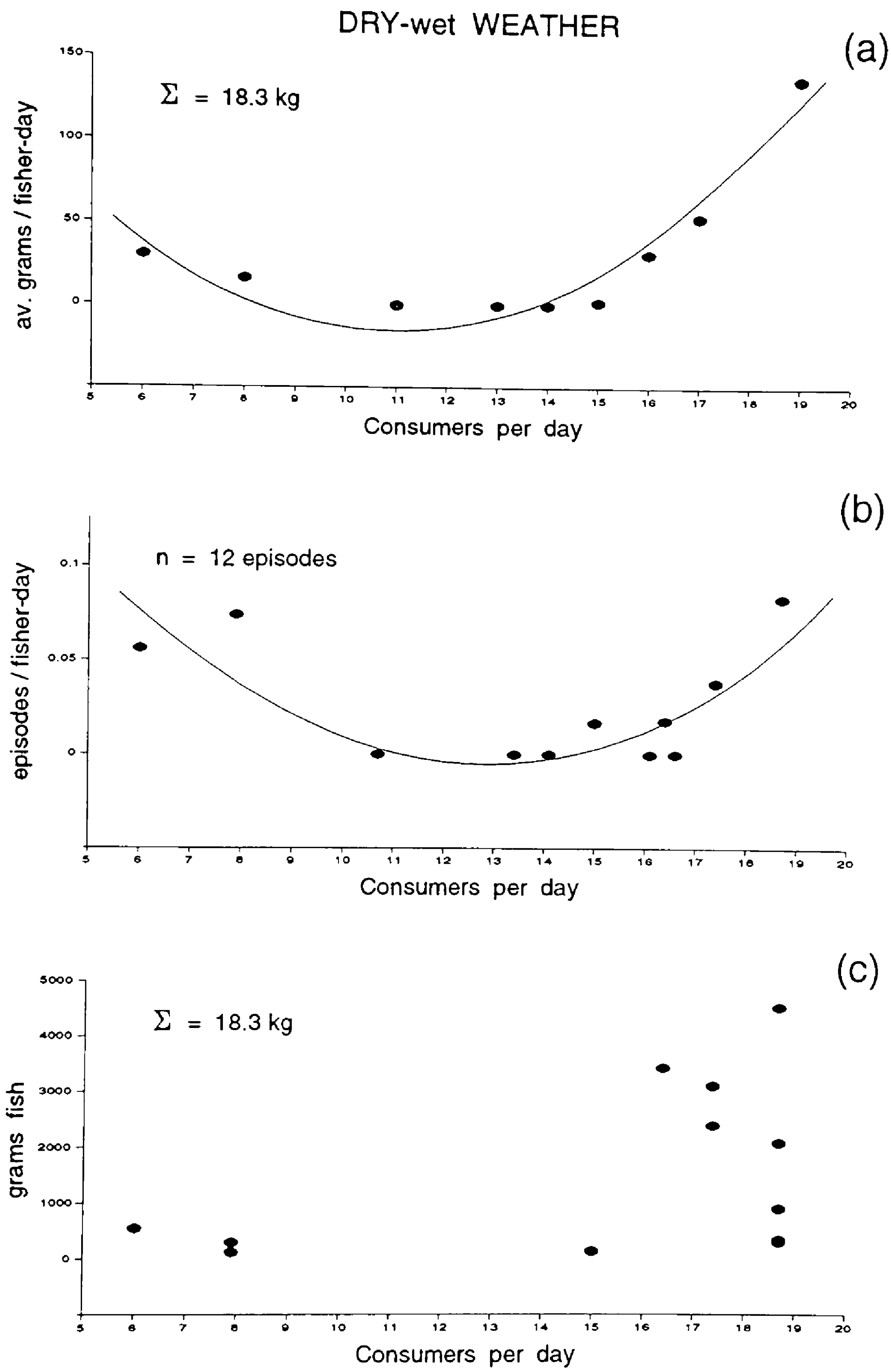

Figure 28 Effect of size of the resource-sharing group on spearfishing in DRY-wet weeks: (*a*) amount of fish produced per fisher-day averaged for weeks with similar numbers of consumers per day, (*b*) number of episodes per fisher-day in each week, and (*c*) size of haul obtained in each episode, relative to average size of the resource-sharing group (consumers per day) at the village.

again began to occasionally spear fish, with the average amount each produced per day increasing as group size increased further (Figure 28*a*; $p > 0.0005$).

Variation in amounts produced primarily reflected the frequency with which men went spearfishing (Figure 28*b*; $p < 0.02$). When size of the consumer group exceeded 16, men also modified the duration and targets of spearfishing episodes, and thus the size of hauls; five of eight episodes in this category produced more that 2000 g of fish[15], compared to a maximum haul of 550 g below that point (Figure 28*c*).

With fish now to be found in smaller streams closer to the village, and travel time a correspondingly smaller component of the costs associated with spearfishing, specific fishing expeditions were feasible even when consumer groups were small. In fact, only two of the successful spearfishing episodes that occurred in these weeks was definitely embedded within other activities, though another two, where context was unknown, I have assumed to have been embedded (Table 60). In addition, the streams chosen for

Table 60 Context and location of successful spearfishing episodes in DRY-wet weather, relative to average size of the resource-sharing group (consumers per day) in the weeks when those episodes occurred.

CONSUMERS /DAY	CONTEXT		LOCATION				
			Dege System			Eastern Swamp	Other
	embed.	discr.	north	main stream	south		
6	-	1	-	1	-	-	-
8	1	1	-	1	-	-	1
11	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-
15	-	1	-	1	-	-	-
16	1	-	1	-	-	-	-
17	1	1	1	-	1	-	-
19	1	4	-	2	-	-	3

[15] The two smallest hauls obtained in the DRY-wet week with the highest average number of consumers per day (September 22-28, 1986), were an artefact of data collection and not real. At this stage, early in the survey, some difficulties still occurred with communication. Of the five fish known to have been caught by two men on this occasion only one was definitely identified as speared. For the others, technique of capture was listed as 'unknown'; they were thus excluded from this analysis.

Table 61 Species composition of the catch from spearfishing in DRY-wet weather relative to average size of the resource-sharing group (consumers per day) in the weeks when those fish were caught.

CONSUMERS /DAY	NUMBER OF FISH CAUGHT				
	Eeltail catfish	Forktail catfish *gumo*	Forktail catfish *soi*	Perch	Other
6	1	-	-	-	-
8	-	-	-	4	-
11	-	-	-	-	-
13	-	-	-	-	-
14	-	-	-	-	-
15	-	-	-	1	-
16	1	-	2	3	-
17	2	-	-	-	-
19	6	1	4	-	-

spearfishing show no evidence that, as potential benefit increased, men were prepared to travel further afield to more productive fishing locations. With a sample size of only twelve episodes, however, definitive conclusions are impossible.

Though men may not have travelled further afield as size of the resource-sharing group increased, the composition of the catch did change (Table 61); in particular, eeltailed catfish increased in both absolute and relative terms. Again, sample size is a problem, but the fact that the observed pattern matches that identified with larger numbers in DRY-dry weather strengths the conclusion.

<u>WET</u> weather:

In WET weather streams of the swamps and foothills were often flooded, and the water table was generally high. As in DRY-wet weeks, fish were often inaccessible. But availability of fish, too, was affected by the persistent high water levels; within-patch productivity of spearfishing, especially in the larger streams, was much lower in this weather than in DRY months. Spearfishing was not the only activity to suffer in these conditions, however. The increased rainfall was widespread, not localized. The difficulties associated with travel in these conditions certainly increased the potential costs associated with linefishing (see below), and may well have affected the costs of procuring game other than fish as well.

The value of spearfishing as a relatively quick way to obtain small quantities of meat from nearby streams would not have been greatly affected by the weather, and may well have been enhanced by the increased costs associated with strategies such as linefishing. Small groups at Gwaimasi could be expected to rely on this technique even more than they did in DRY-wet weather. The actual amount produced per unit time, however, was still low. As number of consumers increased, and with them the benefits to be gained from pursuing other options, reliance on spearfishing should again decline. Of course, efficiency of spearfishing in the larger, more distant, streams also increased as number of consumers rose, but the comparatively low within-patch return rates to be expected in this weather meant that the increase was likely to be slower than that seen in DRY-wet weather.

Again, observed patterns fit these expectations though the relationship in terms of actual amounts produced per fisher-day was not strong. Men relied most on spearfishing when consumer numbers were low[16], the average amount of fish each obtained per day declining as size of the consumer group increased (Figure 29*a*; $p < 0.11$). The pattern is clearer when we look at the probability of an individual choosing to go spearfishing. The frequency of spearfishing at Gwaimasi, measured as number of episodes per fisher-day, declined markedly as number of consumers increased, levelling out at less than one episode every two weeks when consumers numbered between 11 and 17, before perhaps increasing again slightly as numbers increased further (Figure 29*b*; $p < 0.0005$).

Interestingly, while frequency of spearfishing declined, the size of hauls produced still showed a tendency to increase as size of the resource-sharing group increased. People may have been less likely to go spearfishing in the first place, but it seems they did extend their fishing effort once committed. In this weather, the increase was achieved by a tendency to procure larger fish (distorted by capture of a single unusually large fish on one occasion; Figure 29*c*) rather than by obtaining more fish.

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[16] The returns from spearfishing in the WET week with least consumers, an average of only five per day, were rather less than expected on this argument. That week (June 22-28 1987), however, was the week after an old man visiting the village died. People were involved in the aftermath of social interactions with his 'brothers', subject to various taboos, and nervous of the spirit presumed to have been responsible for the death.

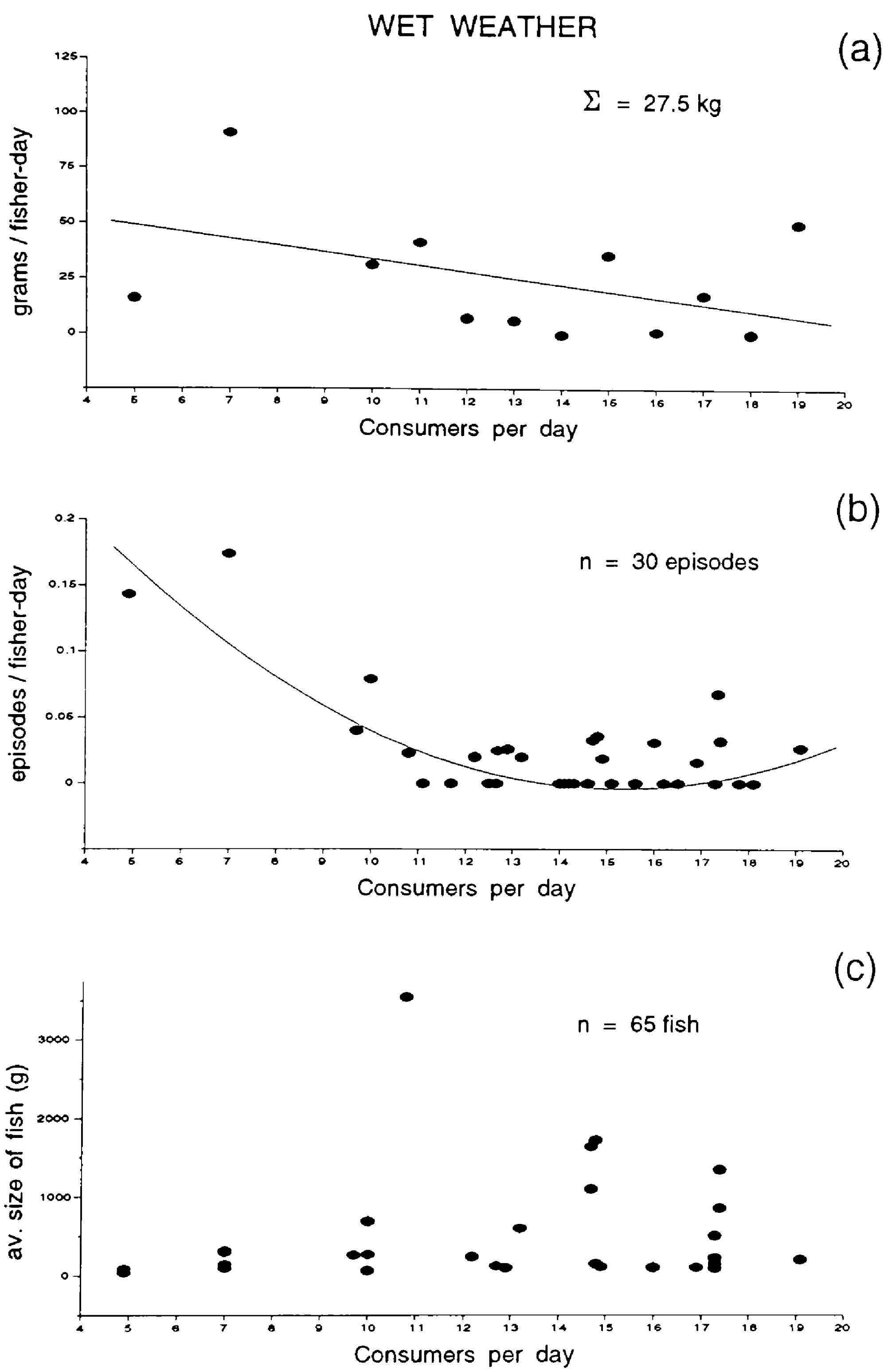

Figure 29 Effect of size of the resource-sharing group on spearfishing in WET weather: (*a*) amount of fish produced per fisher-day averaged for weeks with similar numbers of consumers per day, (*b*) number of episodes per fisher-day in each week, and (*c*) average size of fish obtained in each episode, relative to average size of the resource-sharing group (consumers per day) at the village.

Table 62 Context and location of successful spearfishing episodes in WET weather, relative to average size of the resource-sharing group (consumers per day) in the weeks when those episodes occurred.

CONSUMERS /DAY	CONTEXT		LOCATION				
	embed.	discr.	Dege system north	Dege system main stream	Dege system south	Eastern Swamp	Other
5	2	-	1	-	-	-	1
7	-	4	-	4	-	-	-
10	2	2	2	-	-	2	-
11	1	-	-	-	1	-	-
12	1	-	1	-	-	-	-
13	1	2	1	-	-	-	-
14	-	-	-	-	-	-	-
15	3	2	3	2	-	-	-
16	2	-	2	-	-	-	-
17	7	-	3	2	-	-	2
18	-	-	-	-	-	-	-
19	-	1	1	-	-	-	-

As the efficiency of spearfishing declined relative to that of other strategies for procuring meat men became less willing to travel far to suitable diving locations. In contrast to the pattern seen for DRY-dry weeks, most of the few discretionary fishing trips undertaken in WET weather occurred when size of the consumer group was relatively small (Table 62). As number of consumers increased, episodes of spearfishing were more likely to be embedded within other activities that placed men near suitable diving streams (or, perhaps more importantly in this context, removed them from opportunities to engage in other meat-getting activities). The streams visited, and species composition of the catch, again reflect this shift (Table 62 and Table 63). Half of all episodes of spearfishing in Dege itself, and all those in the tributaries south of Dege or in the eastern swamp streams (few as these were), occurred when consumers at the village numbered less than 11 per day. All Gumo (*Arius latirostris*) caught, therefore, were obtained when group size was relatively small, unlike the pattern seen in other weather. The remainder of the catch was dominated throughout by perch but, as suggested by the observed increase in average size of fish obtained, there was once again a tendency for more eeltailed catfish to be speared as number of consumers increased.

Table 63 Species composition of the catch from spearfishing in WET weather relative to average size of the resource-sharing group (consumers per day) in the weeks when those fish were caught.

CONSUMERS /DAY	NUMBER OF FISH CAUGHT				
	Eeltail catfish	Forktail catfish *gumo*	Forktail catfish *soi*	Perch	Other
5	-	-	-	3	-
7	1	-	-	8	1
10	-	3	1	3	-
11	1	-	-	-	-
12	-	-	-	3	-
13	1	-	-	9	-
14	-	-	-	-	-
15	5	-	1	5	-
16	-	-	-	2	-
17	4	-	3	8	1
18	-	-	-	-	-
19	1	-	-	3	-

Again, in this weather there was a shift in the identity of individuals doing most spearfishing as number of consumers increased. This time, however, it was Gugwi and Simo whose skills best suited spearfishing in the prevailing conditions. These two men were responsible for only 5 of 15 successful spearfishing episodes that occurred when size of the resource-sharing group was less than 14. Others lost interest in spearfishing, however, with the increase in relative value of other meat-getting activities, leaving Gugwi and Simo responsible for 11 of the 15 episodes that occurred with numbers of consumers greater than 14 ($\chi^2=4.82$; $p<0.05$).

(b) **Linefishing**

Nearly all fish obtained by linefishing at Gwaimasi came from the Strickland River.[17] Though there were undoubtedly some locations along that river where fish were more readily caught, lines could be set almost anywhere along the banks, including the beach immediately below the village. Given this, and the fact that other subsistence activities regularly brought people to the river's edge, linefishing entailed little travel

[17] To minimize possible sources of variation fish that were not caught in the Strickland River have been excluded from the following analyses and discussion.

time. There were other costs associated with linefishing - notably the time spent locating bait, and perhaps the risk of lost equipment - but these were directly proportional to the number of lines set and thus to the amount likely to be produced. Efficiency of linefishing, then, would not have changed as number of fish caught in an episode increased, and utility of the technique would not have been affected by the amount of fish that could be used. Any change in linefishing behaviour as size of the resource-sharing group increased could thus be expected to be a reflection of the changing value of alternate strategies of meat procurement, rather than of changes in the value of linefishing itself. There were, however, other factors which may have complicated the patterns.

Linefishing, particularly with set lines, offered much less control than spearfishing over the outcome of any episode. Though each line thrown out represented an opportunity to procure a single fish, a catch on any one bait was not guaranteed. In addition, this technique allowed only very limited control over prey size or type. An increase in the marginal value of procuring additional meat may have increased the opportunity costs associated with uncertainty of returns. As number of consumers increased, therefore, linefishing tactics that maximized the **probability** of procuring fish would have increased in relative value.

Linefishing at Gwaimasi encompassed several distinct tactics for controlling the catch. Productivity could be altered by varying the number of baits set per unit time - either by setting a line more often, by setting more than one line at a time, or by tending a line so that each bait could be replaced as soon as it was taken. The first affects only the average number of fish produced through time. The second alters the average number of fish obtained per episode but not variation in that number; it does, however increase the probability that at least one fish will be procured on any occasion. Only the third tactic is likely to reduce variation in numbers obtained and, correspondingly, offer much in the way of control over size of hauls. Because not all lines catch fish, however, there are problems in discerning from results which of these tactics were employed in an episode of linefishing. A single fish may have been caught using any of these tactics. When two fish were caught in one episode obviously more than one line was used, but whether set or tended could not always be known. If more than two fish were caught on one occasion I have assumed that lines were tended (see 5.2.3).

The comparatively limited control over returns from particular episodes, as well as the diversity of tactics available, means that patterns of change in linefishing behaviour are unlikely to be as clearcut as those for spearfishing behaviour. In fact only in WET weather, where the number of weeks sampled was sufficient to balance out some of the underlying stochastic variation in returns from individual episodes, did significant relationships emerge between amount of fish obtained by line per fisher-day (measured as either weight or number) and size of the resource-sharing group. Frequency of successful linefishing episodes provides a better indication of changes in use of this technique. Because a significant proportion of attempts at set-line fishing may produce no catch, however, short-term fluctuations in success may distort underlying patterns. To minimize the effect of such variation, in each of the following sections I have averaged observed frequencies of linefishing for weeks with similar numbers of consumers.

Patterns of linefishing behaviour may have been further complicated by the fact that both men and women fished with lines at Gwaimasi; the options available to these two groups differed, and responses to change in size of resource-sharing group could be expected to reflect this. I will distinguish the two where appropriate.

DRY-dry weather:

In both DRY-dry and DRY-wet weather the Strickland River was usually low, canoes an attractive form of transport and potential linefishing sites readily accessible. The muddy banks where bait was often found were exposed. Costs associated with linefishing, then, were minimal. In DRY-dry weather, however, other fishing techniques - particularly spearfishing - were also comparatively efficient means of procuring meat.

With spearfishing an attractive alternative to linefishing in DRY-dry weather we could expect males to differ from females in the choices they made. In fact, men obtained most fish by line in the two DRY-dry weeks when size of the resource-sharing group was smallest and the value of spearfishing thus least. When number of consumers in the group exceeded nine, and spearfishing apparently became worthwhile as a meat-getting strategy, the frequency with which men went linefishing dropped dramatically. The minimal costs entailed in use of linefishing, however, ensured that it was not discarded entirely and, as number of consumers increased further, linefishing by men again picked up (Figure 30*a*; $p < 0.04$).[18]

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[18] Note that the week November 24-30 1986, which was excluded in analysis of spearfishing behaviour, is included in this calculation. Linefishing is not subject to the same constraints of time and location that limit choices with relation to spearfishing, and is thus less likely to have been affected by the nature or location of day-time activities. See footnote 10.

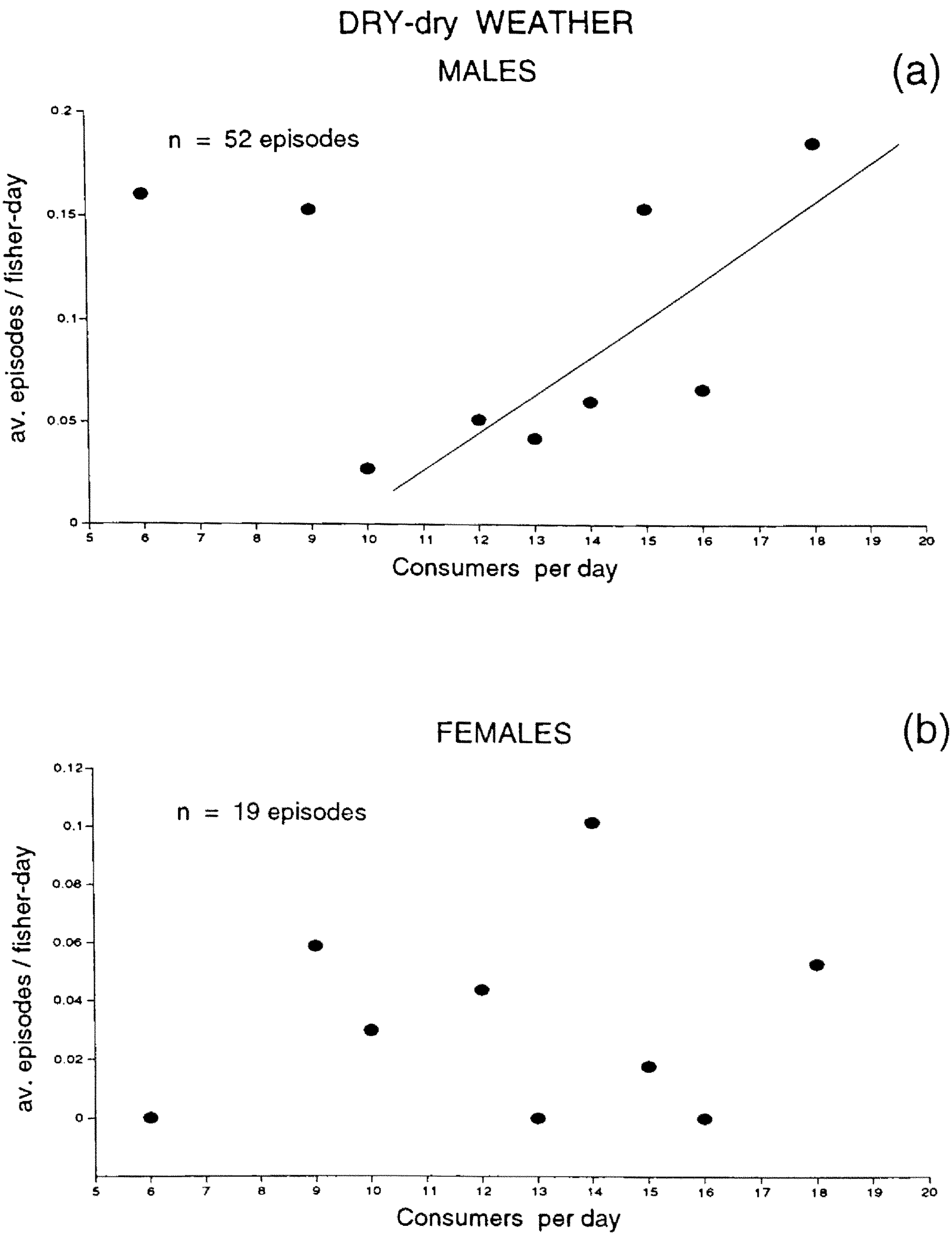

Figure 30 Effect of size of the resource-sharing group on linefishing in DRY-dry weather: average number of successful linefishing episodes per fisher-day by (*a*) male and (*b*) female residents of Gwaimasi, relative to average size of the resource-sharing group (consumers per day) in the weeks when the episodes occurred.

Table 64 Frequency of linefishing episodes producing different numbers of fish in DRY-dry weather, relative to average size of the resource-sharing group (consumers per day) in the weeks when those episodes occurred.

	EPISODES PER 100 FISHER-DAYS					
CONSUMERS /DAY	MALES number of fish caught			FEMALES number of fish caught		
	1	2	>2	1	2	>2
6	12.0	-	4.0	-	-	-
9	15.2	-	-	5.9	-	-
10	1.4	-	1.4	3.0	-	-
12	4.2	0.9	-	2.9	1.5	-
13	4.2	-	-	-	-	-
14	1.7	2.6	1.7	8.0	-	2.3
15	13.1	2.2	2.2	1.8	-	-
16	4.9	-	1.6	-	-	-
18	12.7	1.4	4.2	5.3	-	-

The increase in frequency of linefishing by males with increasing size of the resource-sharing group (above nine consumers per day) entailed more than just setting lines more often. Rather, people changed the way they fished. Table 64 provides a breakdown of the frequency with which hauls of different numbers of fish were obtained, using the categories referred to above. The first hauls by men of two fish - indicating that multiple lines were perhaps being set - appeared when group size reached 12, but that option was rarely used in this weather. More importantly, in terms of quantity, as number of consumers increased above 14 men again began to tend lines as they did when the group was small, producing hauls of more than two fish. They also became willing to travel to locations where fish were more likely to be caught. Table 65 gives a breakdown by context of successful linefishing episodes in DRY-dry weather relative to number of consumers. Episodes near the village would have entailed little travel cost, even if no other task brought people to the river bank. These have been distinguished from episodes that occurred elsewhere, the latter then being further divided into discretionary fishing trips *versus* those embedded in other activities. Four of the five episodes that entailed travel away from the village for the primary purpose of catching fish occurred in weeks where consumers numbered 15 or more.

Table 65 Context of successful linefishing episodes by male and female residents of Gwaimasi in DRY-dry weather, relative to the average size of the resource-sharing group (consumers per day) in the weeks when those episodes occurred.

CONSUMERS /DAY	CONTEXT[a]					
	MALES			FEMALES		
	vill.	embed.	discr.	vill.	embed.	discr.
6	1	3	-	1	-	-
9	6	1	-	1	1	-
10	-	1	1	-	-	-
12	2	3	-	1	2	-
13	-	2	-	-	-	-
14	2	5	-	4	5	-
15	4	3	1	1	-	-
16	1	1	1	-	-	-
18	5	5	2	4	-	-

[a] In this and later tables, 'vill.' refers to episodes of linefishing near the village, which entailed little travel; 'discr.' refers to discretionary episodes away from the village where fishing was the primary reason for going out; 'embed.' refers to episodes away from the village where fishing was embedded in other activities.

Despite this shift to more intensive linefishing tactics as size of the resource-sharing group increased, the average weight of hauls did not change. As expected, then, it seems likely that the shift was concerned as much with reducing the risk of producing nothing than with increasing the amounts produced.

Linefishing by women in DRY-dry weather, in contrast to that by men, did not show any clearcut response to changing numbers of consumers (Figure 30*b*). This absence of pattern, however, may well reflect the small sample of successful fishing episodes by women rather than being an indication of insensitivity to changes in the use-value of fish; nine of the 19 episodes occurred in one week and were related to intensive work at a garden on the bank of the river. As will be seen below, women did modify their linefishing behaviour according to numbers of consumers in other weather conditions.

DRY-wet weather:

The short spells of heavy rain that characterized DRY-wet weather tended to be localized. They had little effect on the Strickland River, and thus on the costs and benefits associated with linefishing. The effect on spearfishing, however, and perhaps on other hunting strategies, was considerable, with efficiency of the former markedly reduced. The **relative** value of linefishing as a means of procuring meat will have been enhanced as a result.

The enhanced value of linefishing in DRY-wet weather was reflected in a greater use of multiple lines and tending of lines, particularly by men; more than half of all linefishing episodes by males in this weather (25 of 42) produced at least two fish, compared to only 15 of 51 episodes in DRY-dry weather and 6 of 33 episodes in WET weather. For men, at least, frequency of linefishing will be a less reliable indicator of intended or actual productivity in this weather, and must be read in combination with sizes of hauls. Women had less access to multiple lines and fewer opportunities to tend lines and, though they too were more likely to use intensive techniques in DRY-wet weather rather than at other times, only 6 of their 23 linefishing episodes in this weather produced two or more fish.

With spearfishing less important in DRY-wet weather linefishing by males and females could be expected to show rather similar patterns of response to changes in size of the resource-sharing group. In fact, neither category showed an unambiguous response. Both males and females caught most fish by line in the week when the resource-sharing group was smallest, with frequency of linefishing declining as number of consumers in the group increased and other meat-getting strategies presumably became more attractive (Figure 31). This pattern was interrupted, however, with what appears to be a sharp peak in linefishing activity by males when the resource-sharing group numbered 15-17 before frequency of fishing again declined. (Women showed an analogous, though smaller, peak in linefishing activity when there were 16 consumers in the group, but also a trough at 13 consumers.)

In weeks when consumers numbered 15-17, lines were not only set more often but were also more likely to be tended (Table 66). Much of the increased fishing activity was focussed on lines set at the village, which might indicate that, for some reason, people had less freedom to pursue other meat-getting strategies in those weeks. But linefishing in

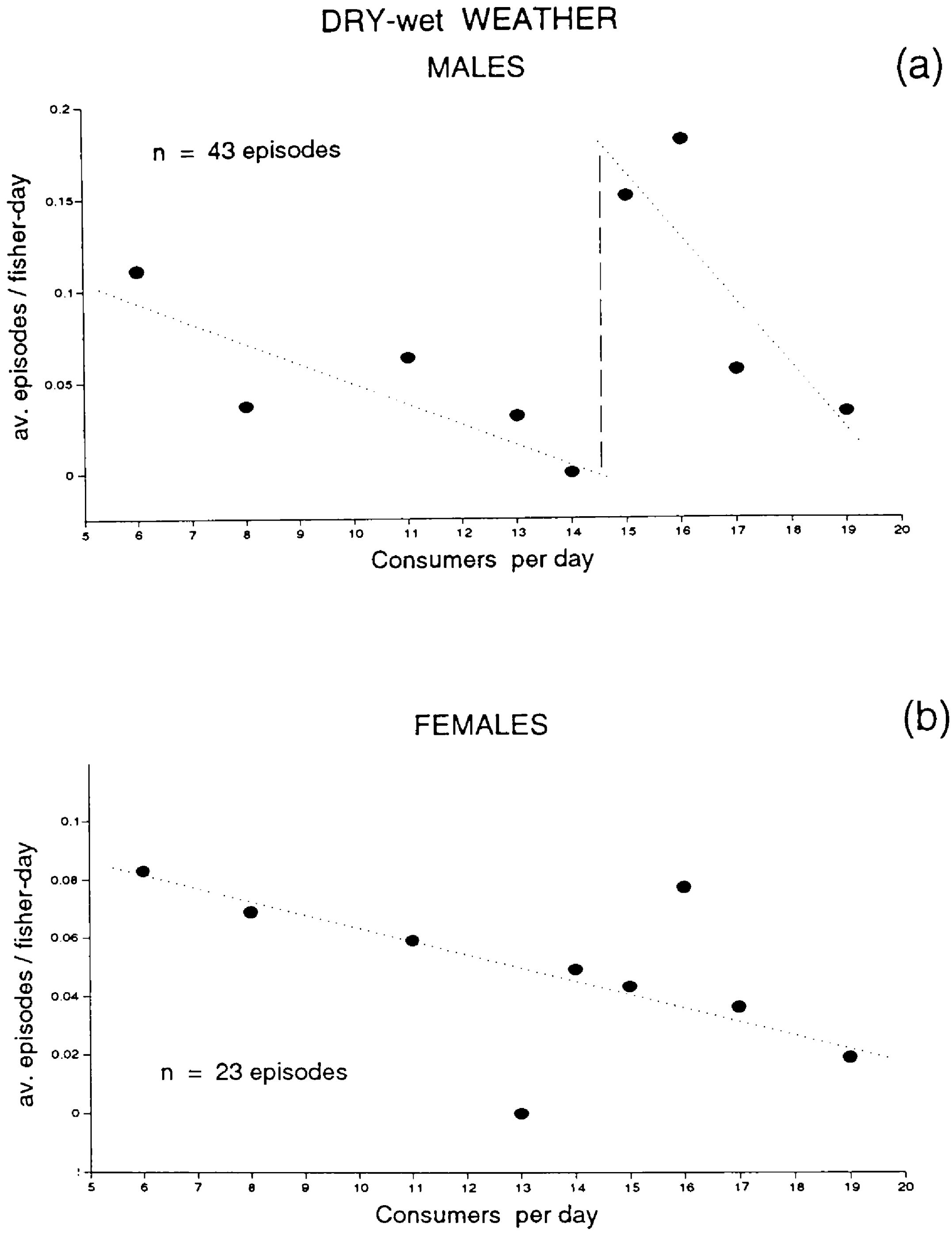

Figure 31 Effect of size of the resource-sharing group on linefishing in DRY-wet weather: average number of successful spearfishing episodes per fisher-day by (*a*) male and (*b*) female residents of Gwaimasi, relative to average size of the resource-sharing group (consumers per day) in the weeks when the fish were caught. (Dotted lines indicate suggested trends, not significant relationships.)

Table 66 Frequency of linefishing episodes producing different numbers of fish in DRY-wet weather, relative to average size of the resource-sharing group (consumers per day) in the weeks when those episodes occurred.

CONSUMERS /DAY	EPISODES PER 100 FISHER-DAYS					
	MALES number of fish caught			FEMALES number of fish caught		
	1	2	>2	1	2	>2
6	-	-	11.1	4.2	4.2	-
8	-	3.7	-	-	6.9	-
11	6.3	-	-	5.9	-	-
13	3.1	-	-	-	-	-
14	-	-	-	4.9	-	-
15	6.7	1.7	6.7	4.3	-	-
16	9.9	3.6	4.5	6.9	0.9	-
17	0.8	3.2	1.6	1.8	0.9	0.9
19	1.7	1.7	-	1.9	-	-

Table 67 Context of successful linefishing episodes by male and female residents of Gwaimasi in DRY-wet weather, relative to average size of the resource-sharing group (consumers per day) in the weeks when those episodes occurred.

CONSUMERS /DAY	CONTEXT					
	MALES			FEMALES		
	vill.	embed.	discr.	vill.	embed.	discr.
6	-	1	1	-	2	-
8	-	-	1	-	2	-
11	-	1	-	-	1	-
13	-	1	-	-	-	-
14	-	-	-	1	1	-
15	2	6	1	2	-	-
16	13	6	1	2	7	-
17	-	4	3	1	3	-
19	1	-	1	-	1	-

association with other activities also increased (Table 67). The weeks concerned (6,7,10 and 15) were not all consecutive, supporting a conclusion that the shift was, in fact, a response to size of the consumer group.

WET weather:

The increased rainfall in WET weather was widespread and persistent, compared to that of DRY weeks. The river level was generally higher, making use of canoes more difficult and restricting access to fishing locations and sources of bait. Since the river could rise several metres overnight there was considerable risk of losing set-lines. Potential costs associated with linefishing increased as a result, reducing its value relative to other meat-getting strategies, including spearfishing.

The lower value of linefishing was reflected in the much reduced frequency of successful linefishing episodes in WET weeks compared to DRY weeks. It also meant that as size of the resource-sharing group increased, and with it the marginal value of obtaining additional meat, linefishing - like spearfishing in this weather - could be expected to reduce further in value relative to other strategies of procuring meat. In fact, both men and women showed a marked decline in frequency of linefishing as the number of resident consumers at Gwaimasi increased (Figure 32; $p < 0.05$ and $p < 0.01$ respectively); linefishing was rare when the resource-sharing group numbered 18 or more.

While overall frequency of linefishing declined as size of the resource-sharing group increased, men and women responded somewhat differently in their choice of strategies. Though men were less likely to set single lines as number of consumers increased, they apparently became more willing to use techniques that offered larger hauls - setting additional lines or tending lines (Table 68; episodes with two or more fish appeared only when the number of consumers per day was ≥ 13). Women, in contrast, did not; if anything, their relative willingness to set additional lines declined as size of the resource-sharing group increased. This fits my earlier observation that women at Gwaimasi generally showed less interest in producing large hauls of fish, and presumably had less to gain from doing so (see 7.2.1). The relative value of tactics which increased the predictability of returns rather than just average number of fish caught, however, did not show the same gender difference. As size of the resource-sharing group increased, both men and women showed an increased willingness to invest time in travel to locations where fish were more likely to be caught (Table 69; all five occasions when people travelled away from the village for the primary purpose of catching fish occurred when consumers at the village numbered at least 13, with four of those five episodes occurring when consumers numbered 16 or more).

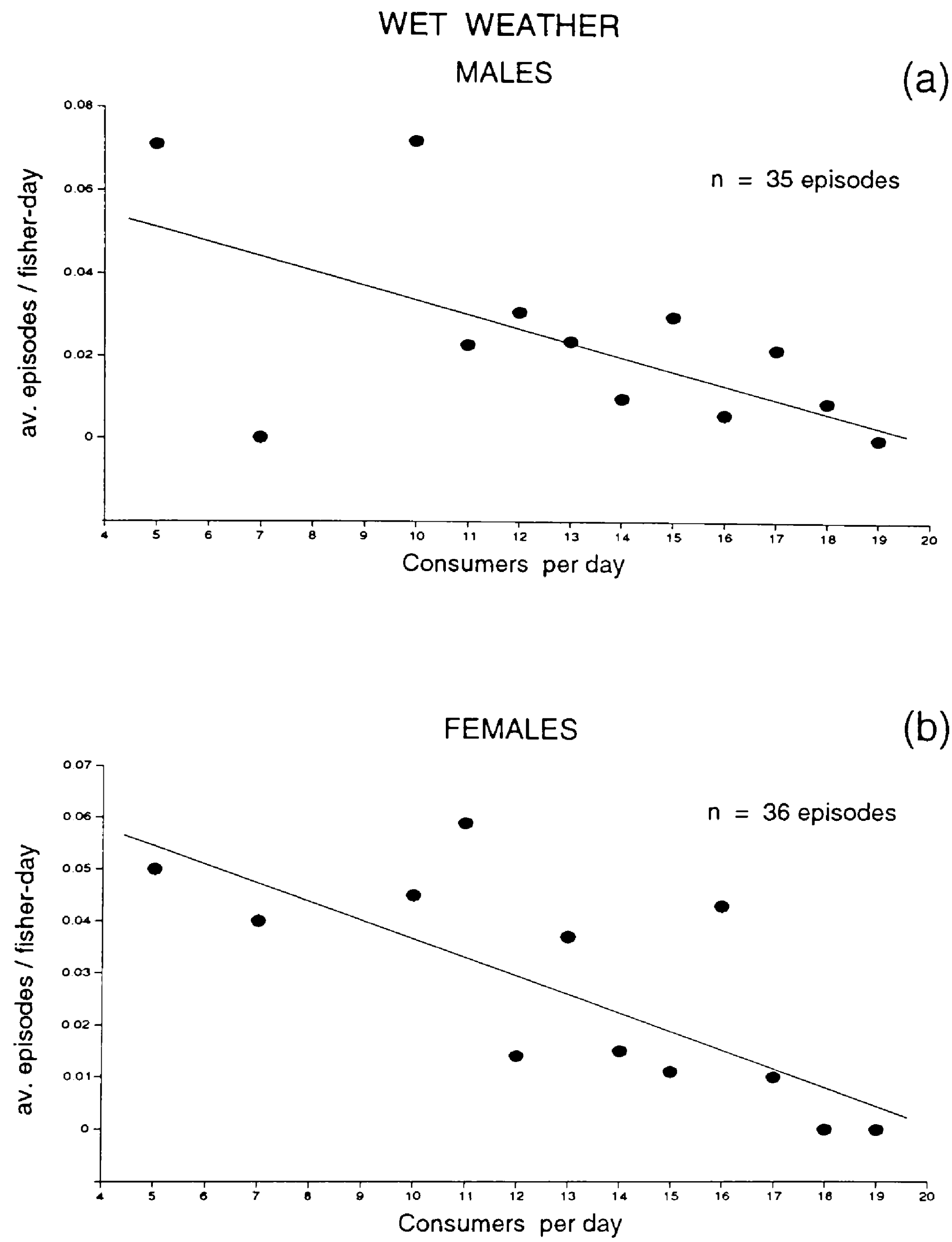

Figure 32 Effect of size of the resource-sharing group on linefishing in WET weather: average number of successful linefishing episodes per fisher-day by (*a*) male and (*b*) female residents of Gwaimasi, relative to average size of the resource-sharing group (consumers per day) in the weeks when the episodes occurred.

Table 68 Frequency of linefishing episodes producing different numbers of fish in WET weather, relative to average size of the resource-sharing group (consumers per day) in the weeks when those episodes occurred.

CONSUMERS /DAY	EPISODES PER 100 FISHER-DAYS					
	MALES number of fish caught			FEMALES number of fish caught		
	1	2	>2	1	2	>2
5	7.1	-	-	-	5.0	-
7	-	-	-	4.0	-	-
10	7.2	-	-	2.9	1.7	-
11	2.3	-	-	5.9	-	-
12	3.1	-	-	1.4	-	-
13	2.0	-	0.3	3.3	0.4	-
14	1.0	-	-	1.5	-	-
15	2.7	0.4	-	1.1	-	-
16	0.6	-	-	4.4	-	-
17	1.9	-	0.3	0.3	0.6	-
18	-	0.9	-	-	-	-
19	-	-	-	-	-	-

Table 69 Context of successful linefishing episodes by male and female residents of Gwaimasi in WET weather, relative to average size of the resource-sharing group (consumers per day) in the weeks when those episodes occurred.

CONSUMERS /DAY	CONTEXT					
	MALES			FEMALES		
	vill.	embed.	discr.	vill.	embed.	discr.
5	1	-	-	1	-	-
7	-	-	-	1	-	-
10	1	3	-	2	1	-
11	-	2	-	1	4	-
12	1	2	-	-	2	-
13	3	1	1	5	5	-
14	-	2	-	1	2	-
15	2	6	-	1	3	-
16	-	1	-	2	3	1
17	4	1	1	-	1	1
18	-	-	1	-	-	-
19	-	-	-	-	-	-

8.4 SUMMARY AND DISCUSSION

I have defined 'resource-sharing group' as a set of individuals who share collective access to a resource; who share *in* a resource. All members of such a group can expect to receive a more-or-less equal share of any produce resulting from appropriation of the resource (though not necessarily of the goods produced by any individual). If needs are limited, the amount of a resource that could be used by the group will be constrained by its size. The amount that any individual could usefully procure on any day would depend, in addition, on what others had obtained. People could thus be expected to adjust their foraging behaviour in the light both of the number of consumers in the resource-sharing group and of the productive activities of others in the group.

The amount of fish procured by residents of Gwaimasi varied not only between individuals but also, for any individual, through time. Patterns of variation in the production of fish, relative to the availability of fish for consumption, indicated that the amount an individual was likely to procure in any fortnight was influenced by the activities of all other residents at the village, and not simply those of family or clan affiliates. Potential production and consumption of fish by visitors, however, did not seem to influence when and how people fished. I thus consider the resource-sharing group at Gwaimasi to have comprised the set of co-residents (but not visitors) based at the village on any day.

Size of the resource-sharing group at Gwaimasi varied as much as sevenfold through the survey (threefold when averaged by week) as residents moved about and beyond the local subsistence area. As the number of adult-equivalent consumers in the group increased, the frequency with which people went fishing, the techniques they favoured and the streams visited, all changed markedly. The reasons are to be found in the changing value of different options as the amount of meat that could be used increased.

The actual pattern of change in fishing behaviour in response to increasing size of the resource-sharing group varied both with technique used and with weather conditions. That variation, however, is understandable in terms of the effect that these factors had on the material outcome to be expected from fishing, as well as from other meat-procurement strategies. The form of the relationships underlying patterns of change can be seen as the same.

Consistency in the form of relationships underlying response to changing size of the resource-sharing group, despite weather-induced differences in that response, is particularly clear in the case of spearfishing. In DRY-dry weather, people at Gwaimasi did not spear fish if there were only a few to be fed. As number of potential consumers increased, however, people became more likely to go spearfishing, increasing not only their frequency of successful episodes but also the time spent fishing during each episode. In DRY-wet weather, in contrast, people did sometimes spear fish when there were few to be fed, but initially became less likely to do so as number of consumers increased. With further increase in numbers, however, frequency of spearfishing again began to pick up. In WET weather, people were even more likely to spear fish when there were few consumers but, again, the frequency with which they did so declined steadily as the size of the resource-sharing group increased. There was some indication, however, that interest in spearfishing might have picked up again at group sizes larger than those that usually existed at Gwaimasi. In summary, spearfishing increased with number of consumers in DRY-dry weather, declined before rising again with number of consumers in DRY-wet weather, and simply declined in WET weather. These patterns seem very different. But the relationships which defined the curves were the same in each case.

As the number of consumers in the resource-sharing group at Gwaimasi changed, the average frequency with which each male went spearfishing also changed, increasing or decreasing. Since the amount of meat that each consumer could use would have been the same regardless of how many were present, it seems that the shifts in behaviour must reflect changing preferences for alternative procurement strategies. Evolutionary ecology suggests that the probability of a particular strategy being chosen would depend on its efficiency RELATIVE to that of other options. Thus, the changes in fishing behaviour observed at Gwaimasi presumably reflect changes in the efficiency either of spearfishing or of alternative meat-getting strategies, as number of consumers increased. (In fact, both probably contributed.)

Where resources are not evenly distributed in the environment, efficiency of a procurement strategy will depend on both the time required to reach a patch of the resource and the rate at which items will be encountered and secured within the patch. Thus, as shown in Figure 33, efficiency will rise as more time is spent within the patch and more of the resource is harvested; it would not take twice as long to procure **2a** as it

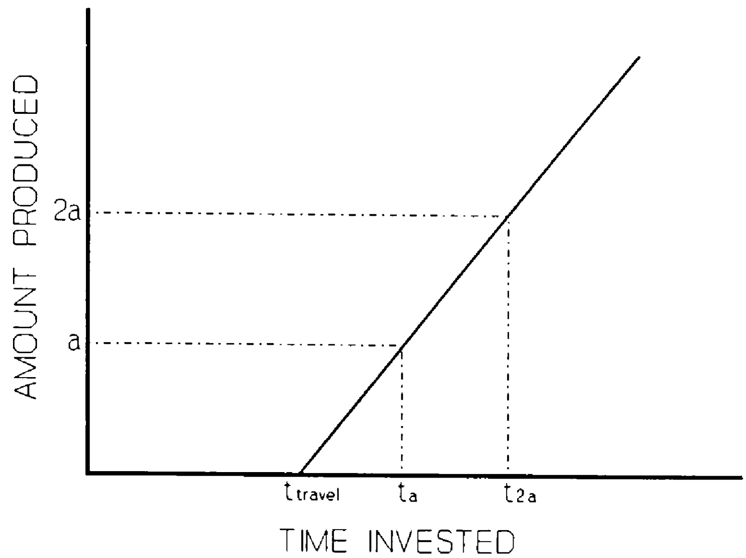

Figure 33 Productivity curve for a patchily distributed resource, showing effect on efficiency as amount produced increases. Because some time must be spent in travel before a patch is reached (t_{travel}), efficiency of production will increase the more time is actually spent foraging in the patch. Thus, while an amount **a** will require time $\mathbf{t_a}$ to harvest, it will not take twice that time to harvest 2**a**.

took to procure **a** in the first place.[19] Clearly, the efficiency of a procurement strategy can only be measured in relation to the amount that is to be produced. If one can only use an amount **a** of the resource in question then the potential for greater efficiency at larger haul sizes is irrelevant.

Alternative strategies for procurement of any resource may differ both in the travel time required to reach a patch and in the return rates that can be expected once there. Figure 34*a* shows hypothetical productivity curves for two different strategies, one requiring little travel to reach patches but with low within-patch return rates, the other requiring more time spent in travel but with much higher within-patch return rates. The latter strategy potentially could be much more efficient than the former. But, as I have argued, the effective efficiency of any strategy will be constrained by the amount of the

[19] In this and following figures I have shown within-patch return rates as constant. Since patches are finite, and the resources they contain can thus be depleted, the rate of harvest could actually be expected to decline through time and there would be a time beyond which further effort would actually reduce efficiency of the strategy (Charnov 1976; this was, in fact, the basis of my assumption that haul sizes indexed the productivity of stream systems; 6.1.3). Here, however, to simplify variables for the purpose of illustration, I assume that the relevant cutoff was above the limit set by requirements.

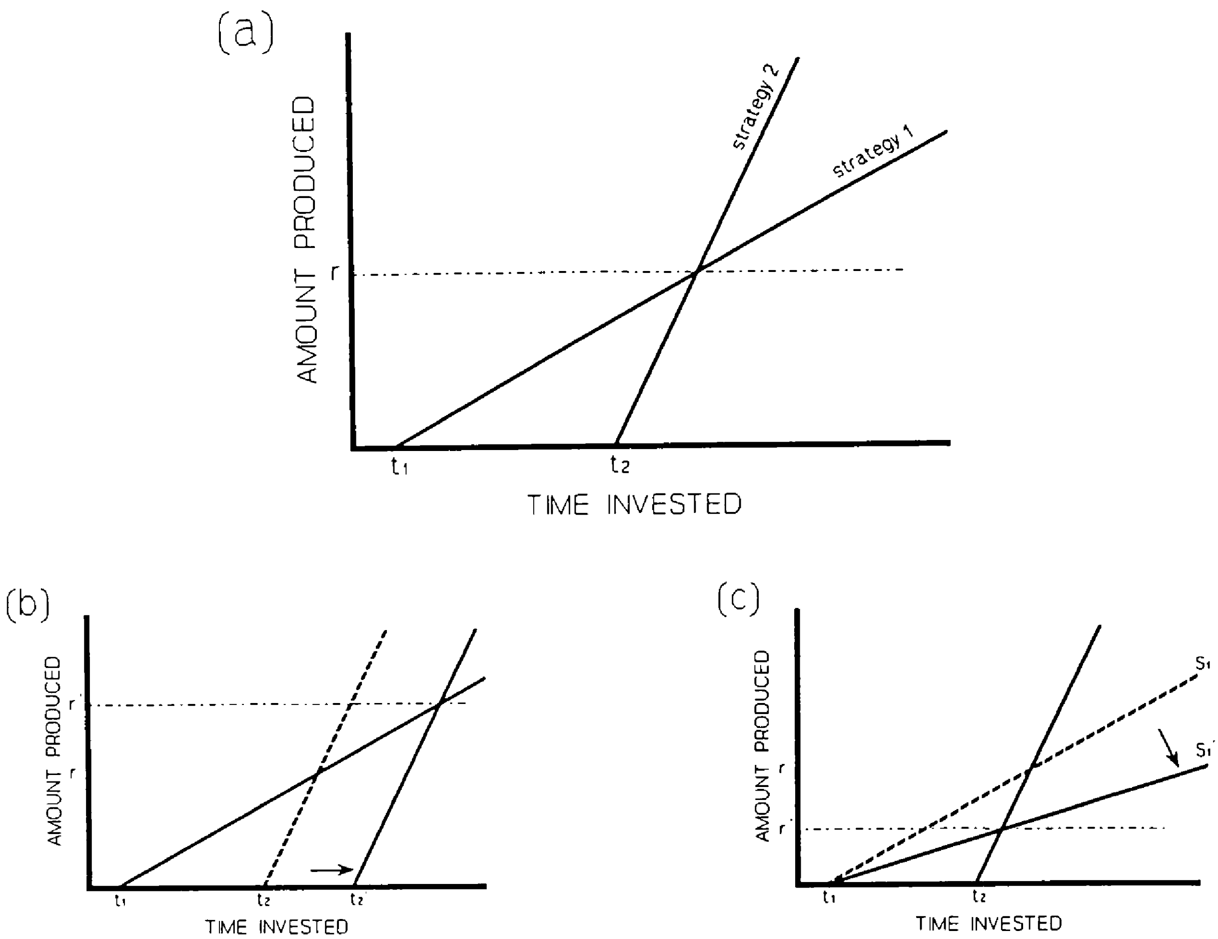

Figure 34 Effect of changes in the amount of a resource that can be used on relative efficiency of alternative procurement strategies: (*a*) Hypothetical productivity curves for two different procurement strategies; strategy 1 requires comparatively little time to reach patches (t_1) but offers low within-patch return rates; strategy 2 requires more time to reach patches (t_2) but also offers higher within-patch return rates. The relative efficiency of the two strategies will depend on the amount of the resource that could be used. Amounts less than **r** would be more efficiently procured using strategy 1, but amounts greater than **r** would be more efficiently procured using strategy 2. Changing either the travel time entailed in reaching patches or the return rate that could be expected would affect the amount of resource that needs to be useful before preferences would change: in (*b*) the increase in travel time from t_1 to t_1' increases this amount (ie. **r' > r**); in (*c*) the decrease in within-patch return rate from S_1 to S_1' decreases this amount (ie. **r' < r**).

resource that can be used. Because productivity curves for the two strategies shown in Figure 34*a* differ, not only the absolute efficiency but also the relative efficiency of each could be expected to change as size of the resource-sharing group increased, and with it the amount of produce that could be used. Strategy 1 would provide the more efficient means to procure any amount less than **r** but amounts larger than this could be obtained more rapidly using strategy 2.

The probability that a forager would choose strategy 1 over strategy 2 can thus be expected to decline as the amount of the resource that can be used increases. Inasmuch as size of the resource-sharing group constrains the amount that can be used, then, the probability that strategy 1 would be preferred should decrease as number of consumers in the group increased. But the particular point at which strategies changed rank would depend on the particular shape of the productivity curve for each. Any change in either the travel entailed in reaching a suitable patch (Figure 34*b*), or in the return rates that can be expected within a patch (Figure 34*c*), would affect the amount of resource that would need to be useful before preferences changed. Thus constraints on production could alter the effect of constraints on consumption.

These observations are clearly relevant to interpreting patterns of spearfishing behaviour at Gwaimasi. In this area, spearfishing itself can be conceptualized as comprising two distinct strategies. People could choose to fish in nearby streams, thus minimizing travel time but at the cost of low within-patch return rates. Alternatively, they could choose to travel to more distant streams in search of higher within-patch return rates. Other options for procurement of meat may have fallen between these two extremes. Figure 35*a* plots a schematized version of the returns to be expected from each option as a function of the time invested. We could expect that people would favour the option which offered the greatest return per unit time but, again, the effective efficiency of each strategy will be constrained by the amount of the resource (in this case meat) that can be used. And again, because productivity curves for the three strategies shown in Figure 35*a* differ, not only the absolute efficiency but also the relative efficiency of each could be expected to change as size of the resource-sharing group increased, and with it the amount of meat that could be used. In general, when number of consumers was small, people could be expected to spear fish in smaller streams, despite the comparatively low within-patch productivity. As number of consumers increased, other options would become more efficient and people could be expected increasingly to prefer these over spearfishing. Further increase in the amount of meat which could be used, however, would enhance the efficiency of spearing fish in large, highly productive streams, despite the time required to reach such streams. Having initially declined, therefore, the preference for spearfishing (though in a somewhat different context) could again be expected to increase.

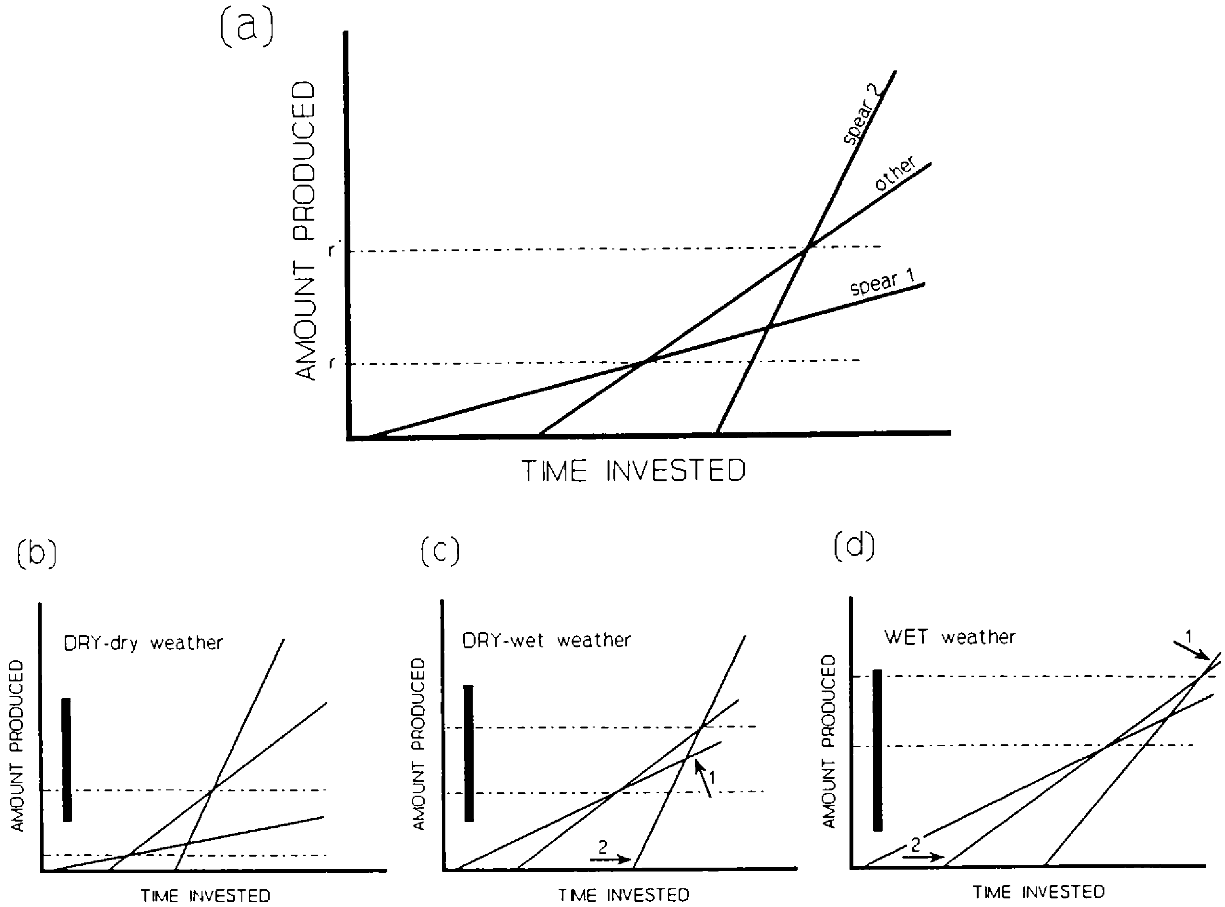

Figure 35 Effect of changes in the amount of meat that could be used on relative efficiency of spearfishing as a procurement strategy at Gwaimasi: (*a*) Spearfishing in small streams near Gwaimasi (Spear 1) entailed little travel time but offered low within-patch return rates. Spearfishing in larger streams (Spear 2) offered much higher within-patch return rates, but also entailed greater investment in travel time. A third strategy is also shown, with intermediate travel costs and intermediate within-patch return rates. Because productivity curves for the three strategies differed, their relative value could be expected to change as the amount that could be used increased; amounts below **r** would be most efficiently produced by spearing fish in small streams, those between **r** and **r'** would be more efficiently procured by other techniques, while those above **r'** would be most efficiently produced by spearfishing in larger streams. The particular points at which strategies change rank are determined by the shapes of the three curves, and are thus affected by weather. In (*b*) DRY-dry weather, within patch productivity of small streams was low, that in larger streams high. In (*c*) DRY-wet weather, within-patch productivity of small streams was greater than in DRY-dry weather (arrow 1 on diagram), while the need to monitor conditions increased the travel costs associated with spearfishing in larger streams (arrow 2). In (*d*) WET weather, the within-patch productivity of spearfishing in larger streams was lower than in DRY weather (arrow 1), while rain increased the costs of travel associated with other options (arrow 2). In each case, those changes increased the amount of food that needed to be useful (and thus the size of the resource-sharing group required) before the alternative strategies would change rank in terms of relative efficiency. Heavy vertical lines indicate the range of amounts that could be used by groups of the sizes spanned in my survey.

Frequency of spearfishing, then, should show a general tendency to first decline and then to rise again as number of consumers in the resource-sharing group increased. But the shape of the productivity curves for each strategy, and thus the point at which strategies changed rank, depended on weather conditions. At Gwaimasi, both efficiency of travel and within-patch return rates changed with the weather. In DRY-dry weather (Figure 35*b*) there were comparatively few fish available in small streams, while travel to larger streams was easy and return rates in those streams were high. In DRY-wet weather (Figure 35*c*), the availability of fish within small streams increased, while the need to monitor the condition of larger streams added to the travel costs associated with their exploitation. Thus, spearfishing in small streams continued to be favoured at larger group sizes than would have been the case in DRY-dry weather, and more consumers would also have been required before travel to large streams replaced other options as the preferred strategy. In WET weather (Figure 35*d*), availability of fish in larger streams declined markedly, reducing within-patch return rates. The difficulty of travel in these conditions, however, also affected the procurement of game other than fish. The effect would have been to increase even further the size of the resource sharing group at which spearfishing in small streams was likely to be abandoned, and that at which travel to large streams might become attractive.

The pattern of change in spearfishing behaviour at Gwaimasi, as size of the resource-sharing group increased, was indeed different in different weather conditions. But, as can be seen from Figure 35*b-d*, this simply reflected the fact that, in each set of conditions, I was sampling a different portion of the same general response curve. In DRY-dry weather, the minimum size of the resource-sharing group was already above that which would have favoured spearfishing in small streams as a strategy for getting meat. In WET weather, the maximum size of the resource-sharing group only just reached the level where people might again have begun to favour spearfishing as a strategy for obtaining meat.

The shape of the effect that size of the resource-sharing group had on linefishing behaviour at Gwaimasi was less clearcut than the effects described for spearfishing; the diversity of linefishing tactics available, and the fact that these varied not only in efficiency but also in reliability of returns, have complicated patterns. Nevertheless, it is clear that number of resident consumers at the village did influence linefishing behaviour. In DRY-dry weather men regularly set lines if there were only a few people to be fed.

As number of consumers increased, however, the frequency of linefishing first dropped abruptly (when spearfishing became warranted), then steadily picked up again. In DRY-wet weather, the frequency of linefishing steadily declined at first as number of consumers increased, then abruptly picked up before again declining. In WET weather, the frequency of linefishing by both men and women steadily declined as number of consumers increased.

In DRY weather at least, the frequency of linefishing, like that of spearfishing, decreased and then increased as number of consumers rose. Whereas the shifts in spearfishing were gradual and continuous, however, those in linefishing were not. It seems, rather, as though a gradual increase in relative value of linefishing (in DRY-dry weather) or a gradual decrease in relative value (during DRY-wet weather) as number of consumers in the resource-sharing group rose was interrupted at certain group sizes, with relative efficiency abruptly returning to that for smaller groups. This may well reflect the fact that potential returns from linefishing, compared to those from spearfishing, tend to be discrete, not continuous. In most cases, a single line is set and a single fish may be caught; there is no scope for intermediate investment, or returns. As the amount of fish that could be used increased, therefore, the relative efficiency of linefishing might rise and fall independently of any change in the efficiency of other meat-procurement strategies (Figure 36).

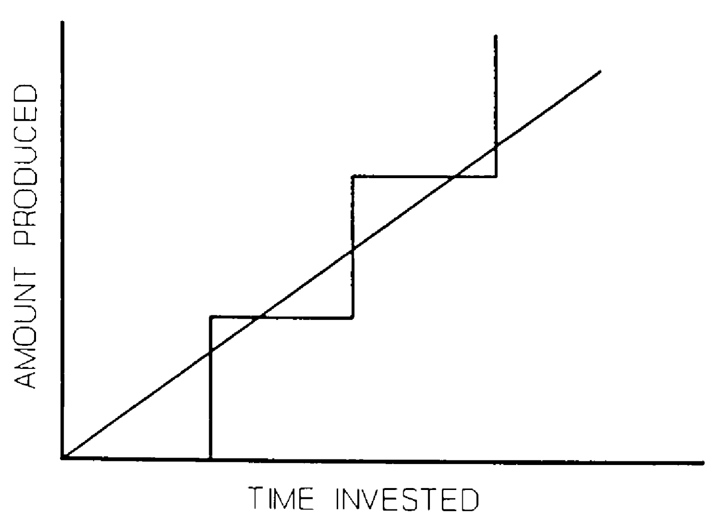

Figure 36 Effect of changes in the amount of meat that could be used on the relative efficiency of set-line fishing (stepped line) compared to that of a hypothetical alternative strategy (straight line). Because the necessary investment was discrete, not continuous, the relative efficiency of linefishing may have oscillated as the amount of meat that could be used increased, irrespective of changes in the efficiency of other strategies.

Of course, streams at Gwaimasi did not fall into the two neat categories suggested. The streams closest to Gwaimasi were also the smallest, but both distance and within-stream productivity are continuous variables. In any case, other activities often reduced the costs of travel to even the largest streams. Nor were the alternative linefishing strategies as discrete as suggested. But it is the structure of the argument that is important. Clearly, size of the resource-sharing group at Gwaimasi, and the constraints that this imposed on the use to be made of produce, affected the relative value of available fishing options. The likelihood that people would choose to fish, and the techniques, streams and targets they favoured, reflected that effect.

CHAPTER 9
CONCLUSIONS AND IMPLICATIONS

This treatise has not been primarily about fishing, nor about people at Gwaimasi - though the activities of those people have featured largely throughout. My central concerns in the work were theoretical and methodological; those concerns are grounded and exemplified in the particulars of fishing at Gwaimasi. For several reasons, explained at the outset (1.4), this body of data was well suited to my illustrative needs but, at least ideally, any body of data should have been amenable to the task. It is time, now, to return from the particulars of past chapters to more general issues.

This chapter begins with a brief overview of the empirical findings of my research, pulling together the conclusions from different chapters to emphasize the connections between them. The emphasis in that summary will be on relationships, not on details of behaviour. It is the existence of relationships that is at issue here; the shapes assumed by those relationships, and their quantification, are summarized in the relevant chapters. This synthesis then provides a context within which to return to the broader theoretical and methodological themes raised in the introduction.

9.1 OVERVIEW OF RESULTS

The early chapters in this work (Chapters 2 to 5) introduced Gwaimasi, the people who lived there, and the place of fishing within broader subsistence arrangements. Fishing was, by and large, a minor activity at Gwaimasi - a digression from the main tasks of gardening, producing sago or socializing, a diversion on quiet days. People did, at times, go out primarily to fish but even then the activity was as much entertainment as chore. Individuals were free to fish as they saw fit, the primary techniques used - spear and line - needing no coordination of effort for success.

This is not to downplay the importance of fishing in the local subsistence economy. Though fish constituted less than a quarter of the meat eaten by people at the village, the compatibility of fishing with other tasks enabled a regularity of procurement that buffered the very erratic input from hunting pigs and cassowaries. Nor do I wish to imply that fishing was a spontaneous, unpatterned activity, subject only to personal whim. Whim may well have played a part in the decisions concerned but, as Chapters 6 to 8 showed, fishing was far from random. People were much more likely to go fishing in some circumstances than in others. The probability that they would choose a particular fishing location or technique, or target particular kinds of fish, altered with the material outcome that could be expected and with the use that could be made of that outcome.

Chapter 6 was concerned with the effect on fishing behaviour of extrinsic constraints on production. I assumed that, all else being equal, the relative value of different options would depend on the weight of fish produced and the time required to procure them. Fish, of course, were restricted to geographically distinct patches within the landscape. The preference accorded to fishing options could thus be expected to depend on the relative rate at which fish were likely to be encountered within the different patches, and the relative time required to reach those patches.

Initial analyses established that the availability and accessibility of fish varied both between stream systems within the Gwaimasi area (6.2.1) and through time as weather conditions changed (6.2.2). This variation was then shown to be reflected in patterns of fishing behaviour. Allowing for the relative time required to reach different fishing locations, people clearly preferred those streams and techniques that produced the largest hauls (6.3.1). Weather-associated changes in the relative productivity of streams or relative effectiveness of techniques were accompanied by corresponding shifts in where and how people chose to fish (6.3.2). Limitations on the time available for fishing did affect the choices made, as did predictability of returns. In general, however, fishing behaviour was consistent with that expected of people who were maximizing rate of production in a patchy environment.

Patterns in the distribution and abundance of fish, and their accessibility using available techniques, affected the material outcome that could be expected from any fishing decision. The preferences displayed by people at Gwaimasi reflected this. But the outcome of a fishing trip may depend as much on the abilities of the fisher as on the availability of fish. The analyses in Chapter 6 pooled data for all fishers. Individuals at Gwaimasi, however, differed both in their ability to procure fish and in the use that could be made of fish acquired.

Chapter 7 examined the effect on fishing behaviour of intrinsic constraints on both production and consumption. There were few constraints that applied generally to all people at Gwaimasi (7.1); Kubo people were, it seems, free to fish anywhere so long as they did not impinge on the likely future returns of others[1], and no species of fish were generally taboo. There were, however, direct and indirect constraints associated with fishing by specific categories of people at Gwaimasi, and by individuals within those categories. The second section of the chapter (7.2) compared the fishing behaviour of men and women, of people at different life-history stages, and of those affiliated with different clan groups, while the third section (7.3) examined the effect of individual variation crosscutting such structural categories. In each case, significant differences were found. Those differences could not be explained simply in normative terms. Rather, I argued that they reflected real differences in the fishing options available to people, in the within-patch return rates that could be expected, or in the time required to reach patches in the first place. Differences in access to equipment, experience or information affected the viability and relative efficiency of fishing techniques. Differences in mobility, and in the spatial arrangement of activities other than fishing, affected travel time. The effect of such intangibles is difficult to quantify, and I did not attempt to do so. In most cases, however, the directions of variation were consistent with those expected of people maximizing production given the respective constraints to which social categories or individuals were subject.

Not all the observed variation in the ways that individuals at Gwaimasi fished can be attributed to differences in the material outcome that could be expected from available options. In some cases, at least, variation in the use that could be made of the outcome seems to have affected fishing behaviour. Thus, differences in the use that pregnant and lactating women (and their spouses) could make of fish were reflected in the different fishing decisions that they made (7.2.2c). And at least some of the differences in the ways that men and women chose to fish may be attributable to differences in the uses that they could make of fish - with men, perhaps, having more to gain by distributing produce widely (7.2.1).

Just as the material outcome of a fishing decision depended on extrinsic constraints as well as on the abilities of the fisher, so the use that could be made of that outcome

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[1] This restriction affected only the use of poison in fishing, a technique that contributed little to the overall catch at Gwaimasi during the survey.

depended not only on the physiological needs of the fisher but also on extrinsic constraints associated with the presence and actions of others. The analyses of Chapter 7 compared the behaviour of fishers with differing requirements in a supposedly fixed context, that of Gwaimasi. But the community of Gwaimasi was not fixed, and changes in the social context of behaviour affected the use that could be made of any outcome.

Chapter 8 looked at the effect on fishing behaviour of extrinsic constraints on requirements. The amount of fish that could be used depended, I argued, on the size of the resource-sharing group. As the size of that group changed, the relative value of alternative fishing options - and thus fishing behaviour - could be expected to alter in predictable ways. This argument was treading new ground in terms of studies in evolutionary ecology. The first part of the chapter (8.1.1) defined the term 'resource-sharing group' as that group which shared collective rights of access to a resource and thus could expect to share equally in all produce resulting from appropriation of that resource. That expectation should mean that individuals would do best by offsetting their procurement activities relative to those of others in the resource-sharing group. From records of variation in fishing returns, then, I identified the resource-sharing group for fish caught at Gwaimasi as the set of co-residents (but not visitors) based at the village on the day of capture (8.1.2).

Variation in the size of the resource-sharing group through the survey (8.2) was then related to patterns of fishing behaviour (8.3). To simplify the identification of patterns, analyses distinguished technique used, prevailing weather conditions and, where relevant, the gender of the fisher - all variables identified in earlier chapters as significantly affecting fishing behaviour. In each case, there were significant changes in the fishing decisions people made as the number of consumers increased. But the patterns identified were not simple. Alternative fishing techniques - and, indeed, other options for procuring meat - differed in the haul sizes that could be expected and in the flexibility and reliability of returns. Changing size of the resource-sharing group thus affected the value of these alternatives differently, with the result that relative values, and not just absolute values, were affected. As a result, there was marked switching between fishing techniques as the number of consumers at the village changed. For each technique, there were changes also in the distances that people were willing to travel to fishing locations, the time or equipment they were prepared to invest at a site, and the selectivity they displayed in targeting species. In general, those changes could be clearly accounted for by changes in the use that could be made of particular outcomes as number of consumers increased.

The conclusion is straightforward. Patterns of fishing behaviour at Gwaimasi cannot be understood in terms of ecological factors alone. I do not mean to imply that such factors were insignificant; they clearly influenced the ways people chose to fish. But at least one aspect of social organization - the size of the resource-sharing group - has been demonstrated to significantly alter the effect of ecological constraints on behaviour.

9.2 IMPLICATIONS

9.2.1 Theory

The ways that people at Gwaimasi chose to fish clearly depended on both social and ecological factors. As I hypothesized in the introduction to this work, change in either domain affected the kinds of behaviour observed. Yet the explanatory significance of social factors - of extrinsic constraints on consumption as distinct from constraints on production - has been largely overlooked, or put aside, by evolutionary ecologists studying subsistence behaviour. There are exceptions, of course. Smith (1985:41-43; 1991a:299-301), for example, argued that patterns of sharing might affect the size of foraging groups. Hill and Kaplan (1988a) showed that family composition could affect time allocated to hunting. And recent discussion of the different foraging patterns of Aché men and women appeal to social constraints for explanation, to differences in the use that could be made of the produce (Hawkes 1990, 1991, 1993) or in the use that could be made of time not spent hunting (Hurtado *et al.* 1985). In general, however, evolutionary ecologists have understood their task to be that of explaining social behaviour in terms of ecological constraints. They ignore the reciprocal causality that my research has demonstrated.

The neglect of social variables in explaining behaviour is somewhat obscured by a confusion of concepts and terminology. Evolutionary ecologists do refer to 'social relations' and the role that these, as distinct from 'ecological relations', play in influencing behaviour. In most cases, however, the relations being examined are social only in the sense that they entail interactions between conspecifics, rather than with other elements of the environment. In Standen and Foley (1989), for example, a series of papers expressly addressing the influence of social factors on behaviour viewed the social environment as, in effect, 'a set of resources' (Standen & Foley 1989:221), conspecifics as a means 'to gain access to resources', and thus as themselves 'a limiting resource' subject to competition (Harcourt 1989:223), and social bonds as 'long term investments' to be maintained (de Waal 1989:244). This is the language of ecology. The fact that the resources to be appropriated bear some similarity to the actor does not alter the nature of the relationship. As I argued in the introduction, such an artificial dichotomy between conspecifics and other elements in the environment, while perhaps analytically convenient, contributes little to understanding. More seriously, analytical emphasis on the identity of interacting entities may obscure differences in the types of relationships that exist between entities.

It is to such a difference in the forms of relationships that I have pointed in my analysis of fishing behaviour at Gwaimasi. The actions of others did affect an individual's ability to procure fish, both directly, through assistance or interference, and indirectly through access to techniques and to the skills required to use those techniques effectively. Other people thus affected the material outcome that could be expected from any fishing effort, in the same sense that distribution and abundance of fish did so. But the actions of others also affected the requirements that an individual brought to fishing; fish obtained by others reduced the amount that could usefully be procured, while the shares that others took from a catch increased the amount that could usefully be procured. While in no way altering the material outcome to be expected these did alter what use the fisher could make of the outcome. The two effects should not be confused or conflated.

In the introduction I interpreted ecological and social relationships as affecting, and in turn being affected by, the processes of production and consumption respectively. In as much as production and consumption themselves are two facets of any action, ecology and society should be seen as mutually constitutive systems mediated by the actor. Figure 37 maps onto that schematic representation the methodological distinctions that I have drawn between types of constraints that affect behaviour (in effect, combining Figures 1 and 2 from the introduction). Two points need to be emphasised. First, I have added another category of constraint to those identified by Stevens and Krebs (1986:10) and now commonly cited (eg. Smith & Winterhalder 1992a:56; 1.2.3). The use that can be made of produce is not simply constrained by characteristics intrinsic to the actor; it may also be subject to extrinsic constraint by social factors. The logical symmetry is obvious when

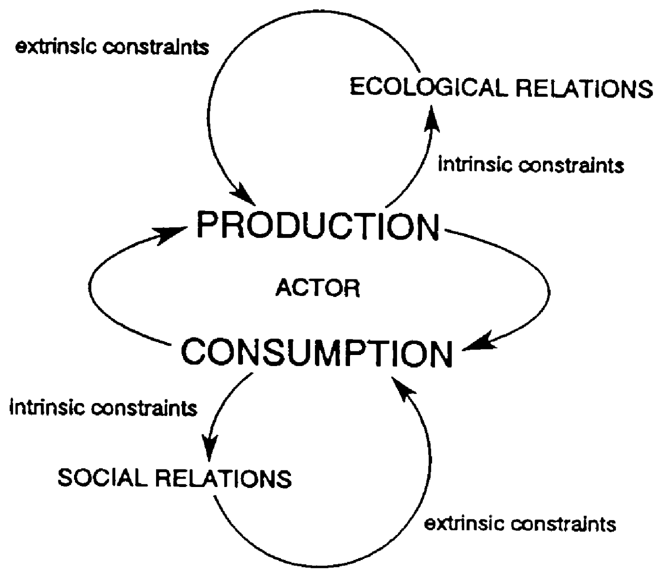

Figure 37 Schematic view of ecological and social relationships as distinct but interdependent components of an individual's interactions with environment. The two are mediated by relationships between production and consumption. Potential outcomes of both production and consumption are constrained by factors extrinsic to the actor, as well as by the abilities and requirements of the actor.

presented in this visual form, but has not been acknowledged before. The second point follows from this. Figure 37 suggests that the contrast to be emphasised is not that between extrinsic and intrinsic constraints *per se* but, rather, that between constraints on production and constraints on consumption.

No study, including my own, incorporates all these different influences on behaviour. Nor should, or could, particular studies be expected to do so (see below). The choice of constraints for study, however, may indicate the causal trajectories followed by different explanatory frames. Figure 38, for example, outlines my interpretation of the paths followed by ecological and social explanations respectively.

Ecological studies, as the name implies, base explanations of behaviour in extrinsic constraints on production (Figure 38a). The outcome of production, in turn, constrains what the actor has available for consumption - and thereby affects the possibilities for exchange and the construction of social relationships.

It was to extrinsic constraints on production that evolutionary ecologists first

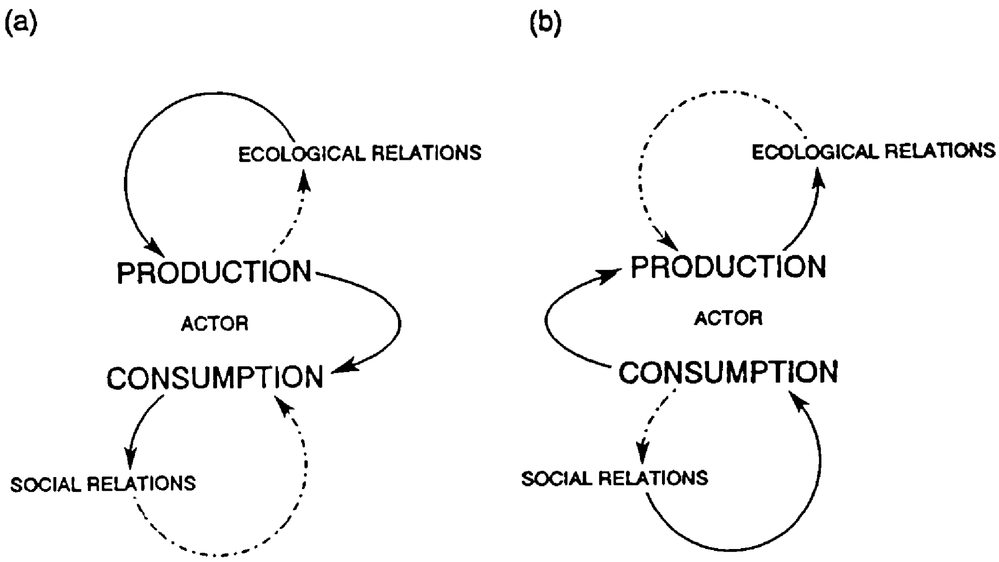

Figure 38 The causal paths followed by (a) ecological explanations and (b) social explanations of behaviour.

looked in seeking explanations for behaviour.[2] Prey-choice and patch-choice models, for example, related behaviour to the kinds and quantities of resources available (Hawkes *et al.* 1982; Hill & Hawkes 1983; Hill *et al.* 1984, 1987); change in patterns of production was explained in terms of the attributes of new resources relative to those of resources previously available (O'Connell & Hawkes 1981), or to change in the relative abundances of high-ranked (but not low-ranked) resources or patches (O'Connell & Hawkes 1984). The choice of alternative hunting techniques (Yost & Kelly 1983), whether to forage alone or with others (Hill & Hawkes 1983; Smith 1985), and where to base oneself relative to others (Dwyer & Minnegal 1985; Heffley 1981), were all issues to be understood in terms of the attributes of available resources. In fact, some of the constraints in these models, such as the time required to secure items after encounter, depended on attributes of the people as much as on attributes of the resources themselves. A few studies have considered the effects on behaviour of intrinsic constraints on production - the effect of hunting technique on optimal prey choice (Hill & Hawkes 1983), or the effect of skill on

[2] The following discussion is illustrated primarily by the work of Hawkes and her associates. Their series of papers about Aché foraging provides a coherent body of work exploring the effect of several types of constraints on a specific aspect of behaviour. More importantly, the sequence in which those constraints were explored, in response to revealed inadequacies in earlier interpretation (Hill *et al.* 1987), illustrates not only the development of explanation within evolutionary ecology but also the implicit explanatory trajectory.

the time allocated to hunting (Hill *et al.* 1985). But the focus was still on production, and on the ecological relationships affecting production. Whether extrinsic or intrinsic to the actor, these contextual variables affected the reproduction of subsistence behaviour by constraining the material outcome to be expected from available options.

The outcome of production, of course, determines what the actor has available for consumption. The next logical step, then, was to explain patterns of distribution and consumption, and the social relations constructed through those exchanges, in terms of attributes of the product. The extent of sharing, for example, has been related to both size of resource items, and the predictability with which such items can be secured (Kaplan *et al.* 1990; Winterhalder 1986). The formation of groups, and the emergence of inequalities within and between groups, similarly has been addressed in terms of resource quality and distribution (eg. Boone 1992). As I noted before, however, the use that can be made of produce depends on the actions of others as much as on the attributes of the product. Existing patterns of social organization may impose extrinsic constraints on the outcome of any use made of produce, and thus affect the reproduction of patterns of consumption.

There is increasing acknowledgement, among evolutionary ecologists, of the way that the 'emergent properties of human social interaction ... may condition the adaptive value of interactive strategies' (Layton 1989:434). In social species, as Standen and Foley (1989:221) noted, "the individual adapts to the constraints of the environment in which it grows up - and that is principally a social environment". But social constraints tend still to be viewed as proximate causes of behaviour, themselves ultimately to be explained by patterns of production and the ecological constraints that condition those patterns. "That social environment has evolved alongside and in response to [characters] which are themselves responses to more strictly ecological factors" (*ibid*). Evolutionary ecologists proceed only rarely to the recognition that the outcome of consumption - the use that can be made of produce - will influence the value of alternative patterns of production. They fail to close the explanatory loop.[3]

[3] Recent papers by Hawkes (1993) and by Winterhalder (1993) do, in fact, begin to shift attention to the effect that constraints on consumption may have on behaviour. Hawkes explicitly incorporated number of consumers as a parameter in models, though she did not discuss the effects on behaviour of variation in this constraint. Winterhalder identified the need to incorporate distribution and consumption dynamics in a framework

Social explanations of behaviour are rarely as explicitly spelled out as the explanations of ecologists - a reflection, perhaps, of the immaterial nature of wants compared to that of capabilities. Nevertheless social explanations, too, can be seen to follow a particular path, based in constraints on consumption rather than constraints on production (Figure 38b). The use that an actor can make of a resource, in turn, constrains the benefits to be gained by procuring that resource - and thereby mediates the ecological relationships affecting production.

The logic of this approach is perhaps best epitomized by Ingold, when he argues, for example, that "sharing does not come into play at the *end* of production, but rather constitutes the common purpose that people *bring into* the productive process itself" (1991a:285).[4] The same perspective underlay Sahlins' (1968, 1974) influential analysis of the 'original affluence' of hunter-gatherer societies. Production among hunter-gatherers, Sahlins asserted, was constrained by their wants, rather than by the availability of resources - by 'limited needs' that, in turn, were a consequence of the imperative to share.[5] Social organization, then, with its consequences for the use that people can make of resources and thus for patterns of consumption, is seen to constrain patterns of production. The relevant attributes of resources in the environment, and thus the ecological relations affecting production, must be understood in terms of socially defined use-value. But social organization does not arise *ex nihilo*. The arguments of Ingold, Sahlins and others within this tradition of social explanation leave aside the constraints that the outcome of production itself imposes on patterns of consumption. Again, the explanatory loop is not closed.

Such brief overviews cannot do justice to the broad topics of either ecological or social enquiry. They present, of necessity, mere caricatures of much more complex issues. But there is often some heuristic value to caricatures. It should be apparent that,

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for analysis of investment in production activities, but did not proceed beyond anecdotal illustration.

[4] I argued earlier (1.1) that the connotation of intentionality in the word 'purpose' is misleading; I would prefer to say, rather, that social factors constrain the requirements that the actor brings to production.

[5] Bird-David (1992a), in a reformulation of Sahlins' argument, also interpreted production as an expression of social relations, and of the 'sharing' which constitutes those relations - but saw the process entailed as one of metaphorical extension of social relations into the ecological domain (see also Bird-David 1990).

while neither ecological nor social approaches to explanation are complete in themselves, neither are they contradictory. Rather, they can be seen as following different paths in navigating the same territory - and traversing somewhat different ground as a consequence. If there is a failure of communication between the different approaches, it lies in the privileged status each accords the point at which analysis is entered - constraints on production and on consumption respectively. By contrast, my analysis asserts that neither production nor consumption has logical priority; each is affected by constraints on the other.

Behaviour, then, is overdetermined; each influential factor must be seen simultaneously as cause and effect. Such a view poses difficulties for the researcher, as distinct from the philosopher. Can one understand anything without grasping the whole?[6] The answer is obviously yes - but only, I assert, if the focus of enquiry is changed from events themselves to the relationships that pattern those events. I have not explained the actual fishing decisions made by people at Gwaimasi. I have, however, identified some of the variables that influenced those decisions, and have explained the shape of their effect. But once it is acknowledged that no explanation can be complete, the importance of understanding how the variables examined relate to each other and to the rest of the system becomes apparent.

Figure 39 positions the different components of my study according to the locus of action for the relationships explored in each of the three substantive analytical chapters. Two observations should be emphasized. First, my focus was on production - specifically, patterns in the production of fish - and this clearly structured the approach that I took. Secondly, the study does not trace a continuous path through the field of relationships in which production is situated. A comparison with Figure 38 reveals that, rather than taking either an ecological or a social approach to interpreting the ways people at Gwaimasi chose to fish, I have combined aspects of the two approaches.

I began, in Chapter 6, with an ecological focus, looking at the relationship between availability of resources and patterns of production. That relationship was strong, and clearly attributable to the constraints that resource availability placed on the material outcome of alternative production strategies. In Chapter 8, I switched to a social

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[6] Schell (cited in Graham 1992:142), for example, stated that overdetermination meant "nothing less than everything is a sufficient explanation for anything".

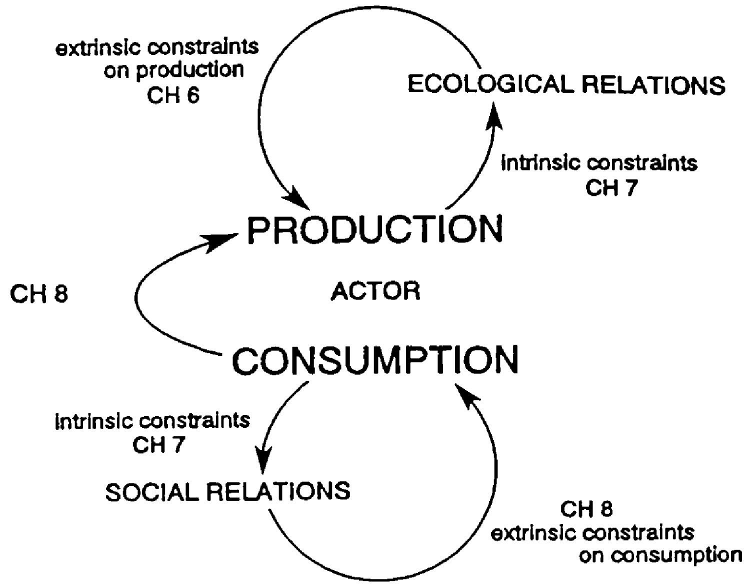

Figure 39 The paths followed in analysis of fishing behaviour at Gwaimasi, indicating the locus of action for relationships explored in Chapters 6, 7 and 8.

perspective, looking at the relationship between size of the resource-sharing group and patterns of production. Again, the relationships were strong - attributable, this time to the constraints that number of consumers placed on the outcome of distributing produce and thus on the use-value of that produce. The production of fish as actually observed at Gwaimasi lies at the intersection of these two influential relationships.

The various analyses in Chapter 7 focus on attributes of the individual, and the effects on behaviour of the intrinsic constraints that those attributes impose. The organization of those analyses crosscuts the distinction between ecological and social relationships. The relationship between gender and fishing behaviour, for example, may be attributed to associated constraints on the outcome of both production and consumption - on the ability to procure resources and on the use that can be made of resources. The relationships examined in that chapter, then, mediate those of the other two. But they do not link them. The fundamental difference between constraints on production and those on consumption remains - one cannot simply be reduced to the other.

When mapped as in Figure 39, a noticeable gap appears in the relationships discussed in my work; I have not examined the role of production in structuring patterns of consumption. The absence is deliberate. I argued in the introduction that production of fish was such a minor component of the overall subsistence system at Gwaimasi that it would have had little effect on the overall system of distribution and consumption. In fact, it was precisely this attribute that made fishing at Gwaimasi a suitable subject for the question I wished to investigate; it effectively dissociated the action of ecological and social constraints. But the relationship does exist. The output of production does constrain, to a greater or lesser extent, what the actor has available for consumption. The significance of that constraint warrants its consideration in analysing other aspects of subsistence at Gwaimasi (eg. Dwyer & Minnegal 1991a, 1992a[7]), or elsewhere.

The intent of my study was not to demonstrate that ecological and social constraints on behaviour were independent determinants of subsistence behaviour. They are not. Rather, it was to show that each, while ultimately dependent on the other, influences behaviour in different ways.

The implication is clear. Ecological and social analyses offer different perspectives on the same behaviours. Rather than debating the relative merits of the two perspectives, we need to recognize that neither is adequate alone. Nor is one innately more important than the other. Production and consumption are "twin facets of a mutually constitutive, and continually evolving, field of relationships between persons and environments" (Ingold 1992:49). I began my analysis of fishing behaviour at Gwaimasi with an examination of constraints on production because I wanted to extend a previous analytical approach. But either production or consumption - the ecological or the social - would be a legitimate entrypoint for analysis.

9.2.1 **Methodology**

In attributing patterns of fishing behaviour at Gwaimasi to an aspect of social organization I have effectively turned on its head the usual line of explanation followed by evolutionary ecologists. I have argued that, at least for the case investigated, patterns of consumption constrain patterns of production rather than the reverse. But the argument is itself firmly positioned within the frame of evolutionary ecology. There is nothing within that methodological frame to dictate the identity of causal factors or the direction of causality.

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[7] These papers address patterns of hunting and gardening at Gwaimasi respectively. Among other factors, each considers the constraints that the organization of production would have placed on community composition and dynamics.

The essential components of explanation within evolutionary ecology have been outlined before (1.2). Basically, evolutionary ecology assumes that patterns of behaviour emerge because the behavioural variants that occur are differentially reproduced. The probability of reproduction is to be understood in terms of the consequences that alternative actions would have for the actor. Those consequences, in turn, will depend on conditions at the time. Accordingly, there will be a functional relationship between behaviour and context - a relationship usually expressed in terms of some measure of outcome. The task for evolutionary ecologists is to deduce the relationships underlying observed variation.

But the shape of a relationship does not, in itself, indicate the direction of dependency. Krebs and Kacelnik (1991:108) noted that elements of a relationship may be considered alternately as constraints or as matters of choice - as independent or dependent variables - depending on the issue to be addressed. Search speed, for example, may be a constraint imposed by abilities of the actor which, through its effects on encounter rate, influences the types of prey pursued. Equally, however, the speed at which to search may be chosen by the actor in response to the types of prey available. The empirical relationship between search speed and the types of prey taken would be the same in both cases.

The relationship between patterns of production and patterns of consumption has been discussed in several papers (Cashdan 1985; Hawkes 1992, 1993; Kaplan & Hill 1985; Kaplan *et al.* 1984, 1990; Winterhalder 1986, 1993). I have no quarrel with the relationships deduced - and often demonstrated - to exist between the two aspects of behaviour. All the papers, however, have taken it for granted that consumption would be the dependent variable. It is this assumption that I have questioned.

Again, it may be worth spelling out the arguments in a little more detail. Winterhalder (1986) has shown that the value of sharing depends on two variables - (1) the extent to which the outcome of production is synchronized among individuals and (2) the extent of variation over time in the output of production by any individual. In other words, as Kaplan and his associates have noted (Kaplan *et al.* 1990), sharing is more useful, and thus more likely to occur, when resources are large and their procurement unpredictable. The relationship underlying these observations, however, does not, in itself, specify which will be the dependent variable. That relationship can be expressed simply: the extent of sharing will be correlated with the size and predictability of hauls produced. Where sharing is mandatory - a constraint rather than a matter for choice - we thus could expect to see a bias towards pursuit of larger hauls and more unpredictable resources. Or, as I observed at Gwaimasi (8.1.2), people may deliberately offset their activities to ensure asynchronous returns.

The emphasis that evolutionary ecology places on production, and on factors affecting the material outcome of production as the basis of explanation, is clearly not inherent in the methodology itself. It reflects, if not ideological preconceptions, then, at least, the materialist orientation of its historical origins. Debts incurred, and alliances established, are difficult to measure compared to the weight of fish obtained in a day. A resource-sharing group does not have the same material reality as a stream. It is perhaps not surprising, then, that the effects of ecological factors tend to be considered first in seeking to explain subsistence behaviour; whatever variation is left over - whatever cannot be explained ecologically - can then be attributed to social factors. But such reliance on argument by default is neither desirable nor necessary. Evolutionary ecology begins with deduction not induction. It is not constrained by the immaterial nature of relationships, for it can model consequences.

The work reported here suggests that the effect of social factors is susceptible to analysis by the sorts of systematic approaches that have, in the past, been reserved for ecological analysis. It would thus be possible to provide much more positive interpretations of the role that social relations play in influencing behaviour.

9.3 CLOSING REMARKS

Patterns of production and consumption are mutually constitutive. So too are methodology and theory. My aim has been to show that a methodology which is commonly used to explore effects of ecological constraints on behaviour is equally applicable to the study of social constraints. The methodology is evolutionary ecology.

Throughout this work I have been aware that many social anthropologists are discomforted or antagonistic when confronted by the arguments and conclusions of evolutionary ecology. They ignore them or dismiss them as 'functionalist', forgetting that the logic of an argument must be separated from the use, or misuse, that may have been made of such logic in the past. The discomfort, I think, arises less from what evolutionary ecologists actually do than from what they fail to do. It is the focus on production - on the ecological - and the apparent subsidiary status accorded consumption and the social that causes concern. But there is a change of mood in evolutionary ecology. The form of the questions being asked is shifting as earlier answers are found to be incomplete and as seemingly simple problems are shown to have complex social dimensions (Smith 1992b:54). Moreover, there is no necessary association between methodology and domain of enquiry. I have demonstrated that the methodology of evolutionary ecology is entirely appropriate to the study of social constraints on behaviour.

In this study, my target was modest. I teased out connections associated with an almost incidental component of subsistence, a component that did not have great impact on the system of distribution and consumption within which it occurred. The task now is to go further - to proceed to untangle and thereby reveal the social dimensions of production in an activity that is central to the economy of a particular people. The necessary theoretical backdrop and the methodology have been tried and found useful.

APPENDICES

1. Records of fish caught within the Gwaimasi area between September 15, 1986 and October 18, 1987.

2. Calculations used for reconstructing weights of fish.

3. Calculations used to attribute responsibility for catching fish where details of fisher are unclear, and to discount fish caught before the survey began.

4. Records of distinct fishing episodes.

5. Records of days available to surveyed residents for village-based fishing, and of the fish procured by those residents in different weather conditions.

6. Records of fisher-days and consumer-days for residents based at Gwaimasi in each week of the survey.

APPENDIX 1

Records of fish caught within the Gwaimasi area
September 15, 1986 - October 18, 1987

This appendix tabulates all records of fish caught within the area used for subsistence by residents of Gwaimasi between September 15, 1986 and October 18, 1987. Some small species of fish, particularly rainbowfish, are under-represented in the data, but I estimate that the list records at least 92% by number, and 98% by weight, of fish caught in the local area during the survey. Some fish included in the list may have been caught in the three days before the survey officially began (see Appendix 2).

VARIABLES:

ID	**Index number**: Fish are numbered individually, according to the sequence in which they were entered into the computerised database - that sequence has no relation to order of capture. These numbers are included to facilitate cross-referencing.
DATE	**Approximate day of capture**: For fish procured by people based at the village, this records the date on which the fish was caught. Fish caught and eaten by people based at a bush house, or brought back smoked from such a stay, could not reliably by assigned to a particular day of capture; in these cases, the date usually recorded is that of return to the village, indicating the episode during which the fish was caught. Dates should be read in conjunction with the data on fishing episodes in Appendix 4.
TAXON	**Identification** by Kubo nomenclature: For scientific identification of Kubo taxa see Table 6 in Chapter 5.
SL	**Skull length**: Skulls of most species were measured from the rostrum to the posterior tip of the dorsal spine. Those of the four species of gudgeon were measured from the rostrum to the foramen magnum. Some skulls were lost, and others were unable to be measured because of damage. Where possible, skulls with minor damage were matched to others from the same species of known length.
*	Indicates that the fish was weighed.
WT	**'Treated' weight**: Fish that were weighed in the field are indicated by an asterisk. These with the associated measures of skull length, provided the basis for reconstructing weights of other specimens (see Appendix 2). In all cases, weights are for cleaned fish. Kubo usually gut fish immediately on capture; the stomach and intestines are opened and emptied, but usually not discarded. Measurements in the field indicated that less than 10% of live weight was lost in this process, and that at least 88% of treated weight was edible.

STREAM	**Where the fish was caught**: In most cases names refer to a particular stream. Names ending in HAFI indicate particular locations along the Strickland River, where the named tributaries enter that river. For locations of streams see Figure 18 in Chapter 5.
TECH.	**Technique used**: H = line; S = spear; O = other; U = unknown.
FISHER(S)	**Who caught the fish**: Only residents of Gwaimasi are distinguished by name in the records; others are simply identified as visitors. When people went fishing together it was not always possible to distinguish who caught which fish in the total haul. In such cases, the fish has been attributed jointly to the two or more individuals involved. Where necessary for analysis, credit for the captures was apportioned among those individuals on the basis of their general fishing record (see Appendix 3).
CONTEXT	
- catch	**Capture context**: V = village-based fishing; B = bush-based fishing; tr. = transitional, fish caught by someone returning to the village from a stay elsewhere, or brought back smoked from a stay elsewhere.
- eat	**Consumption context**: F = eaten by people based at the village; R = eaten by people based in the bush; O = fed to pigs, dogs or cassowaries, or sold to anthropologists.
AFF.	**Affiliation**: Indicates the clan group with which the fisher or fishers were associated. Up = Upgabo resident or/and visitor associated with Upgabo residents; Dn = Downgabo resident or/and visitor associated with Downgabo residents; Up&Dn = residents or/and visitors from both groups; UNKN = unknown.

The records have been sorted according to capture context and, within each capture context, according to date and index number.

FISH DATA

ID	DATE	TAXON	SL (mm)		WT (g)	STREAM	TECH.	FISHER(S)	CONTEXT catch	eat	AFF.
83	15SEP86	SOIGIA	.		375	STRICKLAND	H	HEGOGWA	V	F	Up
84	15SEP86	SOIGIA	97.8	*	465	UNKNOWN	H	SINIO	V	F	Up
85	16SEP86	SOIGIA	97.7	*	435	STRICKLAND	H	SINIO	V	F	Up
86	16SEP86	SOIGIA	99.8	*	320	STRICKLAND	H	BISEIO-MABEI	V	F	Up
88	16SEP86	SOIGIA	106.1		522	UNKNOWN	U	UNKNOWN	V	F	UNKN
89	16SEP86	SOIGIA	105.0	*	440	STRICKLAND	H	UNKNOWN	V	F	UNKN
90	16SEP86	SOIGIA	90.9	*	310	STRICKLAND	H	UNKNOWN	V	F	UNKN
1112	16SEP86	TOBAGA	50.1		131	UNKNOWN	U	UNKNOWN	V	F	UNKN
93	18SEP86	SOIGIA	91.3	*	375	UNKNOWN	U	UNKNOWN	V	F	UNKN
95	18SEP86	SOIGIA	96.2		394	UNKNOWN	U	UNKNOWN	V	F	UNKN
94	19SEP86	SOIGIA	108.2	*	475	STRICKLAND	H	HEGOGWA	V	F	Up
96	19SEP86	SOIGIA	78.1		217	STRICKLAND	H	FILIFI	V	F	Up
97	19SEP86	SOIGIA	104.2	*	330	STRICKLAND	H	HEGOGWA	V	F	Up
98	19SEP86	SOIGIA	106.3	*	510	STRICKLAND	H	HEGOGWA	V	F	Up
100	19SEP86	SOIGIA	110.0	*	595	STRICKLAND	H	HEGOGWA	V	F	Up
619	19SEP86	OWUAHIA	93.0		364	UNKNOWN	U	UNKNOWN	V	F	UNKN
620	19SEP86	OWUAHIA	.	*	490	STRICKLAND	H	HEGOGWA	V	F	Up
621	19SEP86	OWUAHIA	.	*	615	STRICKLAND	H	HEGOGWA	V	F	Up
714	19SEP86	AIODIO	83.7		484	DEGE	S	UNKNOWN	V	F	UNKN
101	20SEP86	SOIGIA	108.2		552	UNKNOWN	U	UNKNOWN	V	F	UNKN
432	20SEP86	GUMO	100.8		475	UNKNOWN	U	UNKNOWN	V	F	UNKN
667	20SEP86	DJAU	135.7		746	UNKNOWN	U	UNKNOWN	V	F	UNKN
668	20SEP86	DJAU	169.0		1314	UNKNOWN	U	UNKNOWN	V	F	UNKN
669	20SEP86	DJAU	125.6		612	UNKNOWN	U	UNKNOWN	V	F	UNKN
716	20SEP86	AIODIO	107.7		972	UNKNOWN	U	UNKNOWN	V	F	UNKN
726	20SEP86	AIODIO	119.6	*	1800	UNKNOWN	U	UNKNOWN	V	F	UNKN
729	20SEP86	AIODIO	162.0		3011	UNKNOWN	U	UNKNOWN	V	F	UNKN
730	20SEP86	AIODIO	164.0		3115	UNKNOWN	U	UNKNOWN	V	F	UNKN
731	20SEP86	AIODIO	106.1		933	UNKNOWN	U	UNKNOWN	V	F	UNKN
732	20SEP86	AIODIO	150.0		2433	UNKNOWN	U	UNKNOWN	V	F	UNKN
733	20SEP86	AIODIO	167.0		3275	UNKNOWN	U	UNKNOWN	V	F	UNKN
734	20SEP86	AIODIO	126.4		1515	UNKNOWN	U	UNKNOWN	V	F	UNKN
735	20SEP86	AIODIO	76.0		370	UNKNOWN	U	UNKNOWN	V	F	UNKN
736	20SEP86	AIODIO	95.3		693	UNKNOWN	U	UNKNOWN	V	F	UNKN
913	20SEP86	TWE	70.4		336	UNKNOWN	U	UNKNOWN	V	F	UNKN
1085	20SEP86	GOI	53.0	*	1900	UNKNOWN	U	UNKNOWN	V	F	UNKN
1086	20SEP86	GOI	74.6		4022	UNKNOWN	U	UNKNOWN	V	F	UNKN
1118	20SEP86	TOBAGA	.		120	MOME	O	UNKNOWN	V	F	UNKN
1128	20SEP86	TOBAGA	55.6		178	UNKNOWN	U	UNKNOWN	V	F	UNKN
1129	20SEP86	TOBAGA	63.2		259	UNKNOWN	U	UNKNOWN	V	F	UNKN
670	21SEP86	DJAU	145.2	*	935	STRICKLAND	H	UNKNOWN	V	F	UNKN
102	22SEP86	SOIGIA	111.3		599	UNKNOWN	H	MABEI	V	F	Up
103	22SEP86	SOIGIA	88.2		307	UNKNOWN	H	MABEI	V	F	Up
104	22SEP86	SOIGIA	108.7	*	575	STRICKLAND	H	SIMO	V	F	Up
433	22SEP86	GUMO	103.2	*	440	DEGE	S	SINIO-VISITOR	V	F	Up
516	22SEP86	SOI	83.2	*	240	DEGE	S	SINIO-VISITOR	V	F	Up
517	22SEP86	SOI	97.6	*	375	DEGE	S	SINIO-VISITOR	V	F	Up
518	22SEP86	SOI	90.5	*	350	DEGE	S	SINIO-VISITOR	V	F	Up
519	22SEP86	SOI	83.2	*	270	DEGE	S	SINIO-VISITOR	V	F	Up
520	22SEP86	SOI	80.6	*	165	DEGE	S	SINIO-VISITOR	V	F	Up
521	22SEP86	SOI	91.2	*	385	DEGE	S	SINIO-VISITOR	V	F	Up
522	22SEP86	SOI	130.7	*	1050	DEGE	S	SINIO-VISITOR	V	O	Up
737	22SEP86	AIODIO	106.3	*	955	DEGE	S	SINIO-VISITOR	V	F	Up
738	22SEP86	AIODIO	92.9	*	635	DEGE	S	SINIO-VISITOR	V	F	Up
739	22SEP86	AIODIO	150.0	*	2900	DEGE	S	SINIO-VISITOR	V	F	Up
740	22SEP86	AIODIO	107.0	*	1000	DEGE	S	SINIO-VISITOR	V	F	Up
741	22SEP86	AIODIO	74.6	*	325	DEGE	S	SINIO-VISITOR	V	F	Up
743	22SEP86	AIODIO	99.6		783	UNKNOWN	U	UNKNOWN	V	F	UNKN
921	22SEP86	TWE	73.0	*	360	DEGE	S	VISITOR	V	F	Up
434	23SEP86	GUMO	173.0		2369	UNKNOWN	U	UNKNOWN	V	F	UNKN
742	23SEP86	AIODIO	142.1		2095	DEGE	S	UNKNOWN	V	F	UNKN
105	24SEP86	SOIGIA	99.2	*	420	STRICKLAND	H	DOGO	V	F	Dn
106	24SEP86	SOIGIA	105.4	*	515	STRICKLAND	H	DOGO	V	F	Dn
107	25SEP86	SOIGIA	97.1	*	475	STRICKLAND	H	SISIGIA	V	F	Up
108	25SEP86	SOIGIA	99.3	*	450	STRICKLAND	H	VISITOR	V	F	Up
744	25SEP86	AIODIO	102.0	*	910	SIGIA	S	DOGO	V	F	Dn
745	25SEP86	AIODIO	93.5		658	KOIOGO	S	MAMO-MAUBO	V	F	Dn

ID	DATE	TAXON	SL (mm)		WT (g)	STREAM	TECH.	FISHER(S)	CONTEXT catch	eat	AFF.
1130	25SEP86	TOBAGA	54.5		167	KOIOGO	U	MAMO-MAUBO	V	F	Dn
1131	25SEP86	TOBAGA	55.5		177	KOIOGO	U	MAMO-MAUBO	V	F	Dn
1132	25SEP86	TOBAGA	53.5		159	KOIOGO	U	MAMO-MAUBO	V	F	Dn
1385	25SEP86	BO	43.8		105	KOIOGO	U	MAMO-MAUBO	V	F	Dn
193	29SEP86	SOIGIA	67.1		140	STRICKLAND	H	DOGO	V	F	Dn
112	01OCT86	SOIGIA	99.4	*	490	STRICKLAND	H	SIMO	V	F	Up
1490	02OCT86	SA	20.7		16	UNKNOWN	O	MABEI	V	F	Up
113	03OCT86	SOIGIA	93.8	*	385	STRICKLAND	H	SINIO	V	F	Up
435	03OCT86	GUMO	.	*	200	I	S	FILIFI	V	F	Up
436	03OCT86	GUMO	76.4	*	285	I	S	FILIFI	V	F	Up
1163	03OCT86	TOBAGA	46.5	*	110	I	S	FILIFI	V	F	Up
1164	03OCT86	TOBAGA	53.5	*	170	I	S	FILIFI	V	F	Up
114	05OCT86	SOIGIA	80.8	*	240	STRICKLAND	H	HEGOGWA	V	F	Up
115	05OCT86	SOIGIA	90.0	*	330	STRICKLAND	H	HEGOGWA	V	F	Up
438	05OCT86	GUMO	110.4	*	625	STRICKLAND	H	HEGOGWA	V	F	Up
536	05OCT86	SOI	90.2		337	DEGE	S	SINIO	V	F	Up
537	05OCT86	SOI	131.1		1068	DEGE	S	SINIO-FILIFI	V	F	Up
538	05OCT86	SOI	84.3		273	DEGE	S	FILIFI	V	F	Up
540	05OCT86	SOI	158.0	*	1750	DEGE	S	SINIO	V	F	Up
541	05OCT86	SOI	102.0	*	475	DEGE	S	SINIO	V	F	Up
542	05OCT86	SOI	.	*	188	DEGE	S	SINIO-FILIFI	V	F	Up
671	05OCT86	DJAU	129.1	*	630	STRICKLAND	H	HEGOGWA	V	F	Up
801	05OCT86	AIODIO	147.9	*	2200	DEGE	S	SINIO	V	F	Up
802	05OCT86	AIODIO	82.2	*	480	DEGE	S	SINIO	V	F	Up
803	05OCT86	AIODIO	91.7	*	590	DEGE	S	SINIO	V	F	Up
804	05OCT86	AIODIO	104.5	*	950	DEGE	S	FILIFI	V	F	Up
805	05OCT86	AIODIO	105.2	*	955	DEGE	S	FILIFI	V	F	Up
806	05OCT86	AIODIO	89.5	*	625	DEGE	S	FILIFI	V	F	Up
807	05OCT86	AIODIO	106.0	*	1200	DEGE	S	FILIFI	V	F	Up
808	05OCT86	AIODIO	170.0	*	3650	DEGE	S	FILIFI	V	F	Up
812	05OCT86	AIODIO	119.6	*	1400	DEGE	S	SINIO	V	F	Up
940	05OCT86	TWE	68.0		309	DEGE	S	FILIFI	V	F	Up
944	05OCT86	TWE	94.4	*	825	DEGE	S	FILIFI	V	F	Up
945	05OCT86	TWE	85.5	*	470	DEGE	S	SINIO	V	O	Up
1075	05OCT86	YASA	87.6	*	515	DEGE	S	SINIO	V	F	Up
1076	05OCT86	YASA	94.4	*	625	DEGE	S	SINIO	V	F	Up
1165	05OCT86	TOBAGA	56.6		187	DEGE	S	FILIFI	V	F	Up
1401	05OCT86	BO	44.0		106	DEGE	S	FILIFI	V	F	Up
1491	05OCT86	SA	29.7		47	DEGE	S	SINIO	V	F	Up
1492	05OCT86	SA	31.9		58	UNKNOWN	O	GOGO	V	F	Dn
1493	05OCT86	SA	31.2		54	UNKNOWN	O	GOGO	V	F	Dn
1494	05OCT86	SA	23.6		23	UNKNOWN	O	GOGO	V	F	Dn
1495	05OCT86	SA	33.0		64	UNKNOWN	O	GOGO	V	F	Dn
1496	05OCT86	SA	29.1		44	UNKNOWN	O	GOGO	V	F	Dn
1514	05OCT86	SA	28.2	*	39	TURU	O	HEGOGWA	V	F	Up
1625	05OCT86	KAIBO	28.2	*	27	GWINTH	O	HEGOGWA	V	F	Up
116	08OCT86	SOIGIA	107.8	*	690	STRICKLAND	H	HEGOGWA	V	F	Up
117	10OCT86	SOIGIA	88.4		309	STRICKLAND	H	FILIFI	V	F	Up
544	11OCT86	SOI	92.0	*	335	DEGE	S	FILIFI	V	F	Up
545	11OCT86	SOI	96.6	*	475	DEGE	S	FILIFI	V	F	Up
546	11OCT86	SOI	103.1	*	520	DEGE	S	FILIFI	V	F	Up
547	11OCT86	SOI	108.3	*	600	DEGE	S	FILIFI	V	F	Up
548	11OCT86	SOI	112.3	*	650	DEGE	S	HEGOGWA	V	O	Up
549	11OCT86	SOI	117.8	*	810	DEGE	S	MAUBO	V	F	Dn
829	11OCT86	AIODIO	105.5	*	1000	DEGE	S	FILIFI	V	F	Up
133	13OCT86	SOIGIA	76.3	*	205	STRICKLAND	H	GASTRICKLAND	V	F	Dn
1186	14OCT86	TOBAGA	42.0		78	FU	S	GUGWI	V	F	Up
1439	14OCT86	BO	41.5		89	TAGU	O	SINIO	V	F	Up
134	15OCT86	SOIGIA	104.7	*	575	STRICKLAND	H	MAUBO	V	F	Dn
135	15OCT86	SOIGIA	97.4	*	435	STRICKLAND	H	SISIGIA	V	F	Up
560	15OCT86	SOI	134.8	*	1025	STRICKLAND	H	BOWA	V	F	Dn
848	15OCT86	AIODIO	162.0	*	3100	STRICKLAND	H	MAUBO	V	F	Dn
453	16OCT86	GUMO	148.0	*	1750	STRICKLAND	H	SISIGIA	V	F	Up
629	16OCT86	OWUAHIA	110.0	*	625	STRICKLAND	H	SISIGIA	V	F	Up
136	17OCT86	SOIGIA	103.1	*	405	STRICKLAND	H	GASTRICKLAND	V	F	Dn
143	20OCT86	SOIGIA	103.6	*	480	STRICKLAND	H	WAFU	V	F	Up
145	20OCT86	SOIGIA	104.3	*	515	STRICKLAND	H	SINIO	V	O	Up
850	21OCT86	AIODIO	90.9		608	TAGU	H	KOSE	V	F	Dn
151	22OCT86	SOIGIA	77.1	*	203	STRICKLAND	H	MAUBO	V	F	Dn
152	23OCT86	SOIGIA	73.5	*	180	STRICKLAND	H	MAUBO	V	F	Dn

ID	DATE	TAXON	SL (mm)		WT (g)	STREAM	TECH.	FISHER(S)	CONTEXT catch	eat	AFF.
153	23OCT86	SOIGIA	80.8	*	225	STRICKLAND	H	MAUBO	V	F	Dn
154	23OCT86	SOIGIA	102.3	*	530	STRICKLAND	H	SINIO	V	F	Up
155	23OCT86	SOIGIA	67.2	*	180	STRICKLAND	H	SINIO	V	F	Up
164	23OCT86	SOIGIA	89.2		317	STRICKLAND	H	BOUA	V	F	Dn
633	23OCT86	OWUAHIA	104.0	*	505	STRICKLAND	H	MAUBO	V	F	Dn
697	23OCT86	OKAIBO	135.5	*	800	STRICKLAND	H	SINIO	V	F	Up
1230	23OCT86	TOBAGA	51.3		140	TAGU	S	SINIO	V	F	Up
160	24OCT86	SOIGIA	72.3	*	174	STRICKLAND	H	GUGWI	V	F	Up
161	24OCT86	SOIGIA	.	*	66	STRICKLAND	H	HEGOGWA	V	F	Up
162	24OCT86	SOIGIA	85.5	*	280	STRICKLAND	H	HEGOGWA	V	F	Up
163	24OCT86	SOIGIA	96.9	*	405	STRICKLAND	H	HEGOGWA	V	F	Up
165	24OCT86	SOIGIA	87.3	*	295	STRICKLAND	H	MAUBO	V	F	Dn
166	24OCT86	SOIGIA	92.7	*	355	STRICKLAND	H	MAUBO	V	F	Dn
167	24OCT86	SOIGIA	49.2		58	STRICKLAND	H	MAUBO	V	F	Dn
698	24OCT86	OKAIBO	71.1	*	97	STRICKLAND	H	MAUBO	V	F	Dn
170	26OCT86	SOIGIA	111.0	*	585	STRICKLAND	H	HEGOGWA	V	F	Up
171	26OCT86	SOIGIA	81.5	*	270	STRICKLAND	H	HEGOGWA	V	F	Up
172	26OCT86	SOIGIA	104.8	*	570	STRICKLAND	H	SIMO	V	F	Up
173	27OCT86	SOIGIA	92.5	*	350	STRICKLAND	H	HEGOGWA	V	F	Up
174	27OCT86	SOIGIA	103.2	*	465	STRICKLAND	H	HEGOGWA	V	F	Up
175	27OCT86	SOIGIA	104.6	*	550	STRICKLAND	H	DOGO	V	F	Dn
176	27OCT86	SOIGIA	51.0	*	61	STRICKLAND	H	DOGO	V	F	Dn
677	27OCT86	DJAU	173.0	*	1050	STRICKLAND	H	SISIGIA	V	F	Up
699	27OCT86	OKAIBO	64.1	*	81	STRICKLAND	H	DOGO	V	F	Dn
177	28OCT86	SOIGIA	108.3		553	STRICKLAND	H	GUGWI	V	F	Up
178	28OCT86	SOIGIA	106.2		523	STRICKLAND	H	GUGWI	V	F	Up
179	28OCT86	SOIGIA	72.0	*	187	STRICKLAND	H	HEGOGWA	V	F	Up
180	28OCT86	SOIGIA	82.6	*	250	STRICKLAND	H	HEGOGWA	V	F	Up
181	28OCT86	SOIGIA	85.8	*	275	STRICKLAND	H	HEGOGWA	V	F	Up
182	28OCT86	SOIGIA	86.6	*	280	STRICKLAND	H	HEGOGWA	V	F	Up
183	28OCT86	SOIGIA	94.8	*	380	STRICKLAND	H	HEGOGWA	V	F	Up
184	28OCT86	SOIGIA	105.6	*	545	STRICKLAND	H	HEGOGWA	V	F	Up
185	28OCT86	SOIGIA	86.6	*	295	STRICKLAND	H	SISIGIA	V	F	Up
186	28OCT86	SOIGIA	118.4	*	775	STRICKLAND	H	SISIGIA	V	F	Up
187	28OCT86	SOIGIA	136.0	*	1140	STRICKLAND	H	SISIGIA	V	F	Up
635	28OCT86	OWUAHIA	100.5	*	395	STRICKLAND	H	HEGOGWA	V	O	Up
188	29OCT86	SOIGIA	57.7		91	STRICKLAND	H	GUGWI	V	F	Up
189	29OCT86	SOIGIA	103.9		491	STRICKLAND	H	GUGWI	V	F	Up
190	29OCT86	SOIGIA	58.4	*	95	STRICKLAND	H	SISIGIA	V	F	Up
191	29OCT86	SOIGIA	112.9	*	520	STRICKLAND	H	SISIGIA	V	F	Up
192	29OCT86	SOIGIA	101.2	*	395	STRICKLAND	H	BISEIO	V	F	Up
194	29OCT86	SOIGIA	100.9	*	495	STRICKLAND	H	BISEIO	V	F	Up
205	29OCT86	SOIGIA	92.2	*	355	STRICKLAND	H	MABEI	V	O	Up
1502	29OCT86	SA	.		35	UNKNOWN	O	MABEI	V	F	Up
1503	29OCT86	SA	.		35	UNKNOWN	O	BISEIO	V	F	Up
214	31OCT86	SOIGIA	109.6	*	665	STRICKLAND	H	GWUHO	V	F	Dn
219	03NOV86	SOIGIA	96.0		392	STRICKLAND	H	MUGWA	V	F	Dn
465	03NOV86	GUMO	130.2	*	920	DEGEHAFI	H	VISITOR	V	F	Up
1515	04NOV86	SA	27.7		38	GWO	O	GOGOI	V	F	Up
1467	05NOV86	BO	47.2		131	SIGIA	H	GASTRICKLAND	V	F	Dn
227	09NOV86	SOIGIA	92.9	*	390	STRICKLAND	H	GOGOI	V	F	Up
599	10NOV86	SOI	.	*	1120	SIGIAHAFI	H	MUGWA	V	F	Dn
1047	10NOV86	AIYO	39.9	*	62	MOME	H	GASTRICKLAND	V	F	Dn
1469	10NOV86	BO	51.3		169	MOME	H	GOGOI	V	F	Up
1470	10NOV86	BO	44.5		110	MOME	H	GOGOI	V	F	Up
229	11NOV86	SOIGIA	106.8		532	DIAMOHAFI	H	GOGO	V	F	Dn
230	11NOV86	SOIGIA	83.8	*	285	STRICKLAND	H	DOGO	V	F	Dn
231	11NOV86	SOIGIA	78.4		219	STRICKLAND	H	MUGWA	V	F	Dn
232	11NOV86	SOIGIA	74.4		189	DIAMOHAFI	H	GOGO	V	F	Dn
233	11NOV86	SOIGIA	108.4		555	DIAMOHAFI	H	GOGO	V	F	Dn
641	11NOV86	OWUAHIA	160.0	*	1925	STRICKLAND	H	GOGOI	V	F	Up
234	12NOV86	SOIGIA	75.5		197	STRICKLAND	H	MAUBO	V	F	Dn
235	12NOV86	SOIGIA	77.4		211	STRICKLAND	H	MAUBO	V	F	Dn
236	12NOV86	SOIGIA	110.5		586	STRICKLAND	H	MAUBO	V	F	Dn
237	12NOV86	SOIGIA	103.4	*	480	STRICKLAND	H	BOWA	V	F	Dn
238	12NOV86	SOIGIA	83.7	*	275	STRICKLAND	H	BOWA	V	F	Dn
239	12NOV86	SOIGIA	60.0		102	STRICKLAND	H	BOWA	V	F	Dn
240	12NOV86	SOIGIA	60.0		102	STRICKLAND	H	MUGWA	V	F	Dn
642	12NOV86	OWUAHIA	121.5	*	795	STRICKLAND	H	BOWA	V	F	Dn
1031	12NOV86	DA	65.6	*	350	STRICKLAND	H	BOWA	V	F	Dn

ID	DATE	TAXON	SL (mm)		WT (g)	STREAM	TECH.	FISHER(S)	CONTEXT catch	eat	AFF.
241	13NOV86	SOIGIA	74.1	*	195	STRICKLAND	H	GOGOI	V	F	Up
242	13NOV86	SOIGIA	110.5		586	STRICKLAND	H	MAUBO	V	F	Dn
243	13NOV86	SOIGIA	103.9		491	STRICKLAND	H	MAUBO	V	F	Dn
244	13NOV86	SOIGIA	103.7		489	STRICKLAND	H	MAUBO	V	F	Dn
468	13NOV86	GUMO	73.2	*	175	KAMU	S	SINIO	V	F	Up
469	13NOV86	GUMO	91.9	*	345	KAMU	S	SINIO	V	F	Up
470	13NOV86	GUMO	102.4	*	560	KAMU	S	SINIO	V	F	Up
471	13NOV86	GUMO	104.8	*	625	KAMU	S	SINIO	V	F	Up
472	13NOV86	GUMO	121.5	*	920	KAMU	S	SINIO	V	F	Up
473	13NOV86	GUMO	133.5	*	1250	KAMU	S	SINIO	V	F	Up
474	13NOV86	GUMO	109.8	*	680	KAMU	S	SINIO	V	O	Up
1101	13NOV86	GOI	89.1	*	7750	KAMU	S	SINIO	V	F	Up
1523	13NOV86	SA	.		35	GWO	O	GOGOI	V	F	Up
1732	13NOV86	SA	25.2		28	GWO	O	GOGOI	V	F	Up
245	15NOV86	SOIGIA	84.1		268	STRICKLAND	H	GASTRICKLAND	V	F	Dn
246	15NOV86	SOIGIA	95.5		386	STRICKLAND	H	GASTRICKLAND	V	F	Dn
247	15NOV86	SOIGIA	95.8		389	STRICKLAND	H	MAUBO	V	F	Dn
248	15NOV86	SOIGIA	110.8		591	STRICKLAND	H	MUGWA	V	F	Dn
253	15NOV86	SOIGIA	138.0	*	1000	STRICKLAND	H	GUGWI	V	F	Up
254	15NOV86	SOIGIA	132.2	*	875	STRICKLAND	H	GUGWI	V	F	Up
644	15NOV86	OWUAHIA	125.6	*	860	STRICKLAND	H	SISIGIA	V	F	Up
255	16NOV86	SOIGIA	81.7	*	255	STRICKLAND	H	GUGWI	V	F	Up
681	16NOV86	DJAU	124.2	*	605	STRICKLAND	H	GUGWI	V	F	Up
1638	16NOV86	TIO	64.6		1371	SIGIAHAFI	O	SIMO-HEGOGWA	V	F	Up
257	18NOV86	SOIGIA	82.7	*	280	STRICKLAND	H	VISITOR	V	F	Up
258	18NOV86	SOIGIA	88.5	*	295	STRICKLAND	H	MAMO	V	F	Dn
265	18NOV86	SOIGIA	93.5	*	350	STRICKLAND	H	VISITOR	V	F	Up
1634	18NOV86	SABO	90.5	*	1450	IA	O	VISITOR	V	F	Up
1641	18NOV86	AWASU	.	*	120	UNKNOWN	S	VISITOR	V	F	Up
268	19NOV86	SOIGIA	100.5	*	465	STRICKLAND	H	DOGO	V	F	Dn
269	19NOV86	SOIGIA	86.8	*	310	STRICKLAND	H	MABEI	V	F	Up
270	19NOV86	SOIGIA	64.5	*	130	STRICKLAND	H	MABEI	V	F	Up
271	19NOV86	SOIGIA	109.4	*	550	STRICKLAND	H	GOGOI	V	F	Up
682	19NOV86	DJAU	160.0	*	1150	STRICKLAND	H	DOGO	V	F	Dn
276	20NOV86	SOIGIA	74.1		186	SIGIAHAFI	H	GASTRICKLAND	V	F	Dn
277	20NOV86	SOIGIA	104.7		502	STRICKLAND	H	GOGO	V	F	Dn
278	20NOV86	SOIGIA	80.7	*	270	STRICKLAND	H	DOGO	V	F	Dn
279	20NOV86	SOIGIA	84.4	*	310	STRICKLAND	H	DOGO	V	F	Dn
280	20NOV86	SOIGIA	81.9	*	265	STRICKLAND	H	DOGO	V	O	Dn
589	20NOV86	SOI	123.2		882	SIGIAHAFI	H	GASTRICKLAND	V	F	Dn
281	21NOV86	SOIGIA	85.2	*	310	STRICKLAND	H	FILIFI	V	O	Up
282	21NOV86	SOIGIA	73.2	*	190	STRICKLAND	H	SISIGIA	V	F	Up
283	21NOV86	SOIGIA	72.7		176	STRICKLAND	H	DOGO	V	F	Dn
284	21NOV86	SOIGIA	64.3		124	STRICKLAND	H	DOGO	V	F	Dn
285	22NOV86	SOIGIA	.	*	410	STRICKLAND	H	SISIGIA	V	F	Up
286	22NOV86	SOIGIA	112.5	*	540	STRICKLAND	H	SINIO-FILIFI	V	F	Up
287	22NOV86	SOIGIA	106.4	*	480	STRICKLAND	H	SIMO	V	F	Up
288	22NOV86	SOIGIA	109.9	*	520	STRICKLAND	H	SINIO-FILIFI	V	F	Up
289	22NOV86	SOIGIA	107.0	*	520	STRICKLAND	H	SINIO-FILIFI	V	F	Up
290	22NOV86	SOIGIA	104.0	*	565	STRICKLAND	H	MAUBO	V	F	Dn
291	22NOV86	SOIGIA	95.5	*	385	STRICKLAND	H	SINIO-FILIFI	V	F	Up
507	22NOV86	SOIGIA	80.5	*	270	STRICKLAND	H	SINIO-FILIFI	V	F	Up
683	22NOV86	DJAU	165.0	*	1150	STRICKLAND	H	SIMO	V	F	Up
702	22NOV86	OKAIBO	73.5		120	STRICKLAND	H	WAFU	V	F	Up
292	23NOV86	SOIGIA	94.3	*	360	STRICKLAND	H	SINIO	V	F	Up
293	23NOV86	SOIGIA	95.3	*	415	STRICKLAND	H	MAUBO	V	F	Dn
294	23NOV86	SOIGIA	98.7		424	STRICKLAND	H	MAUBO	V	F	Dn
295	23NOV86	SOIGIA	81.9		248	STRICKLAND	H	MUGWA	V	F	Dn
645	23NOV86	OWUAHIA	106.5	*	580	STRICKLAND	H	MAUBO	V	O	Dn
684	23NOV86	DJAU	157.0	*	1100	STRICKLAND	H	MAUBO	V	F	Dn
296	24NOV86	SOIGIA	71.4		168	STRICKLAND	H	MAUBO	V	F	Dn
297	24NOV86	SOIGIA	90.9		335	STRICKLAND	H	MAUBO	V	F	Dn
298	24NOV86	SOIGIA	78.8	*	255	STRICKLAND	H	WAFU	V	F	Up
299	24NOV86	SOIGIA	104.6	*	525	STRICKLAND	H	SINIO	V	F	Up
994	24NOV86	TWE	75.0		392	SIGIA	S	VISITOR	V	F	Up
300	25NOV86	SOIGIA	90.9	*	365	STRICKLAND	H	WAFU	V	F	Up
301	25NOV86	SOIGIA	66.5	*	125	STRICKLAND	H	SINIO	V	F	Up
302	25NOV86	SOIGIA	94.3	*	370	STRICKLAND	H	MAUBO	V	O	Dn
303	25NOV86	SOIGIA	66.5	*	160	STRICKLAND	H	SIMO	V	F	Up
304	25NOV86	SOIGIA	63.8	*	110	STRICKLAND	H	MAUBO	V	F	Dn

ID	DATE	TAXON	SL (mm)		WT (g)	STREAM	TECH.	FISHER(S)	CONTEXT catch	CONTEXT eat	AFF.
305	25NOV86	SOIGIA	71.7	*	160	STRICKLAND	H	MAUBO	V	F	Dn
477	25NOV86	GUMO	153.6	*	1375	STRICKLAND	H	MAUBO	V	F	Dn
306	26NOV86	SOIGIA	104.7		502	STRICKLAND	H	MAUBO	V	F	Dn
307	26NOV86	SOIGIA	89.7	*	340	STRICKLAND	H	HEGOGWA	V	F	Up
1265	26NOV86	TOBAGA	50.5		134	DEGE	S	JOSHUA-PLUS	V	F	Up&Dn
1266	26NOV86	TOBAGA	52.2		148	DEGE	S	JOSHUA-PLUS	V	F	Up&Dn
1267	26NOV86	TOBAGA	58.4		205	DEGE	S	JOSHUA-PLUS	V	F	Up&Dn
1268	26NOV86	TOBAGA	50.5		134	DEGE	S	JOSHUA-PLUS	V	F	Up&Dn
1269	26NOV86	TOBAGA	54.6		168	DEGE	S	JOSHUA-PLUS	V	F	Up&Dn
1270	26NOV86	TOBAGA	48.5		119	DEGE	S	JOSHUA-PLUS	V	F	Up&Dn
1271	26NOV86	TOBAGA	45.6		99	DEGE	S	JOSHUA-PLUS	V	F	Up&Dn
308	27NOV86	SOIGIA	72.7	*	215	STRICKLAND	H	GOGOI	V	F	Up
309	27NOV86	SOIGIA	101.0		453	STRICKLAND	H	MAUBO	V	F	Dn
646	27NOV86	OWUAHIA	168.0		2071	STRICKLAND	H	MAUBO	V	F	Dn
656	27NOV86	OWUAHIA	133.8		1061	STRICKLAND	H	MAUBO	V	F	Dn
1032	27NOV86	DA	52.0		160	SIGIA	S	SIMO	V	F	Up
1272	27NOV86	TOBAGA	46.0		102	SIGIA	S	SIMO	V	F	Up
1273	27NOV86	TOBAGA	.		120	SIGIA	S	VISITOR	V	F	Up
1474	27NOV86	BO	.		75	SIGIA	S	VISITOR	V	F	Up
310	28NOV86	SOIGIA	105.5		513	STRICKLAND	H	VISITOR	V	F	Up
311	28NOV86	SOIGIA	84.0		267	STRICKLAND	H	VISITOR	V	F	Up
312	28NOV86	SOIGIA	64.3		124	STRICKLAND	H	VISITOR	V	F	Up
313	28NOV86	SOIGIA	112.1		611	STRICKLAND	H	SINIO	V	F	Up
478	28NOV86	GUMO	120.0		798	STRICKLAND	H	VISITOR	V	F	Up
685	28NOV86	DJAU	163.0		1197	STRICKLAND	H	MAUBO	V	F	Dn
876	28NOV86	AIODIO	126.3		1511	KOTO	S	JOSHUA-PLUS	V	F	Up&Dn
877	28NOV86	AIODIO	107.7		972	KOTO	S	JOSHUA-PLUS	V	F	Up&Dn
878	28NOV86	AIODIO	76.4		376	KOTO	S	JOSHUA-PLUS	V	F	Up&Dn
879	28NOV86	AIODIO	45.9		92	KOTO	S	JOSHUA-PLUS	V	F	Up&Dn
880	28NOV86	AIODIO	102.2		841	KOTO	S	JOSHUA-PLUS	V	F	Up&Dn
881	28NOV86	AIODIO	77.8	*	355	KOTO	S	JOSHUA-PLUS	V	O	Up&Dn
995	28NOV86	TWE	75.1		393	KOTO	S	JOSHUA-PLUS	V	F	Up&Dn
996	28NOV86	TWE	73.4		372	KOTO	S	JOSHUA-PLUS	V	F	Up&Dn
997	28NOV86	TWE	68.0		309	KOTO	S	JOSHUA-PLUS	V	F	Up&Dn
998	28NOV86	TWE	87.1		564	KOTO	S	JOSHUA-PLUS	V	F	Up&Dn
1274	28NOV86	TOBAGA	49.2		124	KOTO	S	JOSHUA-PLUS	V	F	Up&Dn
1275	28NOV86	TOBAGA	47.4		111	KOTO	S	JOSHUA-PLUS	V	F	Up&Dn
1276	28NOV86	TOBAGA	46.6		106	KOTO	S	JOSHUA-PLUS	V	F	Up&Dn
1277	28NOV86	TOBAGA	67.6		316	KOTO	S	JOSHUA-PLUS	V	F	Up&Dn
1278	28NOV86	TOBAGA	53.7		160	KOTO	S	JOSHUA-PLUS	V	F	Up&Dn
1279	28NOV86	TOBAGA	52.2		148	KOTO	S	JOSHUA-PLUS	V	F	Up&Dn
1280	28NOV86	TOBAGA	54.7		169	KOTO	S	JOSHUA-PLUS	V	F	Up&Dn
1281	28NOV86	TOBAGA	47.3		110	KOTO	S	JOSHUA-PLUS	V	F	Up&Dn
1282	28NOV86	TOBAGA	56.9		190	KOTO	S	JOSHUA-PLUS	V	F	Up&Dn
1283	28NOV86	TOBAGA	48.6		120	KOTO	S	JOSHUA-PLUS	V	F	Up&Dn
1284	28NOV86	TOBAGA	51.9		145	KOTO	S	JOSHUA-PLUS	V	F	Up&Dn
1285	28NOV86	TOBAGA	47.4		111	KOTO	S	JOSHUA-PLUS	V	F	Up&Dn
1286	28NOV86	TOBAGA	46.2		103	KOTO	S	JOSHUA-PLUS	V	F	Up&Dn
1287	28NOV86	TOBAGA	45.5		98	KOTO	S	JOSHUA-PLUS	V	F	Up&Dn
1475	28NOV86	BO	47.7		136	KOTO	S	JOSHUA-PLUS	V	F	Up&Dn
314	29NOV86	SOIGIA	107.2	*	510	STRICKLAND	H	DOGO	V	F	Dn
999	29NOV86	TWE	70.4	*	365	SIGIA	S	DOGO	V	F	Dn
1000	29NOV86	TWE	35.0		61	SIGIA	S	DOGO	V	F	Dn
1033	29NOV86	DA	50.2	*	176	SIGIA	S	DOGO	V	F	Dn
315	30NOV86	SOIGIA	108.0	*	610	STRICKLAND	H	MAUBO	V	F	Dn
316	30NOV86	SOIGIA	102.8	*	420	STRICKLAND	H	GWASE	V	F	Dn
317	30NOV86	SOIGIA	65.3	*	150	STRICKLAND	H	GWASE	V	F	Dn
479	30NOV86	GUMO	69.6	*	170	STRICKLAND	H	GWASE	V	F	Dn
686	30NOV86	DJAU	141.3	*	850	STRICKLAND	H	GWASE	V	F	Dn
1642	05DEC86	AWASU	55.7	*	222	STRICKLAND	H	SISIGIA	V	F	Up
592	07DEC86	SOI	99.1		450	SIGIAHAFI	H	HEGOGWA	V	F	Up
321	09DEC86	SOIGIA	123.0		797	STRICKLAND	H	SIMO	V	F	Up
322	10DEC86	SOIGIA	95.4		385	STRICKLAND	H	GUGWI	V	F	Up
323	14DEC86	SOIGIA	93.0		358	STRICKLAND	H	HEGOGWA	V	F	Up
324	14DEC86	SOIGIA	94.4		373	STRICKLAND	H	MAUBO	V	F	Dn
325	14DEC86	SOIGIA	102.0		466	STRICKLAND	H	MAUBO	V	F	Dn
326	14DEC86	SOIGIA	103.0		479	STRICKLAND	H	MAUBO	V	F	Dn
593	14DEC86	SOI	141.7		1358	SIGIAHAFI	H	MAUBO	V	F	Dn
659	15DEC86	OWUAHIA	186.0		2794	STRICKLAND	H	SIMO	V	F	Up
335	16DEC86	SOIGIA	101.3	*	480	STRICKLAND	H	SIMO	V	F	Up

ID	DATE	TAXON	SL (mm)		WT (g)	STREAM	TECH.	FISHER(S)	CONTEXT catch	eat	AFF.
336	17DEC86	SOIGIA	56.3		85	STRICKLAND	H	GOGOI	V	F	Up
344	17DEC86	SOIGIA	94.1		370	STRICKLAND	H	GUGWI	V	F	Up
687	17DEC86	DJAU	178.0		1502	STRICKLAND	H	SIMO	V	F	Up
661	18DEC86	OWUAHIA	182.0	*	2525	STRICKLAND	H	SIMO	V	F	Up
662	21DEC86	OWUAHIA	165.0	*	1950	STRICKLAND	H	SIMO	V	F	Up
349	24DEC86	SOIGIA	79.5	*	250	STRICKLAND	H	GUGWI	V	F	Up
350	24DEC86	SOIGIA	60.5	*	105	STRICKLAND	H	HEGOGWA	V	F	Up
351	24DEC86	SOIGIA	99.6	*	415	STRICKLAND	H	VISITOR	V	F	Dn
352	24DEC86	SOIGIA	118.1	*	750	STRICKLAND	H	VISITOR	V	F	Dn
353	24DEC86	SOIGIA	94.2	*	415	STRICKLAND	H	HEGOGWA	V	O	Up
354	24DEC86	SOIGIA	94.3	*	355	STRICKLAND	H	VISITOR	V	F	Dn
493	24DEC86	GUMO	67.0	*	150	SIGIAHAFI	H	HEGOGWA	V	F	Up
600	24DEC86	SOI	123.8	*	820	SIGIAHAFI	H	HEGOGWA	V	F	Up
355	25DEC86	SOIGIA	88.0		305	STRICKLAND	H	GUGWI	V	F	Up
356	26DEC86	SOIGIA	74.5		189	STRICKLAND	H	KOSE	V	F	Dn
601	26DEC86	SOI	154.5	*	2025	TAGU	S	GUGWI	V	F	Up
602	26DEC86	SOI	102.4	*	480	TAGU	S	GUGWI	V	F	Up
1007	26DEC86	TWE	86.7		558	TAGU	S	GUGWI	V	F	Up
1294	26DEC86	TOBAGA	52.2		148	TAGU	S	GUGWI	V	F	Up
1295	26DEC86	TOBAGA	51.9		145	TAGU	S	GUGWI	V	F	Up
1484	26DEC86	BO	39.9		79	TAGU	S	GUGWI	V	F	Up
494	27DEC86	GUMO	147.7		1480	STRICKLAND	H	SIMO	V	F	Up
361	29DEC86	SOIGIA	113.1	*	560	STRICKLAND	H	HEGOGWA	V	F	Up
362	29DEC86	SOIGIA	88.2	*	210	STRICKLAND	H	HEGOGWA	V	F	Up
363	29DEC86	SOIGIA	.	*	160	STRICKLAND	H	HEGOGWA	V	F	Up
364	29DEC86	SOIGIA	71.4	*	100	STRICKLAND	H	HEGOGWA	V	F	Up
1011	30DEC86	TWE	59.7	*	225	SIGIA	S	FILIFI	V	O	Up
365	31DEC86	SOIGIA	60.4		104	STRICKLAND	H	GUGWI	V	F	Up
894	31DEC86	AIODIO	124.5	*	1700	STRICKLAND	H	GWASE	V	F	Dn
1296	31DEC86	TOBAGA	72.3		385	MOME	S	GUGWI	V	F	Up
1297	31DEC86	TOBAGA	42.9		83	MOME	S	GUGWI	V	F	Up
1298	31DEC86	TOBAGA	38.4		60	MOME	S	GUGWI	V	F	Up
1299	31DEC86	TOBAGA	34.7		44	MOME	S	GUGWI	V	F	Up
1106	01JAN87	GOI	68.1	*	2200	FU	U	GUGWI	V	F	Up
1300	01JAN87	TOBAGA	45.5		98	FU	S	GUGWI	V	F	Up
1301	01JAN87	TOBAGA	45.5		98	FU	S	GUGWI	V	F	Up
1539	01JAN87	SA	20.5		15	DABAGA	H	BOWA-BOUA	V	F	Dn
1540	01JAN87	SA	20.9		16	DABAGA	H	BOWA-BOUA	V	F	Dn
1541	01JAN87	SA	.		35	DABAGA	H	BOWA-BOUA	V	F	Dn
1542	01JAN87	SA	28.0		39	DABAGA	H	BOWA	V	F	Dn
1543	01JAN87	SA	27.1		35	DABAGA	H	BOWA	V	F	Dn
1544	01JAN87	SA	31.3		55	DABAGA	H	BOWA	V	F	Dn
1545	01JAN87	SA	30.8		52	DABAGA	H	BOWA	V	F	Dn
1546	01JAN87	SA	30.2		49	DABAGA	H	BOWA	V	F	Dn
1547	01JAN87	SA	27.0		35	DABAGA	H	BOWA	V	F	Dn
1630	01JAN87	KIGI	35.5		83	FU	S	GUGWI	V	F	Up
366	02JAN87	SOIGIA	58.4		94	STRICKLAND	H	GUGWI	V	F	Up
367	06JAN87	SOIGIA	96.4	*	395	STRICKLAND	H	VISITOR	V	F	Up
368	10JAN87	SOIGIA	93.0	*	395	STRICKLAND	H	VISITOR	V	F	Up
369	11JAN87	SOIGIA	104.5	*	495	STRICKLAND	H	DOGO	V	F	Dn
1302	11JAN87	TOBAGA	44.5		92	SOMASIO	S	GUGWI	V	F	Up
1485	11JAN87	BO	45.4		117	SOMASIO	S	GUGWI	V	F	Up
1639	11JAN87	TIO	56.7	*	465	SIGIAHAFI	O	FILIFI-DOGO	V	F	Up&Dn
896	12JAN87	AIODIO	144.0		2173	SIGIAHAFI	H	MAUBO	V	F	Dn
605	17JAN87	SOI	131.0		1065	SIGIAHAFI	H	KOSE	V	F	Dn
688	17JAN87	DJAU	147.6		927	SIGIAHAFI	H	KOSE	V	F	Dn
377	18JAN87	SOIGIA	69.3		154	STRICKLAND	H	VISITOR	V	F	Up
378	23JAN87	SOIGIA	.	*	510	STRICKLAND	H	MUGWA	V	F	Dn
379	23JAN87	SOIGIA	99.3	*	425	STRICKLAND	H	BOWA	V	F	Dn
690	23JAN87	DJAU	95.0		298	STRICKLAND	H	GOGOI	V	F	Up
380	24JAN87	SOIGIA	105.0		506	STRICKLAND	H	SISIGIA	V	F	Up
390	25JAN87	SOIGIA	107.6	*	505	STRICKLAND	H	SISIGIA	V	F	Up
606	25JAN87	SOI	145.1	*	1450	SIGIAHAFI	H	KOSE	V	F	Dn
391	26JAN87	SOIGIA	70.6		162	STRICKLAND	H	MUGWA	V	F	Dn
1382	29JAN87	TOGOWO	81.4	*	1150	SIGIAHAFI	H	MUGWA	V	F	Dn
393	03FEB87	SOIGIA	101.6	*	460	SIGIAHAFI	H	KOSE	V	F	Dn
691	03FEB87	DJAU	156.0	*	1010	STRICKLAND	H	KOSE	V	F	Dn
398	15FEB87	SOIGIA	89.5	*	300	STRICKLAND	H	GOGOI	V	F	Up
399	19FEB87	SOIGIA	57.7		91	STRICKLAND	H	GUGWI	V	F	Up
692	19FEB87	DJAU	136.1	*	745	STRICKLAND	H	MAUBO	V	F	Dn

ID	DATE	TAXON	SL (mm)		WT (g)	STREAM	TECH.	FISHER(S)	CONTEXT catch	eat	AFF.
400	20FEB87	SOIGIA	80.6	*	240	STRICKLAND	H	MABEI	V	F	Up
401	20FEB87	SOIGIA	83.0	*	220	STRICKLAND	H	GASTRICKLAND	V	F	Dn
497	20FEB87	GUMO	120.6		810	SIGIAHAFI	H	MAUBO	V	F	Dn
498	20FEB87	GUMO	125.0		901	SIGIAHAFI	H	MAUBO	V	F	Dn
608	20FEB87	SOI	134.2	*	1150	SIGIAHAFI	H	TUFA	V	F	Up
1070	22FEB87	AIYO	.		36	TAGU	H	BOWA	V	F	Dn
1071	22FEB87	AIYO	.		36	TAGU	H	BOWA	V	F	Dn
1486	03MAR87	BO	51.5		171	DEGE	H	BOUA	V	F	Dn
1383	06MAR87	TOGOWO	90.1	*	1175	SIGIAHAFI	H	MABEI	V	F	Up
402	12MAR87	SOIGIA	89.1	*	340	STRICKLAND	H	BISEIO	V	F	Up
403	13MAR87	SOIGIA	88.3		308	STRICKLAND	H	SIMO	V	F	Up
411	13MAR87	SOIGIA	.	*	65	STRICKLAND	H	GOGOI	V	F	Up
404	14MAR87	SOIGIA	102.5	*	480	STRICKLAND	H	SISIGIA	V	F	Up
704	14MAR87	OKAIBO	90.9	*	255	STRICKLAND	H	MABEI	V	F	Up
1014	14MAR87	TWE	89.3		600	TAGU	S	GWASE	V	F	Dn
409	15MAR87	SOIGIA	72.7	*	185	STRICKLAND	H	DOGO	V	F	Dn
410	15MAR87	SOIGIA	87.7	*	310	STRICKLAND	H	DOGO	V	F	Dn
412	15MAR87	SOIGIA	90.6	*	335	STRICKLAND	H	DOGO	V	F	Dn
413	15MAR87	SOIGIA	91.7	*	410	STRICKLAND	H	DOGO	V	F	Dn
414	15MAR87	SOIGIA	101.7		462	STRICKLAND	H	SIMO	V	F	Up
415	15MAR87	SOIGIA	106.4	*	490	STRICKLAND	H	DOGO	V	O	Dn
693	15MAR87	DJAU	166.0	*	1200	STRICKLAND	H	GOGOI	V	F	Up
705	15MAR87	OKAIBO	148.1	*	940	STRICKLAND	H	DOGO	V	F	Dn
706	15MAR87	OKAIBO	87.6	*	210	STRICKLAND	H	GOGOI	V	F	Up
1564	15MAR87	SA	27.8		35	I	H	GOGO	V	O	Dn
1565	15MAR87	SA	28.7		40	I	H	GOGO	V	O	Dn
1566	15MAR87	SA	29.4		45	I	H	GOGO	V	O	Dn
1567	15MAR87	SA	29.5		45	I	H	GOGO	V	O	Dn
1568	15MAR87	SA	30.6		60	I	H	GOGO	V	O	Dn
1569	15MAR87	SA	31.2		60	I	H	GOGO	V	O	Dn
1570	15MAR87	SA	.		35	I	H	GOGO	V	F	Dn
1571	15MAR87	SA	.		35	I	H	GOGO	V	F	Dn
1572	15MAR87	SA	34.3		72	I	H	GOGO	V	F	Dn
1573	15MAR87	SA	28.1		39	I	H	GOGO	V	F	Dn
1574	15MAR87	SA	.		35	I	H	GOGO	V	F	Dn
1575	15MAR87	SA	.		35	I	H	GOGO	V	F	Dn
1576	15MAR87	SA	.		35	I	H	GOGO	V	F	Dn
1577	15MAR87	SA	.		35	I	H	GOGO	V	F	Dn
1578	15MAR87	SA	.		35	I	H	GOGO	V	F	Dn
1579	15MAR87	SA	.		35	I	H	GOGO	V	F	Dn
1580	15MAR87	SA	.		35	I	H	GOGO	V	F	Dn
1581	15MAR87	SA	.		35	I	H	GOGO	V	F	Dn
1582	15MAR87	SA	.		35	I	H	GOGO	V	F	Dn
1583	15MAR87	SA	.		35	I	H	GOGO	V	F	Dn
1584	15MAR87	SA	.		35	I	H	GOGO	V	F	Dn
1585	15MAR87	SA	.		35	I	H	GOGO	V	F	Dn
1586	15MAR87	SA	.		35	I	H	GOGO	V	F	Dn
1587	15MAR87	SA	.		35	I	H	GOGO	V	F	Dn
1588	15MAR87	SA	.		35	I	H	GOGO	V	F	Dn
1589	15MAR87	SA	38.2		99	I	H	GOGO	V	F	Dn
1590	15MAR87	SA	29.5		46	I	H	GOGO	V	F	Dn
1591	15MAR87	SA	25.7		30	I	H	GOGO	V	F	Dn
1592	15MAR87	SA	30.2		49	I	H	GOGO	V	F	Dn
1593	15MAR87	SA	.		35	I	H	GOGO	V	F	Dn
1594	15MAR87	SA	.		35	I	H	GOGO	V	F	Dn
1643	16MAR87	AWASU	55.0	*	215	SIGIAHAFI	H	GWUHO	V	F	Dn
416	20MAR87	SOIGIA	110.5	*	610	SIGIAHAFI	H	GWUHO	V	F	Dn
1308	21MAR87	TOBAGA	47.1		109	FU	S	SIMO	V	F	Up
1309	21MAR87	TOBAGA	.		120	FU	S	SIMO	V	F	Up
501	25MAR87	GUMO	97.7		433	STRICKLAND	H	GWASE	V	F	Dn
694	27MAR87	DJAU	149.0	*	920	SIGIAHAFI	H	SISIGIA	V	F	Up
905	01APR87	AIODIO	169.0	*	3400	MOME	S	GUGWI	V	F	Up
1314	01APR87	TOBAGA	56.3		184	FU	S	SIMO	V	F	Up
1315	01APR87	TOBAGA	.		120	FU	S	SIMO	V	F	Up
1316	01APR87	TOBAGA	34.6		44	MOME	S	GUGWI	V	F	Up
1317	06APR87	TOBAGA	67.9		320	FU	S	BISEIO	V	F	Up
1318	06APR87	TOBAGA	58.6		207	FU	S	BISEIO	V	F	Up
1319	06APR87	TOBAGA	57.6		197	FU	S	BISEIO	V	F	Up
1595	06APR87	SA	27.6		37	UNKNOWN	O	MABEI	V	F	Up
1596	06APR87	SA	.		35	UNKNOWN	O	MABEI	V	F	Up

ID	DATE	TAXON	SL (mm)		WT (g)	STREAM	TECH.	FISHER(S)	CONTEXT catch	eat	AFF.
417	07APR87	SOIGIA	114.3	*	735	STRICKLAND	H	MABEI	V	F	Up
418	13APR87	SOIGIA	106.8	*	620	STRICKLAND	H	GOGOI	V	F	Up
615	13APR87	SOI	146.2	*	1250	DEGE	S	JOSHUA-PLUS	V	F	Up&Dn
1018	13APR87	TWE	48.5		135	UNKNOWN	S	JOSHUA-PLUS	V	F	Up&Dn
1320	13APR87	TOBAGA	53.2	*	155	SOMASIO	S	JOSHUA-PLUS	V	O	Up&Dn
1321	13APR87	TOBAGA	50.8	*	140	SOMASIO	S	JOSHUA-PLUS	V	O	Up&Dn
1322	13APR87	TOBAGA	49.5		126	UNKNOWN	S	JOSHUA-PLUS	V	F	Up&Dn
1323	13APR87	TOBAGA	45.9		101	UNKNOWN	S	JOSHUA-PLUS	V	F	Up&Dn
1324	13APR87	TOBAGA	49.3		125	UNKNOWN	S	JOSHUA-PLUS	V	F	Up&Dn
1325	13APR87	TOBAGA	49.2		124	UNKNOWN	S	JOSHUA-PLUS	V	F	Up&Dn
1326	13APR87	TOBAGA	47.5		112	UNKNOWN	S	JOSHUA-PLUS	V	F	Up&Dn
1327	13APR87	TOBAGA	41.6		76	UNKNOWN	S	JOSHUA-PLUS	V	F	Up&Dn
1328	13APR87	TOBAGA	47.3		110	UNKNOWN	S	JOSHUA-PLUS	V	F	Up&Dn
1329	13APR87	TOBAGA	41.1		73	UNKNOWN	S	JOSHUA-PLUS	V	F	Up&Dn
1631	13APR87	KIGI	37.1		95	DOUA	S	JOSHUA-PLUS	V	F	Up&Dn
906	20APR87	AIODIO	123.3	*	1775	FU	O	GUGWI	V	F	Up
1019	20APR87	TWE	74.3	*	405	FU	O	GUGWI	V	F	Up
1330	20APR87	TOBAGA	40.5		70	FU	S	GUGWI	V	O	Up
1610	20APR87	SA	30.2	*	48	TOSU	O	GUGWI	V	O	Up
1611	20APR87	SA	40.1	*	108	TOSU	O	GUGWI	V	O	Up
1612	20APR87	SA	.		35	TOSU	U	GUGWI-SISIGIA	V	O	Up
502	21APR87	GUMO	125.7	*	1125	KAMU	S	BISEIO	V	F	Up
503	21APR87	GUMO	93.8	*	430	KAMU	S	TUFA	V	F	Up
504	21APR87	GUMO	.	*	251	KAMU	S	BISEIO	V	O	Up
1489	21APR87	BO	.	*	111	KAMU	S	TUFA	V	F	Up
419	24APR87	SOIGIA	107.8	*	420	STRICKLAND	H	GOGOI	V	F	Up
420	24APR87	SOIGIA	51.0		64	STRICKLAND	H	GOGOI	V	F	Up
421	25APR87	SOIGIA	97.5	*	440	SIGIAHAFI	H	GWASE	V	F	Dn
422	25APR87	SOIGIA	98.9		427	STRICKLAND	H	SIMO	V	O	Up
423	25APR87	SOIGIA	95.5	*	415	SIGIAHAFI	H	SISIGIA	V	F	Up
505	25APR87	GUMO	76.1		206	SIGIAHAFI	H	SIMO	V	O	Up
506	25APR87	GUMO	114.3	*	770	STRICKLAND	H	GUGWI	V	F	Up
424	27APR87	SOIGIA	60.8	*	119	STRICKLAND	H	GOGOI	V	F	Up
425	30APR87	SOIGIA	104.9		505	STRICKLAND	H	VISITOR	V	F	Up
1	01MAY87	SOIGIA	79.8		231	STRICKLAND	H	MABEI	V	F	Up
2	01MAY87	TIO	64.0	*	1250	SIGIAHAFI	O	GUGWI	V	F	Up
3	02MAY87	KAUFO	.		30	GWI	O	SIMO	V	F	Up
4	02MAY87	SOIGIA	95.1		381	STRICKLAND	H	MABEI	V	F	Up
5	03MAY87	SOIGIA	95.5	*	455	STRICKLAND	H	MABEI	V	F	Up
6	04MAY87	SOIGIA	70.5		162	STRICKLAND	H	MABEI	V	F	Up
7	07MAY87	SOIGIA	96.3	*	430	STRICKLAND	H	GOGOI	V	F	Up
8	10MAY87	TOBAGA	45.2		97	TAGU	S	GUGWI	V	F	Up
9	10MAY87	TOBAGA	47.3		110	TAGU	S	SIMO	V	O	Up
18	11MAY87	TOBAGA	59.9		221	TAGU	S	GUGWI	V	F	Up
19	11MAY87	TOBAGA	61.6	*	250	TAGU	S	GUGWI	V	F	Up
20	11MAY87	TOBAGA	37.6		56	TAGU	S	GUGWI	V	F	Up
21	11MAY87	AIODIO	69.3	*	295	DEGE	O	GUGWI-SISIGIA	V	O	Up
22	11MAY87	AIODIO	141.0	*	1920	DEGE	O	GUGWI-SISIGIA	V	O	Up
23	11MAY87	TWE	63.0	*	305	TAGU	S	GUGWI	V	F	Up
41	18MAY87	SOIGIA	.	*	290	STRICKLAND	H	GUGWI	V	F	Up
42	21MAY87	BO	46.6	*	125	DEGE	S	BISEIO	V	O	Up
43	21MAY87	TOBAGA	52.8	*	140	DEGE	S	BISEIO	V	O	Up
44	21MAY87	TOBAGA	42.5	*	80	DEGE	S	BISEIO	V	F	Up
45	21MAY87	TOBAGA	46.0	*	90	DEGE	S	BISEIO	V	F	Up
46	21MAY87	TOBAGA	50.9	*	135	DEGE	S	BISEIO	V	F	Up
47	21MAY87	TOBAGA	56.3	*	182	DEGE	S	BISEIO	V	F	Up
50	23MAY87	TOBAGA	47.4		111	DEGE	S	VISITOR	V	F	Dn
51	23MAY87	TOBAGA	48.0		115	DEGE	S	VISITOR	V	F	Dn
52	23MAY87	TOBAGA	61.4		238	DEGE	S	VISITOR	V	F	Dn
53	24MAY87	TOBAGA	46.3	*	110	YUWENA	S	VISITOR	V	F	Dn
54	24MAY87	BO	40.2	*	80	YUWENA	S	VISITOR	V	F	Dn
55	25MAY87	TOBAGA	41.0	*	75	SIGIA	S	VISITOR	V	F	Dn
56	25MAY87	TOBAGA	44.4	*	95	SIGIA	S	VISITOR	V	F	Dn
57	25MAY87	BO	28.8	*	30	SIGIA	S	VISITOR	V	F	Dn
58	27MAY87	SOIGIA	70.0	*	160	STRICKLAND	H	SIMO	V	F	Dn
59	29MAY87	SA	26.8		34	TASU	H	SISIGIA	V	F	Up
60	29MAY87	SA	31.0		53	TASU	H	SISIGIA	V	F	Up
61	29MAY87	OWUAHIA	192.0	*	3068	STRICKLAND	H	SIMO	V	F	Up
62	30MAY87	SOI	134.4	*	1175	DEGE	S	VISITOR	V	F	Dn
63	30MAY87	TOBAGA	39.4		64	FU	S	VISITOR	V	F	Dn

ID	DATE	TAXON	SL (mm)		WT (g)	STREAM	TECH.	FISHER(S)	CONTEXT catch	CONTEXT eat	AFF.
64	30MAY87	TOBAGA	41.7		76	FU	S	VISITOR	V	F	Dn
69	31MAY87	SOIGIA	94.5	*	325	STRICKLAND	H	VISITOR	V	F	Dn
1670	02JUN87	SOIGIA	99.8		438	STRICKLAND	H	SIMO	V	F	Up
1676	03JUN87	SOIGIA	91.6		342	STRICKLAND	H	SISIGIA	V	F	Up
1677	04JUN87	DA	53.7		174	I	S	VISITOR	V	F	Dn
1679	04JUN87	GOI	90.1	*	6500	I	S	FILIFI-PLUS	V	F	Up&Dn
1680	06JUN87	SOIGIA	79.5	*	200	STRICKLAND	H	VISITOR	V	F	Dn
1681	07JUN87	SOIGIA	.	*	350	STRICKLAND	H	VISITOR	V	F	Dn
1684	08JUN87	TOBAGA	63.6		264	TAGU	S	GUGWI	V	O	Up
1685	10JUN87	SOIGIA	85.5		281	STRICKLAND	H	SISIGIA	V	F	Up
1686	11JUN87	SOIGIA	108.5		556	STRICKLAND	H	SINIO	V	F	Up
1696	23JUN87	SOIGIA	93.4		362	STRICKLAND	H	SIMO	V	F	Up
1697	23JUN87	SOIGIA	95.5	*	325	STRICKLAND	H	GOGOI	V	F	Up
1698	23JUN87	SOIGIA	92.5		352	STRICKLAND	H	GOGOI	V	F	Up
1699	24JUN87	BO	33.6		47	SOMASIO	S	GUGWI	V	F	Up
1700	24JUN87	BO	46.9		129	SOMASIO	S	GUGWI	V	F	Up
1710	29JUN87	SOIGIA	81.7	*	240	STRICKLAND	H	SISIGIA	V	O	Up
1711	29JUN87	SOIGIA	75.7	*	220	STRICKLAND	H	SISIGIA	V	F	Up
1712	30JUN87	TOBAGA	43.2	*	81	DEGE	S	GUGWI	V	O	Up
1713	30JUN87	TOBAGA	42.0		78	DEGE	S	GUGWI	V	F	Up
1714	30JUN87	TOBAGA	51.0		138	DEGE	S	GUGWI	V	F	Up
1725	01JUL87	TOBAGA	49.1		123	NODI	S	GWASE	V	F	Dn
1726	01JUL87	DJAU	155.0	*	1300	STRICKLAND	H	GWASE	V	F	Dn
1727	01JUL87	DJAU	160.0	*	1390	STRICKLAND	H	GWASE	V	F	Dn
1738	05JUL87	DJAU	134.5	*	950	STRICKLAND	H	BOWA	V	F	Dn
1739	05JUL87	SOIGIA	75.3	*	220	STRICKLAND	H	BOWA	V	F	Dn
1740	06JUL87	SOIGIA	81.3	*	250	GWAIHAFI	H	YASOBIDUA	V	F	Dn
1757	08JUL87	SOIGIA	77.3	*	210	STRICKLAND	H	BOWA	V	F	Dn
1762	10JUL87	BO	38.0		68	DEGE	S	GWASE	V	F	Dn
1763	10JUL87	TOBAGA	39.9		67	DEGE	S	GWASE	V	F	Dn
1764	10JUL87	TOBAGA	54.9		171	DEGE	S	GWASE	V	F	Dn
1765	10JUL87	SOI	88.5	*	330	DEGE	S	GWASE	V	F	Dn
1766	10JUL87	SOI	96.5	*	425	DEGE	S	GWASE	V	F	Dn
1798	13JUL87	SOI	109.6	*	630	DEGE	S	SIMO	V	F	Up
1799	13JUL87	SOI	103.5	*	575	DEGE	O	SIMO	V	F	Up
1800	15JUL87	SOI	147.2	*	1500	MOME	S	GUGWI	V	F	Up
1801	15JUL87	AIODIO	131.7	*	2550	MOME	S	GUGWI	V	F	Up
1815	16JUL87	TOBAGA	48.4		118	TAGU	S	GWASE	V	F	Dn
1819	19JUL87	SOIGIA	76.6	*	210	KAMUHAFI	H	DOGO	V	F	Dn
1820	19JUL87	SOIGIA	60.4	*	97	SIGIAHAFI	H	VISITOR	V	F	Up
1821	19JUL87	SOIGIA	108.8	*	585	SIGIAHAFI	H	TUFA	V	O	Up
1822	19JUL87	SOIGIA	74.1	*	170	SIGIAHAFI	H	TUFA	V	F	Up
1823	19JUL87	SOIGIA	86.9	*	295	SIGIAHAFI	H	TUFA	V	F	Up
1824	19JUL87	SOIGIA	102.4	*	405	SIGIAHAFI	H	TUFA	V	F	Up
1825	19JUL87	SOIGIA	79.5	*	225	SIGIAHAFI	H	VISITOR	V	F	Up
1826	19JUL87	SOIGIA	112.6	*	550	SIGIAHAFI	H	VISITOR	V	F	Up
1827	19JUL87	SOI	136.2	*	1200	SIGIAHAFI	H	VISITOR	V	F	Up
1828	19JUL87	SOI	133.8	*	1225	DEGE	S	MAUBO	V	F	Dn
1829	19JUL87	TWE	81.1	*	445	DEGE	S	MAUBO	V	F	Dn
1830	19JUL87	AIODIO	62.2	*	210	DEGE	S	MAUBO	V	F	Dn
1831	19JUL87	TWE	93.9	*	725	SIGIA	S	MAMO	V	F	Dn
1832	20JUL87	BO	43.6	*	90	I	S	GUGWI	V	F	Up
1833	20JUL87	TOBAGA	41.1	*	75	I	S	GUGWI	V	F	Up
1834	20JUL87	TOBAGA	42.0	*	90	I	S	GUGWI	V	F	Up
1835	20JUL87	TOBAGA	44.7	*	98	I	S	GUGWI	V	F	Up
1836	20JUL87	SOIGIA	96.7	*	410	STRICKLAND	H	GASTRICKLAND	V	F	Dn
1837	20JUL87	BO	41.4	*	110	DEGE	S	DOGO	V	F	Dn
1838	20JUL87	TOBAGA	51.6	*	145	DEGE	S	DOGO	V	F	Dn
1839	20JUL87	TWE	60.4	*	170	DEGE	S	DOGO	V	F	Dn
1840	20JUL87	TWE	76.1	*	360	DEGE	S	DOGO	V	F	Dn
1841	20JUL87	TWE	.	*	235	DEGE	S	SINIO	V	F	Up
1842	20JUL87	AIODIO	99.1	*	790	DEGE	S	SINIO	V	F	Up
1843	20JUL87	AIODIO	101.2	*	750	DEGE	S	SINIO	V	F	Up
1844	20JUL87	AIODIO	102.3	*	900	DEGE	S	SINIO	V	F	Up
1845	20JUL87	AIODIO	109.8	*	1030	DEGE	S	SINIO	V	F	Up
1846	20JUL87	AIODIO	154.7	*	2950	DEGE	S	SINIO	V	F	Up
1847	20JUL87	SOI	99.2	*	475	DEGE	S	SINIO	V	F	Up
1848	20JUL87	SOI	103.4	*	560	DEGE	S	SINIO	V	F	Up
1849	20JUL87	SOI	135.5	*	1200	DEGE	S	SINIO	V	F	Up
1850	20JUL87	SOI	140.5	*	1410	DEGE	S	SINIO	V	F	Up

ID	DATE	TAXON	SL (mm)		WT (g)	STREAM	TECH.	FISHER(S)	CONTEXT catch	CONTEXT eat	AFF.
1851	20JUL87	SOI	113.6	*	810	DEGE	S	SINIO	V	O	Up
1852	20JUL87	BO	39.1		75	DEGE	S	VISITOR	V	F	Up
1853	20JUL87	TOBAGA	40.0		67	DEGE	S	VISITOR	V	F	Up
1854	20JUL87	TOBAGA	48.9		122	DEGE	S	VISITOR	V	F	Up
1855	20JUL87	AIYO	33.5		38	DEGE	S	VISITOR	V	F	Up
2003	20JUL87	TWE	85.7	*	630	DEGE	S	SINIO	V	F	Up
1856	23JUL87	SOIGIA	56.5		86	STRICKLAND	H	MAUBO	V	F	Dn
1884	01AUG87	SOIGIA	91.4	*	360	STRICKLAND	H	SINIO	V	F	Up
1885	02AUG87	SA	22.8		21	I	O	BISEIO	V	F	Up
1886	02AUG87	SA	24.3		26	I	O	BISEIO	V	F	Up
1887	02AUG87	SA	31.0		53	I	O	BISEIO	V	F	Up
1888	07AUG87	SOIGIA	102.8		477	STRICKLAND	H	SINIO	V	F	Up
1892	07AUG87	AIODIO	154.0	*	1040	STRICKLAND	H	GOGOI	V	F	Up
1893	07AUG87	SOIGIA	98.4		420	STRICKLAND	H	SINIO	V	F	Up
1897	08AUG87	TOBAGA	53.2		156	DEGE	S	VISITOR	V	F	Dn
1898	08AUG87	TOBAGA	55.0		172	DEGE	S	VISITOR	V	F	Dn
1899	09AUG87	SA	24.4		26	KOGU	H	SISIGIA	V	O	Up
1900	09AUG87	SA	25.5		30	KOGU	H	SISIGIA	V	O	Up
1901	09AUG87	SA	26.1		32	KOGU	H	SISIGIA	V	O	Up
1902	09AUG87	SA	26.6		33	KOGU	H	SISIGIA	V	O	Up
1903	09AUG87	SA	27.7		38	KOGU	H	SISIGIA	V	O	Up
1916	22AUG87	SOIGIA	87.0	*	300	SIGIAHAFI	H	DOGO	V	O	Dn
1917	22AUG87	SOIGIA	100.0	*	470	SIGIAHAFI	H	DOGO	V	F	Dn
1919	25AUG87	AIODIO	172.0		3554	YUWENA	S	SINIO	V	F	Up
1921	27AUG87	SOIGIA	67.5	*	150	STRICKLAND	H	TUFA	V	F	Up
1922	28AUG87	SOIGIA	96.3	*	380	SIGIAHAFI	H	TUFA	V	F	Up
1939	31AUG87	GUMO	144.5		1387	KAMUHAFI	O	SIMO	V	F	Up
1944	03SEP87	AIODIO	138.2	*	2080	DEGE	S	GWASE	V	F	Dn
1945	03SEP87	AIODIO	98.2	*	750	DEGE	S	GWASE	V	F	Dn
1946	03SEP87	SOI	96.5	*	460	DEGE	S	GWASE	V	O	Dn
1947	03SEP87	AIODIO	167.0	*	2775	DEGE	S	SINIO	V	F	Up
1948	03SEP87	AIODIO	84.2	*	505	DEGE	S	SINIO	V	F	Up
1959	06SEP87	TOBAGA	29.8		28	FU	O	VISITOR	V	F	Up
1960	07SEP87	AWASU	64.0	*	295	KAMUHAFI	O	VISITOR	V	F	Up
1961	08SEP87	SOIGIA	.	*	285	STRICKLAND	H	BOWA	V	F	Dn
1970	11SEP87	BO	32.3		42	FU	H	GOGOI	V	F	Up
1971	11SEP87	KIGI	32.8		66	FU	H	GOGOI	V	F	Up
1972	15SEP87	KAUFO	.		25	SOMASIO	H	WAFU	V	F	Up
1975	28SEP87	AIODIO	88.0	*	550	DEGE	S	GWASE	V	F	Dn
1978	29SEP87	SOIGIA	76.3	*	220	STRICKLAND	H	GWASE	V	O	Dn
1979	29SEP87	SOIGIA	92.2		349	STRICKLAND	H	GWASE	V	F	Dn
1980	29SEP87	GUMO	93.8		384	STRICKLAND	H	GWASE	V	F	Dn
1981	30SEP87	SA	25.4		29	WOIMU	O	GOGOI	V	F	Up
1983	30SEP87	SOIGIA	93.4		362	STRICKLAND	H	BOWA	V	F	Dn
1985	04OCT87	SOIGIA	58.4	*	70	STRICKLAND	H	BOWA	V	F	Dn
1986	04OCT87	SOIGIA	114.3	*	500	STRICKLAND	H	BOWA	V	F	Dn
1987	04OCT87	SOIGIA	91.8	*	400	STRICKLAND	H	GWASE	V	O	Dn
1988	04OCT87	GUMO	97.8	*	380	STRICKLAND	H	GWASE	V	F	Dn
1989	04OCT87	SOIGIA	46.0	*	30	STRICKLAND	H	GWASE	V	F	Dn
1990	04OCT87	SOIGIA	63.7	*	110	STRICKLAND	H	GWASE	V	F	Dn
1991	04OCT87	SOIGIA	77.1	*	200	STRICKLAND	H	GWASE	V	F	Dn
1992	04OCT87	SOIGIA	95.7	*	340	STRICKLAND	H	GWASE	V	F	Dn
1993	04OCT87	SOIGIA	96.0	*	455	STRICKLAND	H	GWASE	V	F	Dn
1994	04OCT87	SOIGIA	109.0	*	510	STRICKLAND	H	GWASE	V	F	Dn
1995	04OCT87	SA	24.7		27	NODI	H	YASOBIDUA	V	F	Dn
1996	11OCT87	AIODIO	64.0	*	230	DEGE	S	TUFA	V	O	Up
1997	11OCT87	SOI	.	*	290	TAGU	S	DOGO	V	O	Dn
1998	11OCT87	AIODIO	86.7	*	505	DEGE	S	TUFA	V	F	Up
1999	11OCT87	SOI	126.2	*	1060	DEGE	S	TUFA	V	F	Up
2000	11OCT87	AIODIO	97.1	*	700	TAGU	S	DOGO	V	F	Dn
2001	11OCT87	SOI	90.2	*	340	TAGU	S	DOGO	V	F	Dn
2002	11OCT87	SOI	96.0	*	480	TAGU	S	DOGO	V	F	Dn
2028	14OCT87	KAIBO	.		10	GWO	O	GUGWI	V	F	Up
709	16SEP86	AIODIO	74.7		353	DEGE	S	FILIFI	tr.	F	Up
1021	16SEP86	DA	61.0		237	DEGE	U	FILIFI-VISITOR	tr.	F	Up
1117	16SEP86	TOBAGA	58.5	*	220	DEGE	S	FILIFI-VISITOR	tr.	F	Up
92	17SEP86	SOIGIA	108.0	*	625	STRICKLAND	U	GUGWI-SISIGIA	tr.	O	Up
427	19SEP86	GUMO	135.8		1153	UNKNOWN	S	SINIO	tr.	F	Up
429	19SEP86	GUMO	70.4		164	AUTI	S	FILIFI-VISITOR	tr.	F	Up
430	19SEP86	GUMO	.		450	AUTI	S	FILIFI-VISITOR	tr.	F	Up

ID	DATE	TAXON	SL (mm)		WT (g)	STREAM	TECH.	FISHER(S)	CONTEXT catch	eat	AFF.
710	19SEP86	AIODIO	124.1		1440	DEGE	S	SINIO	tr.	F	Up
1072	19SEP86	YASA	70.5		223	DEGE	S	SINIO	tr.	F	Up
715	20SEP86	AIODIO	.		600	UNKNOWN	U	FILIFI	tr.	F	Up
809	05OCT86	AIODIO	80.0	*	395	KOTO	S	GUGWI	tr.	F	Up
810	05OCT86	AIODIO	142.3	*	1700	KOTO	S	GUGWI	tr.	F	Up
811	05OCT86	AIODIO	142.7	*	2200	KOTO	S	GUGWI	tr.	F	Up
813	05OCT86	AIODIO	94.6	*	720	KOTO	S	GUGWI	tr.	F	Up
943	05OCT86	TWE	72.8	*	315	KOTO	S	GUGWI	tr.	F	Up
1173	05OCT86	TOBAGA	52.9		153	KOTO	S	GUGWI	tr.	F	Up
1408	05OCT86	BO	39.6		77	KOTO	S	GUGWI	tr.	F	Up
452	15OCT86	GUMO	106.1	*	515	AUTIHAFI	H	VISITOR	tr.	F	Up
561	15OCT86	SOI	138.0	*	1300	AUTIHAFI	H	VISITOR	tr.	F	Up
562	15OCT86	SOI	128.7	*	1050	AUTIHAFI	H	VISITOR	tr.	F	Up
563	15OCT86	SOI	129.9	*	975	AUTIHAFI	H	VISITOR	tr.	0	Up
564	19OCT86	SOI	100.6		472	DEGE	S	SINIO	tr.	F	Up
849	19OCT86	AIODIO	79.0		412	DEGE	S	SINIO	tr.	F	Up
1191	19OCT86	TOBAGA	58.9		210	DEGE	S	SINIO	tr.	F	Up
1440	19OCT86	BO	43.4		102	DEGE	S	SINIO	tr.	F	Up
144	20OCT86	SOIGIA	90.0	*	310	STRICKLAND	H	VISITOR	tr.	F	Up
457	20OCT86	GUMO	119.1		781	AUTIHAFI	H	VISITOR	tr.	F	Up
696	20OCT86	OKAIBO	178.0	*	1275	AUTIHAFI	H	VISITOR	tr.	F	Up
579	24OCT86	SOI	127.3	*	845	SIGIA	S	VISITOR	tr.	F	Dn
202	30OCT86	SOIGIA	60.0		102	STRICKLAND	H	VISITOR	tr.	F	Dn
203	30OCT86	SOIGIA	72.9		178	STRICKLAND	H	VISITOR	tr.	F	Dn
204	30OCT86	SOIGIA	100.5		447	STRICKLAND	H	VISITOR	tr.	F	Dn
206	30OCT86	SOIGIA	88.9	*	320	SIGIAHAFI	H	VISITOR	tr.	F	Dn
463	30OCT86	GUMO	126.0	*	870	SIGIAHAFI	H	VISITOR	tr.	F	Dn
1506	31OCT86	SA	32.0		58	UNKNOWN	U	VISITOR	tr.	F	Up
1507	31OCT86	SA	22.6		21	UNKNOWN	U	VISITOR	tr.	F	Up
1508	31OCT86	SA	43.9		151	UNKNOWN	U	VISITOR	tr.	F	Up
1509	31OCT86	SA	.		35	UNKNOWN	U	VISITOR	tr.	F	Up
1510	31OCT86	SA	.		35	UNKNOWN	O	VISITOR	tr.	F	Up
1516	11NOV86	SA	19.6		13	NODI	H	SISIGIA	tr.	F	Up
1517	11NOV86	SA	24.7		27	NODI	H	SISIGIA	tr.	F	Up
1518	11NOV86	SA	25.0		28	NODI	H	SISIGIA	tr.	F	Up
1519	11NOV86	SA	26.7		34	NODI	H	SISIGIA	tr.	F	Up
1520	11NOV86	SA	27.4		37	NODI	H	SISIGIA	tr.	F	Up
1521	11NOV86	SA	27.7		38	NODI	H	SISIGIA	tr.	F	Up
1522	11NOV86	SA	29.7		47	NODI	H	SISIGIA	tr.	F	Up
588	13NOV86	SOI	105.0	*	510	DEGE	S	FILIFI	tr.	F	Up
872	13NOV86	AIODIO	134.7		1806	DEGE	S	FILIFI	tr.	F	Up
873	13NOV86	AIODIO	92.5		638	DEGE	S	FILIFI	tr.	F	Up
263	18NOV86	SOIGIA	111.9		608	STRICKLAND	H	HEGOGWA	tr.	F	Up
266	18NOV86	SOIGIA	96.0		392	STRICKLAND	H	SISIGIA	tr.	F	Up
267	18NOV86	SOIGIA	105.9		519	STRICKLAND	H	HEGOGWA	tr.	F	Up
272	18NOV86	SOIGIA	104.7		502	STRICKLAND	H	HEGOGWA	tr.	F	Up
273	18NOV86	SOIGIA	110.6	*	495	STRICKLAND	H	GUGWI	tr.	0	Up
274	18NOV86	SOIGIA	103.1		481	STRICKLAND	H	HEGOGWA	tr.	F	Up
275	18NOV86	SOIGIA	100.2		443	STRICKLAND	H	HEGOGWA	tr.	F	Up
475	18NOV86	GUMO	95.6	*	410	STRICKLAND	H	GUGWI	tr.	F	Up
480	05DEC86	GUMO	119.3		785	AUTI	S	FILIFI	tr.	F	Up
481	05DEC86	GUMO	81.5		253	AUTI	S	FILIFI	tr.	F	Up
482	05DEC86	GUMO	88.5		323	AUTI	S	FILIFI	tr.	F	Up
483	05DEC86	GUMO	101.4		484	AUTI	S	FILIFI	tr.	F	Up
591	05DEC86	SOI	124.5		911	AUTI	S	FILIFI	tr.	F	Up
1102	13DEC86	GOI	86.1	*	6500	IA	U	GUGWI	tr.	F	Up
1376	19DEC86	TOGOWO	64.6	*	400	MOIYOHAFI	H	MAUBO	tr.	0	Dn
1067	22DEC86	AIYO	38.1		55	SOMASIO	H	BOUA	tr.	R	Dn
603	29DEC86	SOI	117.4		760	SIGIA	S	GUGWI	tr.	F	Up
1010	29DEC86	TWE	63.7		263	SIGIA	S	GUGWI	tr.	F	Up
395	03FEB87	SOIGIA	96.8		401	STRICKLAND	H	GUGWI	tr.	F	Up
1548	03FEB87	SA	30.6		51	KOGU	H	SISIGIA	tr.	F	Up
1549	03FEB87	SA	34.5		73	KOGU	H	SISIGIA	tr.	F	Up
1550	03FEB87	SA	27.2		36	KOGU	H	SISIGIA	tr.	F	Up
1551	03FEB87	SA	31.0		53	KOGU	H	SISIGIA	tr.	F	Up
1552	03FEB87	SA	30.3		50	KOGU	H	SISIGIA	tr.	F	Up
1553	03FEB87	SA	31.6		56	KOGU	H	SISIGIA	tr.	F	Up
1554	03FEB87	SA	27.9		39	KOGU	H	SISIGIA	tr.	F	Up
1555	03FEB87	SA	26.9		35	KOGU	H	SISIGIA	tr.	F	Up
1556	03FEB87	SA	28.1		39	KOGU	H	SISIGIA	tr.	F	Up

ID	DATE	TAXON	SL (mm)		WT (g)	STREAM	TECH.	FISHER(S)	CONTEXT catch	eat	AFF.
1557	03FEB87	SA	30.0		48	KOGU	H	SISIGIA	tr.	F	Up
1558	03FEB87	SA	.		35	KOGU	H	SISIGIA	tr.	F	Up
1559	03FEB87	SA	.		35	KOGU	H	SISIGIA	tr.	F	Up
1560	03FEB87	SA	.		35	KOGU	H	SISIGIA	tr.	F	Up
1561	03FEB87	SA	.		35	KOGU	H	SISIGIA	tr.	F	Up
1562	03FEB87	SA	.		35	KOGU	H	SISIGIA	tr.	F	Up
1563	03FEB87	SA	.		35	KOGU	H	SISIGIA	tr.	F	Up
2051	03FEB87	SA	.		35	KOGU	H	SISIGIA	tr.	F	Up
496	15FEB87	GUMO	152.0		1612	DEGEHAFI	H	BISEIO	tr.	F	Up
610	05MAR87	SOI	138.4		1262	DEGE	S	FILIFI	tr.	F	Up
1013	05MAR87	TWE	80.0		459	DEGE	S	FILIFI	tr.	O	Up
611	06MAR87	SOI	140.5	*	1350	DEGE	S	GUGWI	tr.	F	Up
1488	21MAR87	BO	.		75	UNKNOWN	U	VISITOR	tr.	F	Dn
1597	13APR87	SA	29.3		45	KOGU	H	SISIGIA	tr.	F	Up
1598	13APR87	SA	28.6		42	KOGU	H	SISIGIA	tr.	F	Up
1599	13APR87	SA	33.6		68	KOGU	H	SISIGIA	tr.	F	Up
1600	13APR87	SA	27.4		37	KOGU	H	SISIGIA	tr.	F	Up
1601	13APR87	SA	25.3		29	KOGU	H	SISIGIA	tr.	F	Up
1602	13APR87	SA	33.5		67	KOGU	H	SISIGIA	tr.	F	Up
1603	13APR87	SA	31.3		55	KOGU	H	SISIGIA	tr.	F	Up
1604	13APR87	SA	24.0		25	KOGU	H	SISIGIA	tr.	F	Up
1605	13APR87	SA	.		35	KOGU	H	SISIGIA	tr.	F	Up
1606	13APR87	SA	.		35	KOGU	H	SISIGIA	tr.	F	Up
1607	13APR87	SA	.		35	KOGU	H	SISIGIA	tr.	F	Up
1608	13APR87	SA	34.6		74	KOGU	H	SISIGIA	tr.	F	Up
1609	13APR87	SA	37.3		92	KOGU	H	SISIGIA	tr.	F	Up
2054	13APR87	SA	.		35	KOGU	H	SISIGIA	tr.	O	Up
2055	13APR87	SA	.		35	KOGU	H	SISIGIA	tr.	O	Up
2056	13APR87	SA	.		35	KOGU	H	SISIGIA	tr.	O	Up
2057	13APR87	SA	.		35	KOGU	H	SISIGIA	tr.	O	Up
2058	13APR87	SA	.		35	KOGU	H	SISIGIA	tr.	O	Up
2059	13APR87	SA	.		35	KOGU	H	SISIGIA	tr.	O	Up
1617	22APR87	SA	30.5		51	KOGU	S	SIMO	tr.	F	Up
1618	22APR87	SA	28.0		39	KOGU	S	SIMO	tr.	F	Up
1619	22APR87	SA	21.5		18	KOGU	S	SIMO	tr.	F	Up
1620	22APR87	SA	24.6		26	KOGU	S	SIMO	tr.	F	Up
1621	22APR87	SA	27.0		35	KOGU	S	SIMO	tr.	F	Up
1622	22APR87	SA	29.8		47	KOGU	S	SIMO	tr.	F	Up
1623	22APR87	SA	30.9		53	KOGU	S	SIMO	tr.	F	Up
1624	22APR87	SA	31.3		55	KOGU	S	SIMO	tr.	F	Up
48	21MAY87	SOIGIA	88.1	*	306	AUTIHAFI	H	SIMO	tr.	F	Up
49	21MAY87	AWASU	63.1	*	350	GWIHAFI	O	SIMO	tr.	O	Up
1664	02JUN87	BO	41.7		91	YUWENA	U	BISEIO-MABEI	tr.	F	Up
1665	02JUN87	TOBAGA	52.2		148	YUWENA	U	BISEIO-MABEI	tr.	F	Up
1666	02JUN87	TOBAGA	58.3		204	YUWENA	U	BISEIO-MABEI	tr.	F	Up
1667	02JUN87	AIYO	35.3		44	YUWENA	H	MABEI	tr.	F	Up
1668	02JUN87	TOBAGA	55.4		176	YUWENA	S	BISEIO	tr.	F	Up
1669	02JUN87	BO	41.5		89	YUWENA	H	MABEI	tr.	F	Up
1671	02JUN87	TOBAGA	60.4		227	YUWENA	U	BISEIO-MABEI	tr.	F	Up
1672	02JUN87	TOBAGA	62.9		255	YUWENA	U	BISEIO-MABEI	tr.	F	Up
1673	02JUN87	TOBAGA	65.1		283	YUWENA	U	BISEIO-MABEI	tr.	F	Up
1675	02JUN87	BO	41.8		91	YUWENA	H	MABEI	tr.	F	Up
1678	02JUN87	BO	52.5		181	YUWENA	U	BISEIO-MABEI	tr.	F	Up
1682	07JUN87	SOIGIA	104.6	*	495	STRICKLAND	H	GOGOI	tr.	F	Up
1693	20JUN87	BO	45.9		121	DEGE	S	GUGWI	tr.	O	Up
1694	20JUN87	TOBAGA	43.0		83	DEGE	S	GUGWI	tr.	O	Up
1695	20JUN87	TOBAGA	45.0		95	DEGE	S	GUGWI	tr.	O	Up
1709	28JUN87	TOBAGA	37.5	*	50	TU	S	GWASE	tr.	O	Dn
1729	03JUL87	SA	25.2		28	A	H	GOGO	tr.	F	Dn
1730	03JUL87	SA	25.9		31	A	H	GOGO	tr.	F	Dn
1731	03JUL87	SA	30.4		50	A	H	GOGO	tr.	F	Dn
1733	03JUL87	SA	33.6		68	A	H	GOGO	tr.	F	Dn
1774	11JUL87	YASA	76.0		274	AUTI	S	SINIO	tr.	F	Up
1775	11JUL87	GUMO	93.0		374	AUTI	S	SINIO	tr.	O	Up
1776	11JUL87	AIODIO	148.5		2366	AUTI	S	SINIO	tr.	F	Up
1793	11JUL87	GUMO	109.4		606	AUTI	S	SINIO	tr.	F	Up
1794	12JUL87	AIODIO	126.8		1528	AUTI	S	SINIO	tr.	F	Up
1808	16JUL87	TWE	70.2	*	310	DEGE	S	MAUBO	tr.	F	Dn
1809	16JUL87	TWE	72.6	*	310	DEGE	S	DOGO	tr.	O	Dn
1810	16JUL87	AIODIO	61.4	*	185	DEGE	S	MAUBO	tr.	F	Dn

ID	DATE	TAXON	SL (mm)		WT (g)	STREAM	TECH.	FISHER(S)	CONTEXT catch	eat	AFF.
1811	16JUL87	AIODIO	63.3	*	230	DEGE	S	MAUBO	tr.	F	Dn
1816	18JUL87	SOIGIA	103.5	*	530	STRICKLAND	H	VISITOR	tr.	F	Up
1817	18JUL87	GUMO	113.7	*	630	STRICKLAND	H	VISITOR	tr.	F	Up
1857	24JUL87	TOBAGA	48.9	*	111	DEGE	S	GUGWI	tr.	F	Up
1858	24JUL87	TOBAGA	56.1	*	162	DEGE	S	GUGWI	tr.	F	Up
1859	24JUL87	AIODIO	51.5	*	109	DEGE	S	GUGWI	tr.	F	Up
1860	24JUL87	AIODIO	96.6	*	620	DEGE	S	GUGWI	tr.	F	Up
1861	24JUL87	AIODIO	105.4	*	970	DEGE	S	GUGWI	tr.	F	Up
1862	24JUL87	AIODIO	111.8	*	1050	DEGE	S	GUGWI	tr.	F	Up
1881	29JUL87	SOI	134.5		1156	AUTI	S	FILIFI	tr.	F	Up
1882	29JUL87	TOGOWO	86.3		1159	AUTI	S	FILIFI	tr.	F	Up
1879	30JUL87	SOI	144.2	*	1300	STRICKLAND	H	VISITOR	tr.	F	Up
1880	30JUL87	SOI	138.1	*	1250	STRICKLAND	H	VISITOR	tr.	F	Up
1909	14AUG87	GUMO	154.4		1689	DEGE	S	MAUBO	tr.	F	Dn
1937	30AUG87	AIODIO	82.5		465	DEGE	S	GUGWI	tr.	F	Up
1938	30AUG87	TOBAGA	62.4		249	DEGE	S	GUGWI	tr.	F	Up
1942	03SEP87	GUMO	161.0	*	1480	KAMUHAFI	O	VISITOR	tr.	F	Up&Dn
1943	03SEP87	TIO	60.5	*	825	KAMUHAFI	O	VISITOR	tr.	F	Up&Dn
1949	03SEP87	AIODIO	130.8	*	1250	AUTI	S	VISITOR	tr.	F	Up
1950	03SEP87	AIODIO	144.0	*	2300	AUTI	S	VISITOR	tr.	F	Up
1951	03SEP87	AIODIO	123.0		1405	DEGE	S	GUGWI	tr.	F	Up
1952	03SEP87	AIODIO	173.0		3611	DEGE	S	GUGWI	tr.	F	Up
1953	03SEP87	GUMO	60.3		103	DEGE	S	GUGWI	tr.	F	Up
1955	03SEP87	AIODIO	78.1		400	DEGE	O	GUGWI-SISIGIA	tr.	F	Up
1956	03SEP87	AIODIO	98.0		749	DEGE	O	GUGWI-SISIGIA	tr.	F	Up
1957	03SEP87	AIODIO	151.3		2492	DEGE	O	GUGWI-SISIGIA	tr.	F	Up
1958	03SEP87	AIODIO	68.6		279	DEGE	O	GUGWI-SISIGIA	tr.	F	Up
2004	11OCT87	TWE	72.4		360	IA	S	FILIFI	tr.	F	Up
2005	11OCT87	TOBAGA	43.0		83	IA	S	FILIFI	tr.	F	Up
2006	11OCT87	SOI	135.5		1183	YA	S	FILIFI	tr.	F	Up
2007	12OCT87	AIODIO	164.0		3115	SOMASIO	S	MAMO	tr.	F	Dn
2008	13OCT87	TOBAGA	58.4		205	SOMASIO	O	GWASE-MAUBO	tr.	F	Dn
2014	13OCT87	TOBAGA	28.9		26	SOMASIO	O	GWASE-MAUBO	tr.	F	Dn
2024	13OCT87	TOBAGA	29.6		28	SOMASIO	O	GWASE-MAUBO	tr.	F	Dn
2025	13OCT87	AIODIO	132.6		1729	SOMASIO	O	GWASE-MAUBO	tr.	F	Dn
2026	13OCT87	AIODIO	140.0	*	2250	SOMASIO	O	GWASE-MAUBO	tr.	F	Dn
2027	13OCT87	TWE	72.4	*	330	SOMASIO	O	GWASE-MAUBO	tr.	F	Dn
2029	17OCT87	AIODIO	158.0	*	2400	KOTO	S	GUGWI	tr.	F	Up
513	15SEP86	SOI	77.5		211	DEGE	S	FILIFI	B	R	Up
708	15SEP86	AIODIO	77.9		397	DEGE	S	FILIFI	B	R	Up
1113	15SEP86	TOBAGA	50.7		135	DEGE	S	VISITOR	B	R	Up
1114	15SEP86	TOBAGA	50.6		135	DEGE	S	VISITOR	B	R	Up
1115	16SEP86	TOBAGA	50.7		135	DEGE	S	VISITOR	B	R	Up
1116	16SEP86	TOBAGA	51.8		144	DEGE	S	VISITOR	B	R	Up
91	17SEP86	SOIGIA	76.9		207	STRICKLAND	U	GUGWI-SISIGIA	B	R	Up
617	17SEP86	OWUAHIA	160.0		1795	STRICKLAND	H	GUGWI-SISIGIA	B	R	Up
618	17SEP86	OWUAHIA	178.0		2455	STRICKLAND	H	GUGWI-SISIGIA	B	R	Up
666	17SEP86	DJAU	140.2		812	STRICKLAND	H	GUGWI-SISIGIA	B	R	Up
428	18SEP86	GUMO	130.3		1020	AUTI	S	FILIFI-VISITOR	B	R	Up
711	19SEP86	AIODIO	115.5		1180	AUTI	S	FILIFI-VISITOR	B	R	Up
712	19SEP86	AIODIO	87.7		551	AUTI	S	FILIFI-VISITOR	B	R	Up
713	19SEP86	AIODIO	126.7		1525	DEGE	S	UNKNOWN	B	R	UNKN
909	19SEP86	TWE	85.5		539	DEGE	S	UNKNOWN	B	R	UNKN
910	19SEP86	TWE	70.4		336	DEGE	S	UNKNOWN	B	R	UNKN
939	19SEP86	TWE	68.2		311	UNKNOWN	U	UNKNOWN	B	R	UNKN
622	30SEP86	OWUAHIA	164.0		1930	STRICKLAND	H	WODAI	B	R	Dn
623	30SEP86	OWUAHIA	173.0		2258	STRICKLAND	H	VISITOR	B	R	Dn
624	30SEP86	OWUAHIA	178.0		2455	STRICKLAND	H	VISITOR	B	R	Dn
625	30SEP86	OWUAHIA	170.0		2145	STRICKLAND	H	VISITOR	B	R	Dn
626	30SEP86	OWUAHIA	209.0		3937	STRICKLAND	H	WODAI	B	R	Dn
627	30SEP86	OWUAHIA	154.8		1628	STRICKLAND	H	WODAI	B	R	Dn
110	01OCT86	SOIGIA	111.1		596	STRICKLAND	H	WODAI	B	R	Dn
111	01OCT86	SOIGIA	106.5		528	STRICKLAND	H	WODAI	B	R	Dn
535	01OCT86	SOI	114.0		694	UNKNOWN	U	UNKNOWN	B	R	UNKN
793	01OCT86	AIODIO	92.6		640	SIGIA	S	MAMO	B	R	Dn
794	01OCT86	AIODIO	150.0		2433	SIGIA	S	MAMO	B	R	Dn
1158	01OCT86	TOBAGA	60.8		231	KOIOGO	S	MAUBO	B	R	Dn
1159	01OCT86	TOBAGA	61.6		240	KOIOGO	S	MAUBO	B	R	Dn
1160	01OCT86	TOBAGA	50.5		134	KOIOGO	S	MAUBO	B	R	Dn
1161	01OCT86	TOBAGA	46.3		104	KOIOGO	S	MAUBO	B	R	Dn

ID	DATE	TAXON	SL (mm)	WT (g)	STREAM	TECH.	FISHER(S)	CONTEXT catch	CONTEXT eat	AFF.
1162	01OCT86	TOBAGA	43.1	84	KOIOGO	S	MAUBO	B	R	Dn
1251	01OCT86	TOBAGA	54.9	171	DEGE	S	GWUHO	B	R	Dn
1252	01OCT86	TOBAGA	41.4	75	SIGIA	S	MAUBO	B	R	Dn
1255	01OCT86	TOBAGA	47.7	113	SIGIA	S	MAUBO	B	R	Dn
2049	01OCT86	TWE	56.4	196	SIGIA	S	MAMO	B	R	Dn
1025	02OCT86	DA	56.4	196	KOIOGO	S	MAUBO	B	R	Dn
437	04OCT86	GUMO	110.5	625	KOTO	S	GUGWI	B	R	Up
795	04OCT86	AIODIO	84.7	500	KOTO	S	GUGWI	B	R	Up
796	04OCT86	AIODIO	127.0	1535	KOTO	S	GUGWI	B	R	Up
797	04OCT86	AIODIO	106.7	948	KOTO	S	GUGWI	B	R	Up
798	04OCT86	AIODIO	84.3	494	KOTO	S	GUGWI	B	R	Up
799	04OCT86	AIODIO	95.3	693	KOTO	S	GUGWI	B	R	Up
941	04OCT86	TWE	97.1	736	DEGE	S	DOGO	B	R	Dn
942	04OCT86	TWE	47.0	125	DEGE	S	DOGO	B	R	Dn
1166	04OCT86	TOBAGA	50.8	136	DEGE	S	DOGO	B	R	Dn
1167	04OCT86	TOBAGA	46.3	104	DEGE	S	DOGO	B	R	Dn
1168	04OCT86	TOBAGA	47.7	113	DEGE	S	DOGO	B	R	Dn
1169	04OCT86	TOBAGA	57.1	192	KOTO	S	GUGWI	B	R	Up
1170	04OCT86	TOBAGA	54.7	169	KOTO	S	GUGWI	B	R	Up
1402	04OCT86	BO	49.2	149	DEGE	S	DOGO	B	R	Dn
1403	04OCT86	BO	49.2	149	KOTO	S	GUGWI	B	R	Up
1404	04OCT86	BO	46.1	122	KOTO	S	GUGWI	B	R	Up
1405	04OCT86	BO	40.4	82	KOTO	S	GUGWI	B	R	Up
1406	04OCT86	BO	43.3	101	KOTO	S	GUGWI	B	R	Up
1171	05OCT86	TOBAGA	50.3	132	DEGE	S	VISITOR	B	R	Dn
1172	05OCT86	TOBAGA	44.0	89	DEGE	S	VISITOR	B	R	Dn
1407	05OCT86	BO	44.3	109	DEGE	S	VISITOR	B	R	Dn
137	20OCT86	SOIGIA	80.7	238	STRICKLAND	H	VISITOR	B	R	Dn
138	20OCT86	SOIGIA	86.4	290	STRICKLAND	H	VISITOR	B	R	Dn
139	20OCT86	SOIGIA	77.0	208	STRICKLAND	H	VISITOR	B	R	Dn
228	20OCT86	SOIGIA	61.7	110	STRICKLAND	H	GWASE	B	R	Dn
630	20OCT86	OWUAHIA	163.0	1895	STRICKLAND	H	GWASE	B	R	Dn
1078	20OCT86	YASA	70.5	223	MOIYO	S	VISITOR	B	R	Dn
1099	20OCT86	GOI	69.6	3327	DIGU	S	GWASE	B	R	Dn
1257	20OCT86	TOBAGA	52.6	151	TU	S	GWASE	B	R	Dn
1441	20OCT86	BO	35.6	56	MOIYO	S	VISITOR	B	R	Dn
146	22OCT86	SOIGIA	87.0	295	UNKNOWN	U	VISITOR	B	R	Dn
147	22OCT86	SOIGIA	84.4	271	UNKNOWN	U	VISITOR	B	R	Dn
148	22OCT86	SOIGIA	64.1	123	UNKNOWN	U	VISITOR	B	R	Dn
149	22OCT86	SOIGIA	67.2	141	UNKNOWN	U	VISITOR	B	R	Dn
150	22OCT86	SOIGIA	87.0	295	UNKNOWN	U	VISITOR	B	R	Dn
631	22OCT86	OWUAHIA	196.0	3259	STRICKLAND	H	WODAI	B	R	Dn
632	22OCT86	OWUAHIA	168.0	2071	UNKNOWN	U	VISITOR	B	R	Dn
863	26OCT86	AIODIO	82.5	465	DEGE	S	GUGWI	B	R	Up
1250	26OCT86	TOBAGA	40.3	69	DEGE	S	GUGWI	B	R	Up
1466	26OCT86	BO	26.0	22	DEGE	S	GUGWI	B	R	Up
700	29OCT86	OKAIBO	73.3	119	STRICKLAND	H	MAUBO	B	R	Dn
701	29OCT86	OKAIBO	81.8	163	STRICKLAND	H	MAUBO	B	R	Dn
195	30OCT86	SOIGIA	92.7	354	STRICKLAND	H	GWUHO-VISITOR	B	R	Dn
196	30OCT86	SOIGIA	109.6	573	STRICKLAND	H	GWUHO-VISITOR	B	R	Dn
197	30OCT86	SOIGIA	69.3	154	STRICKLAND	H	MAUBO	B	R	Dn
198	30OCT86	SOIGIA	112.6	619	STRICKLAND	H	GWUHO	B	R	Dn
199	30OCT86	SOIGIA	99.7	437	STRICKLAND	H	GWUHO	B	R	Dn
200	30OCT86	SOIGIA	74.0	186	STRICKLAND	H	WODAI	B	R	Dn
201	30OCT86	SOIGIA	114.5	649	STRICKLAND	H	WODAI	B	R	Dn
207	30OCT86	SOIGIA	107.2	538	STRICKLAND	H	VISITOR	B	R	Dn
208	30OCT86	SOIGIA	103.5	486	UNKNOWN	U	VISITOR	B	R	Dn
209	30OCT86	SOIGIA	103.5	486	UNKNOWN	U	VISITOR	B	R	Dn
210	30OCT86	SOIGIA	103.4	485	UNKNOWN	U	VISITOR	B	R	Dn
211	30OCT86	SOIGIA	91.0	336	UNKNOWN	U	VISITOR	B	R	Dn
212	30OCT86	SOIGIA	91.4	340	UNKNOWN	U	VISITOR	B	R	Dn
213	30OCT86	SOIGIA	73.8	184	UNKNOWN	U	VISITOR	B	R	Dn
215	30OCT86	SOIGIA	83.4	262	STRICKLAND	H	SISIGIA	B	R	Dn
216	30OCT86	SOIGIA	105.9	519	STRICKLAND	H	SISIGIA	B	R	Up
218	30OCT86	SOIGIA	101.1	454	STRICKLAND	H	MUGWA	B	R	Up
462	30OCT86	GUMO	104.6	531	STRICKLAND	H	GWUHO-VISITOR	B	R	Dn
464	30OCT86	GUMO	152.7	1634	UNKNOWN	U	VISITOR	B	R	Dn
581	30OCT86	SOI	129.7	1033	SIGIA	S	VISITOR	B	R	Dn
582	30OCT86	SOI	104.0	522	SIGIAHAFI	U	GWUHO	B	R	Dn
583	30OCT86	SOI	128.1	994	SIGIAHAFI	U	GWUHO	B	R	Dn

ID	DATE	TAXON	SL (mm)	WT (g)	STREAM	TECH.	FISHER(S)	CONTEXT catch	CONTEXT eat	AFF.
584	30OCT86	SOI	105.4	545	SIGIA	S	MAUBO	B	R	Dn
585	30OCT86	SOI	104.6	532	SIGIA	S	MAUBO	B	R	Dn
586	30OCT86	SOI	149.5	1602	UNKNOWN	U	VISITOR	B	R	Dn
587	30OCT86	SOI	148.3	1563	UNKNOWN	U	VISITOR	B	R	Dn
636	30OCT86	OWUAHIA	158.0	1729	STRICKLAND	H	VISITOR	B	R	Dn
637	30OCT86	OWUAHIA	166.0	2000	STRICKLAND	H	VISITOR	B	R	Dn
638	30OCT86	OWUAHIA	152.0	1543	STRICKLAND	H	WODAI	B	R	Dn
639	30OCT86	OWUAHIA	198.0	3358	UNKNOWN	U	VISITOR	B	R	Dn
640	30OCT86	OWUAHIA	178.0	2455	UNKNOWN	U	VISITOR	B	R	Dn
651	30OCT86	OWUAHIA	89.4	324	STRICKLAND	H	GWUHO-VISITOR	B	R	Dn
652	30OCT86	GUMO	75.3	200	STRICKLAND	H	GWUHO-VISITOR	B	R	Dn
653	30OCT86	OWUAHIA	124.7	862	STRICKLAND	H	GWUHO-VISITOR	B	R	Dn
654	30OCT86	OWUAHIA	51.1	63	STRICKLAND	H	GWUHO-VISITOR	B	R	Dn
655	30OCT86	OWUAHIA	79.7	231	UNKNOWN	U	VISITOR	B	R	Dn
678	30OCT86	DJAU	158.0	1105	STRICKLAND	H	GWUHO	B	R	Dn
679	30OCT86	DJAU	164.0	1216	STRICKLAND	H	VISITOR	B	R	Dn
680	30OCT86	DJAU	126.0	617	UNKNOWN	U	VISITOR	B	R	Dn
864	30OCT86	AIODIO	107.3	963	DEGE	S	GWUHO	B	R	Dn
865	30OCT86	AIODIO	78.0	398	DEGE	S	GWUHO	B	R	Dn
1229	30OCT86	TOBAGA	56.2	183	UNKNOWN	U	VISITOR	B	R	Dn
1253	30OCT86	TOBAGA	57.7	198	UNKNOWN	U	VISITOR	B	R	Dn
1254	30OCT86	TOBAGA	54.5	167	UNKNOWN	U	VISITOR	B	R	Dn
1504	30OCT86	SA	34.6	74	GWINTH	O	GWUHO	B	R	Dn
1505	30OCT86	SA	29.5	46	UNKNOWN	U	VISITOR	B	R	Dn
1511	30OCT86	SA	24.7	27	UNKNOWN	U	UNKNOWN	B	R	UNKN
1512	30OCT86	SA	31.0	53	UNKNOWN	U	UNKNOWN	B	R	UNKN
1513	30OCT86	SA	20.9	16	UNKNOWN	U	UNKNOWN	B	R	UNKN
1644	30OCT86	SEMESI	113.0	2000	SIGIAHAFI	H	VISITOR	B	R	Dn
217	31OCT86	SOIGIA	124.5	826	STRICKLAND	H	SISIGIA	B	R	Up
220	03NOV86	SOIGIA	83.2	260	STRICKLAND	H	GUGWI	B	R	Up
221	03NOV86	SOIGIA	112.4	616	STRICKLAND	H	GUGWI	B	R	Up
222	03NOV86	SOIGIA	100.7	449	STRICKLAND	H	SISIGIA	B	R	Up
223	03NOV86	SOIGIA	49.4	58	STRICKLAND	H	SISIGIA	B	R	Up
224	03NOV86	SOIGIA	96.0	392	STRICKLAND	H	SISIGIA	B	R	Up
1040	05NOV86	AIYO	33.5	38	DEGE	H	BOUA	B	R	Dn
1041	05NOV86	AIYO	36.1	47	DEGE	H	BOUA	B	R	Dn
1042	05NOV86	AIYO	36.1	47	DEGE	H	BOUA	B	R	Dn
1043	05NOV86	AIYO	38.0	54	DEGE	H	BOUA	B	R	Dn
1044	05NOV86	AIYO	43.0	77	DEGE	H	BOUA	B	R	Dn
1045	05NOV86	AIYO	31.0	31	DEGE	H	BOUA	B	R	Dn
1046	05NOV86	AIYO	31.0	31	DEGE	H	BOUA	B	R	Dn
866	08NOV86	AIODIO	154.4	2636	AUTI	S	HEGOGWA	B	R	Up
1256	08NOV86	TOBAGA	58.4	205	AUTI	S	HEGOGWA	B	R	Up
1468	08NOV86	BO	42.1	93	AUTI	S	HEGOGWA	B	R	Up
225	09NOV86	SOIGIA	91.3	339	STRICKLAND	H	GUGWI	B	R	Up
226	09NOV86	SOIGIA	105.5	513	STRICKLAND	H	GUGWI	B	R	Up
466	09NOV86	GUMO	113.7	680	STRICKLAND	H	GUGWI	B	R	Up
467	11NOV86	GUMO	145.7	1422	STRICKLAND	H	GUGWI	B	R	Up
993	11NOV86	TWE	102.3	835	DEGE	S	FILIFI	B	R	Up
1258	11NOV86	TOBAGA	47.0	108	DEGE	S	FILIFI	B	R	Up
1471	11NOV86	BO	46.1	122	DEGE	S	FILIFI	B	R	Up
870	12NOV86	AIODIO	86.8	535	DUWA	O	VISITOR	B	R	Up
871	12NOV86	AIODIO	75.3	361	DUWA	S	VISITOR	B	R	Up
1100	12NOV86	GOI	76.5	4308	DUWA	O	VISITOR	B	R	Up
1259	12NOV86	TOBAGA	44.8	94	DUWA	O	VISITOR	B	R	Up
1260	12NOV86	TOBAGA	56.6	187	DUWA	S	SIMO	B	R	Up
1261	12NOV86	TOBAGA	49.1	123	DUWA	S	SIMO	B	R	Up
1262	12NOV86	TOBAGA	39.1	63	DUWA	S	SIMO	B	R	Up
1263	12NOV86	TOBAGA	42.7	82	DUWA	S	SIMO	B	R	Up
1537	12NOV86	SA	.	35	UNKNOWN	O	GOGOI	B	R	Up
867	13NOV86	AIODIO	90.5	601	DEGE	S	FILIFI	B	R	Up
1083	14NOV86	YASA	89.9	437	DEGE	S	FILIFI	B	R	Up
1264	14NOV86	TOBAGA	52.8	153	DEGE	S	FILIFI	B	R	Up
249	15NOV86	SOIGIA	89.6	321	STRICKLAND	H	BOWA	B	R	Dn
250	15NOV86	SOIGIA	101.3	457	STRICKLAND	H	BOWA	B	R	Dn
251	15NOV86	SOIGIA	107.0	535	STRICKLAND	H	BOWA	B	R	Dn
252	15NOV86	SOIGIA	103.3	483	STRICKLAND	H	BOWA	B	R	Dn
643	15NOV86	OWUAHIA	122.8	824	STRICKLAND	H	BOWA	B	R	Dn
256	16NOV86	SOIGIA	116.5	682	STRICKLAND	H	SINIO	B	R	Up
874	17NOV86	AIODIO	103.6	873	DEGE	S	SINIO	B	R	Up

ID	DATE	TAXON	SL (mm)	WT (g)	STREAM	TECH.	FISHER(S)	CONTEXT catch	eat	AFF.
259	18NOV86	SOIGIA	75.3	195	STRICKLAND	H	DOGO	B	R	Dn
260	18NOV86	SOIGIA	71.4	168	STRICKLAND	H	DOGO	B	R	Dn
261	18NOV86	SOIGIA	81.0	241	STRICKLAND	H	DOGO	B	R	Dn
262	18NOV86	SOIGIA	78.1	217	STRICKLAND	H	DOGO	B	R	Dn
264	18NOV86	SOIGIA	64.3	124	STRICKLAND	H	HEGOGWA	B	R	Up
476	18NOV86	GUMO	103.8	519	STRICKLAND	H	MAUBO	B	R	Dn
875	18NOV86	AIODIO	111.3	1065	DEGE	S	BISEIO	B	R	Up
1048	18NOV86	AIYO	30.3	29	TASA	H	SISIGIA	B	R	Up
1472	18NOV86	BO	32.1	41	TASA	H	SISIGIA	B	R	Up
1473	18NOV86	BO	33.5	47	TASA	H	SISIGIA	B	R	Up
1524	18NOV86	SA	33.9	69	TASA	H	SISIGIA	B	R	Up
1525	18NOV86	SA	29.6	46	TASA	H	SISIGIA	B	R	Up
1526	18NOV86	SA	31.5	56	TASA	H	SISIGIA	B	R	Up
1527	18NOV86	SA	.	35	TASA	H	SISIGIA	B	R	Up
1528	18NOV86	SA	.	35	TASA	H	SISIGIA	B	R	Up
1529	18NOV86	SA	.	35	TASA	H	SISIGIA	B	R	Up
1530	18NOV86	SA	.	35	TASA	H	SISIGIA	B	R	Up
1531	18NOV86	SA	.	35	TASA	H	SISIGIA	B	R	Up
1532	18NOV86	SA	.	35	TASA	H	SISIGIA	B	R	Up
1533	18NOV86	SA	.	35	TASA	H	SISIGIA	B	R	Up
1534	18NOV86	SA	33.0	64	UNKNOWN	O	GOGOI	B	R	Up
1535	18NOV86	SA	33.1	65	UNKNOWN	O	GOGOI	B	R	Up
1536	18NOV86	SA	26.6	33	UNKNOWN	O	GOGOI	B	R	Up
2052	18NOV86	SA	.	35	TASA	H	SISIGIA	B	R	Up
2053	18NOV86	SA	.	35	TASA	H	SISIGIA	B	R	Up
1375	21NOV86	TOGOWO	77.6	802	UNKNOWN	S	GWUHO	B	R	Dn
657	02DEC86	OWUAHIA	142.3	1271	STRICKLAND	H	HEGOGWA	B	R	Up
1288	02DEC86	TOBAGA	57.6	197	TU	S	SIMO	B	R	Up
658	03DEC86	OWUAHIA	147.5	1413	STRICKLAND	H	GOGOI	B	R	Up
318	05DEC86	SOIGIA	108.7	559	STRICKLAND	H	UNKNOWN	B	R	UNKN
319	05DEC86	SOIGIA	99.6	435	STRICKLAND	H	UNKNOWN	B	R	UNKN
320	05DEC86	SOIGIA	96.1	393	STRICKLAND	H	UNKNOWN	B	R	UNKN
590	05DEC86	SOI	99.1	450	DEGE	S	GUGWI	B	R	Up
882	05DEC86	AIODIO	176.0	3787	DEGE	S	GUGWI	B	R	Up
883	05DEC86	AIODIO	126.0	1502	DEGE	S	GUGWI	B	R	Up
1289	05DEC86	TOBAGA	46.9	108	DEGE	S	GUGWI	B	R	Up
1290	05DEC86	TOBAGA	43.8	88	DEGE	S	GUGWI	B	R	Up
1476	05DEC86	BO	38.3	70	MOIYO	H	GOGOI	B	R	Up
1477	05DEC86	BO	33.7	48	MOIYO	H	GOGOI	B	R	Up
1478	05DEC86	BO	42.7	97	DEGE	S	GUGWI	B	R	Up
1538	05DEC86	SA	.	35	MOIYO	H	GOGOI	B	R	Up
1049	12DEC86	AIYO	44.2	83	DAMI	H	BOUA	B	R	Dn
1050	12DEC86	AIYO	41.1	68	DAMI	H	BOUA	B	R	Dn
1051	12DEC86	AIYO	38.3	56	DAMI	H	BOUA	B	R	Dn
1052	12DEC86	AIYO	38.7	57	DAMI	H	BOUA	B	R	Dn
1053	12DEC86	AIYO	32.4	35	DAMI	H	BOUA	B	R	Dn
1054	12DEC86	AIYO	33.8	39	DAMI	H	BOUA	B	R	Dn
1055	12DEC86	AIYO	31.7	33	DAMI	H	BOUA	B	R	Dn
884	13DEC86	AIODIO	149.7	2420	DEGE	S	SINIO	B	R	Up
594	14DEC86	SOI	120.6	825	DEGE	S	SIMO	B	R	Up
328	16DEC86	SOIGIA	71.5	168	STRICKLAND	H	DOGO	B	R	Dn
329	16DEC86	SOIGIA	71.5	168	STRICKLAND	H	DOGO	B	R	Dn
330	16DEC86	SOIGIA	79.1	225	STRICKLAND	H	DOGO	B	R	Dn
331	16DEC86	SOIGIA	91.9	346	STRICKLAND	H	DOGO	B	R	Dn
332	16DEC86	SOIGIA	109.8	576	STRICKLAND	H	DOGO	B	R	Dn
333	16DEC86	SOIGIA	109.4	570	STRICKLAND	H	DOGO	B	R	Dn
334	16DEC86	SOIGIA	106.5	528	STRICKLAND	H	DOGO	B	R	Dn
341	16DEC86	SOIGIA	95.2	382	STRICKLAND	H	GUGWI-SISIGIA	B	R	Up
342	16DEC86	SOIGIA	69.4	154	STRICKLAND	H	GUGWI-SISIGIA	B	R	Up
343	16DEC86	SOIGIA	73.8	184	STRICKLAND	H	GUGWI-SISIGIA	B	R	Up
595	16DEC86	SOI	113.6	686	SIGIAHAFI	H	MAUBO	B	R	Dn
660	16DEC86	OWUAHIA	138.6	1176	STRICKLAND	H	DOGO	B	R	Dn
327	17DEC86	SOIGIA	65.9	133	STRICKLAND	H	GASTRICKLAND	B	R	Dn
337	17DEC86	SOIGIA	89.8	323	STRICKLAND	H	GWASE	B	R	Dn
338	17DEC86	SOIGIA	94.2	371	STRICKLAND	H	GWASE	B	R	Dn
339	17DEC86	SOIGIA	94.2	371	STRICKLAND	H	GWASE	B	R	Dn
340	17DEC86	SOIGIA	93.0	358	STRICKLAND	H	GWASE	B	R	Dn
1479	17DEC86	BO	40.7	84	IA	S	GUGWI	B	R	Up
1480	17DEC86	BO	41.2	87	IA	S	GUGWI	B	R	Up
1481	17DEC86	BO	45.9	121	IA	S	GUGWI	B	R	Up

ID	DATE	TAXON	SL (mm)	WT (g)	STREAM	TECH.	FISHER(S)	CONTEXT catch	CONTEXT eat	AFF.
1482	17DEC86	BO	36.4	60	IA	S	GUGWI	B	R	Up
1483	17DEC86	BO	37.0	63	IA	S	GUGWI	B	R	Up
345	18DEC86	SOIGIA	110.5	586	STRICKLAND	H	MAUBO	B	R	Dn
346	18DEC86	SOIGIA	112.1	611	STRICKLAND	H	MAUBO	B	R	Dn
347	18DEC86	SOIGIA	74.5	189	STRICKLAND	H	MAUBO	B	R	Dn
888	21DEC86	AIODIO	73.3	335	DEGE	S	DOGO	B	R	Dn
889	21DEC86	AIODIO	74.0	344	DEGE	S	DOGO	B	R	Dn
890	21DEC86	AIODIO	49.7	114	DEGE	S	DOGO	B	R	Dn
1292	21DEC86	TOBAGA	59.4	216	SOMASIO	H	BOUA	B	R	Dn
1293	21DEC86	TOBAGA	47.1	109	SOMASIO	H	BOUA	B	R	Dn
887	22DEC86	AIODIO	64.6	236	SOMASIO	H	BOUA	B	R	Dn
1006	22DEC86	TWE	80.5	466	SOMASIO	H	BOUA	B	R	Dn
1056	22DEC86	AIYO	44.2	83	DEGE	H	MUGWA	B	R	Dn
1057	22DEC86	AIYO	37.6	53	DEGE	H	MUGWA	B	R	Dn
1058	22DEC86	AIYO	33.0	37	DEGE	H	MUGWA	B	R	Dn
1059	22DEC86	AIYO	29.6	27	DEGE	H	MUGWA	B	R	Dn
1060	22DEC86	AIYO	26.5	20	DEGE	H	MUGWA	B	R	Dn
1061	22DEC86	AIYO	30.3	29	SOMASIO	H	BOUA	B	R	Dn
1062	22DEC86	AIYO	35.5	45	SOMASIO	H	BOUA	B	R	Dn
1063	22DEC86	AIYO	32.9	36	SOMASIO	H	BOUA	B	R	Dn
1064	22DEC86	AIYO	36.2	48	SOMASIO	H	BOUA	B	R	Dn
1065	22DEC86	AIYO	39.7	61	SOMASIO	H	BOUA	B	R	Dn
1066	22DEC86	AIYO	39.7	61	SOMASIO	H	BOUA	B	R	Dn
1068	22DEC86	AIYO	42.7	75	SOMASIO	H	BOUA	B	R	Dn
1069	22DEC86	AIYO	43.3	78	SOMASIO	H	BOUA	B	R	Dn
348	23DEC86	SOIGIA	79.5	228	STRICKLAND	H	UNKNOWN	B	R	UNKN
357	26DEC86	SOIGIA	114.5	649	STRICKLAND	H	DOGO	B	R	Dn
358	26DEC86	SOIGIA	92.2	349	STRICKLAND	H	DOGO	B	R	Dn
359	26DEC86	SOIGIA	109.5	571	STRICKLAND	H	MAMO	B	R	Dn
360	26DEC86	SOIGIA	71.8	170	STRICKLAND	H	MAMO	B	R	Dn
1008	26DEC86	TWE	109.7	990	AU	S	DOGO	B	R	Dn
392	31JAN87	SOIGIA	102.9 *	490	STRICKLAND	H	MABEI	V	F	Up
495	01JAN87	GUMO	104.3	526	AUTI	H	SIMO	B	R	Up
1378	01JAN87	TOGOWO	64.6	425	DEGEHAFI	H	HEGOGWA	B	R	Up
1379	02JAN87	TOGOWO	72.2	624	UNKNOWN	U	VISITOR	B	R	Up
370	15JAN87	SOIGIA	79.5	228	STRICKLAND	H	VISITOR	B	R	Up
371	15JAN87	SOIGIA	76.1	201	STRICKLAND	H	BOUA	B	R	Dn
372	15JAN87	SOIGIA	102.7	475	STRICKLAND	H	BOUA	B	R	Dn
373	15JAN87	SOIGIA	108.0	549	STRICKLAND	H	BOUA	B	R	Dn
374	15JAN87	SOIGIA	104.5	500	STRICKLAND	H	GUGWI	B	R	Up
375	15JAN87	SOIGIA	109.1	565	STRICKLAND	H	SISIGIA	B	R	Up
376	15JAN87	SOIGIA	99.6	435	STRICKLAND	H	SISIGIA	B	R	Up
703	16JAN87	OKAIBO	79.5	150	STRICKLAND	H	SISIGIA	B	R	Up
689	18JAN87	DJAU	175.0	1437	DEGEHAFI	H	DOGO	B	R	Dn
897	18JAN87	AIODIO	96.9	726	DEGE	S	DOGO	B	R	Dn
898	18JAN87	AIODIO	93.1	650	KOTO	H	MAMO	B	R	Dn
899	18JAN87	AIODIO	146.7	2288	KOTO	H	MAMO	B	R	Dn
1012	25JAN87	TWE	64.6	272	DEGE	S	MAUBO	B	R	Dn
396	02FEB87	SOIGIA	102.5	473	STRICKLAND	H	SISIGIA	B	O	Up
397	02FEB87	SOIGIA	103.7	489	STRICKLAND	H	SISIGIA	B	R	Up
394	02FEB87	SOIGIA	96.5	398	STRICKLAND	H	SISIGIA	B	R	Up
609	05MAR87	SOI	129.2	1021	DEGE	S	FILIFI	B	R	Up
1305	06MAR87	TOBAGA	50.6	135	DEGE	S	GUGWI	B	R	Up
1487	06MAR87	BO	.	75	DEGE	S	GUGWI	B	R	Up
405	15MAR87	SOIGIA	121.1	763	STRICKLAND	H	GWUHO	B	R	Dn
406	15MAR87	SOIGIA	82.1	250	STRICKLAND	H	MAUBO-GWUHO	B	R	Dn
407	15MAR87	SOIGIA	102.2	469	STRICKLAND	H	MAUBO-GWUHO	B	R	Dn
408	15MAR87	SOIGIA	82.1	250	STRICKLAND	H	MAUBO-GWUHO	B	R	Dn
499	15MAR87	GUMO	154.8	1702	STRICKLAND	H	GWUHO	B	R	Dn
500	15MAR87	GUMO	89.0	328	STRICKLAND	H	MAUBO-GWUHO	B	R	Dn
612	15MAR87	SOI	134.3	1150	STRICKLAND	H	MAUBO	B	R	Dn
613	15MAR87	SOI	124.5	911	STRICKLAND	H	GWUHO	B	R	Dn
1015	15MAR87	TWE	83.6	511	DEGE	S	BISEIO	B	R	Up
1306	17MAR87	TOBAGA	43.6	87	DEGE	S	GUGWI	B	R	Up
1307	17MAR87	TOBAGA	39.5	65	DEGE	S	GUGWI	B	R	Up
1310	22MAR87	TOBAGA	47.8	114	DEGE	S	GUGWI	B	R	Up
1311	22MAR87	TOBAGA	43.4	86	DEGE	S	GUGWI	B	R	Up
1312	01APR87	TOBAGA	.	120	TU	S	MAUBO	B	R	Dn
1313	01APR87	TOBAGA	.	120	TU	S	MAUBO	B	R	Dn
1331	20APR87	TOBAGA	65.3	285	DEGE	S	GWASE	B	R	Dn

ID	DATE	TAXON	SL (mm)	WT (g)	STREAM	TECH.	FISHER(S)	CONTEXT catch	eat	AFF.
1332	20APR87	TOBAGA	.	120	DEGE	S	GWASE	B	R	Dn
1613	22APR87	SA	27.5	37	DUWA	H	SISIGIA	B	R	Up
1614	22APR87	SA	.	35	DUWA	H	SISIGIA	B	R	Up
1615	22APR87	SA	.	35	DUWA	H	SISIGIA	B	R	Up
1616	22APR87	SA	.	35	DUWA	H	SISIGIA	B	R	Up
1035	24APR87	DA	56.5	196	SIGIA	S	SIMO	B	R	Up
1036	24APR87	DA	46.1	120	SIGIA	S	MAMO	B	R	Dn
1333	24APR87	TOBAGA	.	120	SIGIA	S	SIMO	B	R	Up
1020	25APR87	TWE	.	375	DUWA	S	FILIFI	B	R	Up
1334	29APR87	TOBAGA	70.4	356	TAGU	S	BISEIO	B	R	Up
10	10MAY87	BO	30.3	35	TU	H	BOUA	B	R	Dn
11	10MAY87	BO	31.2	38	TU	H	BOUA	B	R	Dn
12	10MAY87	BO	31.3	38	TU	H	BOUA	B	R	Dn
13	10MAY87	BO	33.9	49	TU	H	BOUA	B	R	Dn
14	10MAY87	TOBAGA	46.5	105	TU	S	MAMO	B	R	Dn
15	10MAY87	TOBAGA	47.1	109	TU	S	MAMO	B	R	Dn
16	10MAY87	TOBAGA	54.9	171	TU	S	MAMO	B	R	Dn
17	10MAY87	TOBAGA	62.2	247	TU	S	MAMO	B	R	Dn
27	13MAY87	AIODIO	116.1	1197	DEGE	S	SINIO	B	R	Up
28	13MAY87	AIODIO	103.2	864	DEGE	S	BISEIO	B	R	Up
24	15MAY87	AIODIO	88.3	561	SIGIA	S	MAMO	B	R	Dn
25	15MAY87	TOBAGA	70.3	354	TU	S	MAMO	B	R	Dn
26	15MAY87	TWE	85.8	544	TU	S	MAMO	B	R	Dn
29	15MAY87	SA	29.6	46	DOSU	H	GOGO	B	R	Dn
30	15MAY87	SA	30.0	48	DOSU	H	GOGO	B	R	Dn
31	15MAY87	SA	31.9	58	DOSU	H	GOGO	B	R	Dn
34	15MAY87	SA	24.5	26	DOSU	H	GOGO	B	R	Dn
35	15MAY87	SA	24.6	26	DOSU	H	GOGO	B	R	Dn
36	15MAY87	SA	26.8	34	DOSU	H	GOGO	B	R	Dn
37	15MAY87	SA	27.8	38	DOSU	H	GOGO	B	R	Dn
38	15MAY87	SA	29.2	44	DOSU	H	GOGO	B	R	Dn
39	15MAY87	SA	31.3	55	DOSU	H	GOGO	B	R	Dn
40	15MAY87	TOBAGA	49.9	129	DEGE	S	BISEIO	B	R	Up
65	30MAY87	TOBAGA	47.5	112	DEGE	S	BISEIO	B	R	Up
66	30MAY87	TOBAGA	48.6	120	DEGE	S	BISEIO	B	R	Up
67	30MAY87	TOBAGA	52.1	147	DEGE	S	BISEIO	B	R	Up
68	30MAY87	TOBAGA	53.7	160	DEGE	S	BISEIO	B	R	Up
1645	02JUN87	TOBAGA	45.7	100	IA	S	FILIFI	B	R	Up
1646	02JUN87	BO	37.2	64	IA	S	FILIFI	B	R	Up
1647	02JUN87	BO	35.9	58	IA	S	FILIFI	B	R	Up
1649	02JUN87	BO	42.1	93	YUWENA	H	MABEI	B	R	Up
1650	02JUN87	BO	44.5	110	YUWENA	H	MABEI	B	R	Up
1651	02JUN87	BO	46.9	129	YUWENA	S	BISEIO	B	R	Up
1652	02JUN87	TOBAGA	52.1	147	YUWENA	S	BISEIO	B	R	Up
1653	02JUN87	TOBAGA	62.8	254	YUWENA	S	BISEIO	B	R	Up
1654	02JUN87	BO	33.8	48	YUWENA	H	YASIMO	B	R	Up
1655	02JUN87	BO	53.1	187	YUWENA	S	BISEIO	B	R	Up
1656	02JUN87	TOBAGA	46.4	104	YUWENA	S	BISEIO	B	R	Up
1657	02JUN87	TOBAGA	63.8	266	YUWENA	S	BISEIO	B	R	Up
1658	02JUN87	TOBAGA	42.5	81	YUWENA	S	BISEIO	B	R	Up
1659	02JUN87	TOBAGA	49.7	128	YUWENA	S	BISEIO	B	R	Up
1660	02JUN87	TOBAGA	50.1	131	YUWENA	S	BISEIO	B	R	Up
1661	02JUN87	BO	39.6	77	YUWENA	H	MABEI	B	R	Up
1662	02JUN87	BO	54.9	207	YUWENA	H	MABEI	B	R	Up
1663	02JUN87	BO	66.4	366	YUWENA	H	MABEI	B	R	Up
1674	02JUN87	AIODIO	83.0	473	IA	S	FILIFI	B	R	Up
1683	06JUN87	GOI	74.6	4022	KOIOGO	S	MAUBO	B	R	Dn
1692	15JUN87	TWE	64.2	268	SIGIA	S	MAUBO	B	R	Dn
1701	24JUN87	TOBAGA	.	120	UNKNOWN	U	UNKNOWN	B	R	UNKN
1702	25JUN87	SA	27.5	37	IA	H	MABEI	B	R	Up
1703	25JUN87	DJAU	100.8	347	STRICKLAND	H	VISITOR	B	R	Up
1704	25JUN87	SOIGIA	59.6	100	STRICKLAND	H	VISITOR	B	R	Up
1708	25JUN87	SOIGIA	83.4	262	UNKNOWN	H	WAFU	B	R	Up
1705	26JUN87	GUMO	90.0	339	YA	S	SINIO	B	R	Up
1706	26JUN87	GUMO	97.0	424	YA	S	SINIO	B	R	Up
1707	26JUN87	BO	53.1	187	YA	S	SINIO	B	R	Up
1715	30JUN87	SOIGIA	96.7	400	STRICKLAND	H	VISITOR	B	R	Up
1716	30JUN87	BO	43.2	101	IA	H	VISITOR	B	R	Up
1717	30JUN87	SA	26.3	32	IA	H	VISITOR	B	R	Up
1718	30JUN87	SA	27.0	35	IA	H	VISITOR	B	R	Up

ID	DATE	TAXON	SL (mm)	WT (g)	STREAM	TECH.	FISHER(S)	CONTEXT catch	CONTEXT eat	AFF.
1719	30JUN87	SA	28.6	42	IA	H	VISITOR	B	R	Up
1720	30JUN87	SA	34.6	74	IA	H	VISITOR	B	R	Up
1721	30JUN87	AIODIO	162.0	3011	AUTI	S	VISITOR	B	R	Up
1722	30JUN87	YASA	68.3	204	AUTI	S	FILIFI	B	R	Up
1723	30JUN87	TWE	81.2	476	AUTI	S	FILIFI	B	R	Up
1724	30JUN87	GUMO	80.5	244	AUTI	S	FILIFI	B	R	Up
1734	03JUL87	YASA	77.9	294	YUWENA	S	MAUBO	B	R	Dn
1735	03JUL87	TOBAGA	41.5	75	YUWENA	S	MAUBO	B	R	Dn
1736	03JUL87	TOBAGA	54.1	164	YUWENA	S	MAUBO	B	R	Dn
1737	03JUL87	TOBAGA	55.4	176	YUWENA	S	MAUBO	B	R	Dn
1741	05JUL87	TWE	47.6	129	DEGE	S	GUGWI	B	R	Up
1742	05JUL87	TWE	72.5	361	DEGE	S	GUGWI	B	R	Up
1743	05JUL87	TOBAGA	43.9	89	DEGE	S	GUGWI	B	O	Up
1744	07JUL87	BO	27.8	27	SIGIA	H	GWASE	B	R	Dn
1745	07JUL87	BO	31.4	39	SIGIA	H	GWASE	B	R	Dn
1746	07JUL87	BO	35.7	57	SIGIA	H	GWASE	B	R	Dn
1747	07JUL87	BO	38.2	70	SIGIA	H	GWASE	B	R	Dn
1748	07JUL87	BO	38.9	73	SIGIA	H	GWASE	B	R	Dn
1749	07JUL87	BO	40.9	85	SIGIA	H	GWASE	B	R	Dn
1750	07JUL87	BO	45.5	118	SIGIA	H	GWASE	B	R	Dn
1751	08JUL87	GUMO	92.5	368	STRICKLAND	H	GOGOI	B	R	Up
1752	08JUL87	GUMO	115.0	703	STRICKLAND	H	GOGOI	B	R	Up
1753	08JUL87	SOIGIA	84.6	273	STRICKLAND	H	GOGOI	B	R	Up
1754	08JUL87	SOIGIA	108.7	559	STRICKLAND	H	GOGOI	B	R	Up
1755	08JUL87	SA	24.9	27	HAWI	H	VISITOR	B	R	Up
1758	08JUL87	TOBAGA	50.9	137	YA	S	BISEIO	B	R	Up
1759	08JUL87	TOBAGA	56.4	185	YA	S	BISEIO	B	R	Up
1760	08JUL87	TOBAGA	57.1	192	YA	S	BISEIO	B	R	Up
1761	08JUL87	BO	48.1	139	YA	S	BISEIO	B	R	Up
1767	11JUL87	GUMO	127.6	958	AUTI	S	SINIO	B	R	Up
1768	11JUL87	GUMO	82.9	266	AUTI	S	SINIO	B	R	Up
1784	12JUL87	AIODIO	174.0	3669	DEGE	S	GUGWI	B	R	Up
1785	12JUL87	AIODIO	70.8	304	DEGE	S	GUGWI	B	R	Up
1786	12JUL87	BO	38.9	73	DEGE	S	GUGWI	B	R	Up
1787	12JUL87	TOBAGA	36.1	50	DEGE	S	GUGWI	B	R	Up
1788	12JUL87	TOBAGA	44.5	92	DEGE	S	GUGWI	B	R	Up
1789	12JUL87	TOBAGA	50.6	135	DEGE	S	GUGWI	B	R	Up
1790	12JUL87	TOBAGA	53.0	154	DEGE	S	GUGWI	B	R	Up
1795	12JUL87	BO	40.8	85	DEGE	S	GUGWI	B	O	Up
1796	12JUL87	TOBAGA	51.2	139	DEGE	S	GUGWI	B	O	Up
1797	12JUL87	TOBAGA	59.1	213	DEGE	S	GUGWI	B	O	Up
1802	16JUL87	SOI	156.0	1827	DEGE	S	DOGO	B	R	Dn
1803	16JUL87	TWE	43.8	106	DEGE	S	DOGO	B	R	Dn
1804	16JUL87	BO	37.2	64	DEGE	S	MAUBO	B	R	Dn
1805	16JUL87	TOBAGA	48.8	121	DEGE	S	MAUBO	B	R	Dn
1806	16JUL87	TOBAGA	51.3	140	DEGE	S	MAUBO	B	R	Dn
1807	16JUL87	TOBAGA	58.1	202	DEGE	S	MAUBO	B	R	Dn
1812	16JUL87	SOIGIA	102.6	474	STRICKLAND	H	GOGOI	B	R	Up
1813	16JUL87	SOIGIA	111.7	605	STRICKLAND	H	GOGOI	B	R	Up
1814	16JUL87	OWUAHIA	106.8	547	STRICKLAND	H	GOGOI	B	R	Up
1818	18JUL87	OWUAHIA	185.0	2750	STRICKLAND	H	SIMO	B	R	Up
1863	24JUL87	SOIGIA	92.3	350	STRICKLAND	H	GOGOI	B	R	Up
1864	24JUL87	SOIGIA	104.3	497	STRICKLAND	H	GOGOI	B	R	Up
1865	24JUL87	OKAIBO	220.0	2707	STRICKLAND	H	GOGOI	B	R	Up
1883	27JUL87	AIODIO	166.0	3221	KOTO	S	MAUBO	B	R	Dn
1866	28JUL87	GUMO	141.0	1290	STRICKLAND	H	GUGWI	B	R	Up
1867	28JUL87	TOGOWO	85.5	1122	STRICKLAND	H	SISIGIA	B	R	Up
1870	28JUL87	TWE	69.9	330	AUTI	S	FILIFI	B	R	Up
1871	28JUL87	TWE	82.0	487	AUTI	S	FILIFI	B	R	Up
1878	28JUL87	TOBAGA	.	120	UNKNOWN	U	GWASE	B	R	Dn
1889	07AUG87	BO	29.1	31	DEGE	H	SISIGIA	B	R	Up
1890	07AUG87	BO	37.8	67	DEGE	H	SISIGIA	B	R	Up
1891	07AUG87	GUMO	75.0	197	DEGE	H	SISIGIA	B	R	Up
1894	08AUG87	SA	22.3	20	GWI	H	MABEI	B	R	Up
1895	08AUG87	SA	22.7	21	GWI	H	MABEI	B	R	Up
1896	08AUG87	SA	24.0	25	GWI	H	MABEI	B	R	Up
1904	09AUG87	TWE	94.0	680	YUWENA	S	VISITOR	B	R	Dn
1905	09AUG87	TOBAGA	49.4	125	YUWENA	S	VISITOR	B	R	Dn
1906	09AUG87	TOBAGA	60.4	227	YUWENA	S	VISITOR	B	R	Dn
1907	12AUG87	TOBAGA	49.8	128	UNKNOWN	U	UNKNOWN	B	R	UNKN

ID	DATE	TAXON	SL (mm)	WT (g)	STREAM	TECH.	FISHER(S)	CONTEXT catch	CONTEXT eat	AFF.
1908	13AUG87	AIODIO	113.2	1116	KOTO	S	MAUBO	B	R	Dn
1911	15AUG87	AIODIO	58.7	181	DEGE	S	GWASE	B	R	Dn
1912	15AUG87	AIODIO	87.1	540	DEGE	S	GWASE	B	R	Dn
1913	15AUG87	TOBAGA	60.6	229	DEGE	S	GWASE	B	R	Dn
1914	15AUG87	TOBAGA	65.4	286	DEGE	S	GWASE	B	R	Dn
1918	23AUG87	AIODIO	98.3	755	YA	S	FILIFI	B	R	Up
1923	28AUG87	AIODIO	58.0	175	DEGE	S	GWASE	B	R	Dn
1924	28AUG87	AIODIO	63.1	221	DEGE	S	GWASE	B	R	Dn
1925	28AUG87	AIODIO	92.5	638	DEGE	S	GWASE	B	R	Dn
1926	28AUG87	TOBAGA	54.5	167	DEGE	S	GWASE	B	R	Dn
1927	29AUG87	SOIGIA	66.0	134	STRICKLAND	H	SIMO	B	R	Up
1928	29AUG87	SOIGIA	90.0	326	STRICKLAND	H	SIMO	B	R	Up
1929	29AUG87	SOIGIA	92.5	352	STRICKLAND	H	SIMO	B	R	Up
1930	29AUG87	SOIGIA	97.5	410	STRICKLAND	H	SIMO	B	R	Up
1931	29AUG87	SOIGIA	102.4	471	STRICKLAND	H	SIMO	B	R	Up
1932	30AUG87	BO	34.6	52	DEGE	S	GUGWI	B	R	Up
1933	30AUG87	TOBAGA	51.0	138	DEGE	S	GUGWI	B	R	Up
1934	30AUG87	AIODIO	80.6	436	DEGE	S	GUGWI	B	R	Up
1935	30AUG87	AIODIO	98.7	764	DEGE	S	GUGWI	B	R	Up
1936	30AUG87	AIODIO	107.8	975	DEGE	S	GUGWI	B	R	Up
1940	31AUG87	KAUFO	.	25	SIGIA	U	DOGO	B	R	Dn
1941	31AUG87	KAUFO	.	25	SIGIA	O	DOGO	B	R	Dn
1954	03SEP87	TOBAGA	60.0	222	DEGE	S	GUGWI	B	O	Up
1962	08SEP87	TOBAGA	69.0	335	TU	S	DOGO	B	R	Dn
1963	08SEP87	DA	47.4	128	TU	S	DOGO	B	R	Dn
1964	08SEP87	DA	55.8	191	TU	S	DOGO	B	R	Dn
1965	08SEP87	DA	57.6	206	TU	S	DOGO	B	R	Dn
1966	10SEP87	TOBAGA	41.3	74	DEGE	S	GUGWI	B	R	Up
1967	10SEP87	AIODIO	119.2	1288	DEGE	S	GUGWI	B	R	Up
1968	10SEP87	SOI	109.8	618	DEGE	S	GUGWI	B	R	Up
1969	11SEP87	AIODIO	108.3	988	KOTO	H	DOGO	B	R	Dn
1973	19SEP87	AIODIO	59.7	190	DEGE	S	DOGO	B	R	Dn
1974	19SEP87	AIODIO	123.5	1421	DEGE	S	DOGO	B	R	Dn
2009	13OCT87	AIODIO	83.4	479	SOMASIO	O	GWASE-MAUBO	B	R	Dn
2010	13OCT87	AIODIO	97.5	738	SOMASIO	O	GWASE-MAUBO	B	R	Dn
2011	13OCT87	TWE	67.3	301	SOMASIO	O	GWASE-MAUBO	B	R	Dn
2012	13OCT87	TWE	78.0	431	SOMASIO	O	GWASE-MAUBO	B	R	Dn
2013	13OCT87	AIODIO	138.5	1951	SOMASIO	O	GWASE-MAUBO	B	R	Dn
2015	13OCT87	AIODIO	157.0	2760	SOMASIO	O	GWASE-MAUBO	B	R	Dn
2016	13OCT87	TOBAGA	45.5	98	SOMASIO	O	GWASE-MAUBO	B	R	Dn
2017	13OCT87	TOBAGA	50.9	137	SOMASIO	O	GWASE-MAUBO	B	R	Dn
2018	13OCT87	TOBAGA	51.7	143	SOMASIO	O	GWASE-MAUBO	B	R	Dn
2019	13OCT87	TOBAGA	53.2	156	SOMASIO	O	GWASE-MAUBO	B	R	Dn
2020	13OCT87	AIYO	30.5	30	SOMASIO	O	GWASE-MAUBO	B	R	Dn
2021	13OCT87	AIYO	30.5	30	SOMASIO	O	GWASE-MAUBO	B	R	Dn
2022	13OCT87	AIYO	31.0	31	SOMASIO	O	GWASE-MAUBO	B	R	Dn
2023	13OCT87	AIYO	33.5	38	SOMASIO	O	GWASE-MAUBO	B	R	Dn
2030	16OCT87	AIODIO	62.3	214	KOTO	S	DOGO	B	R	Dn
2031	16OCT87	AIODIO	65.5	245	KOTO	S	DOGO	B	R	Dn
2032	16OCT87	AIODIO	98.2	753	KOTO	S	DOGO	B	R	Dn
2033	18OCT87	GOI	75.3	4126	TU	S	MAMO	B	R	Dn

APPENDIX 2

Calculations used for reconstructing weights of fish

The length of each skull purchased during the survey (n=2040) was measured in millimetres. Skulls of most species were measured from the rostrum to the posterior tip of the dorsal spine. Those of the four species of gudgeon were measured from the rostrum to the foramen magnum. Some skulls (<4 % of the total; n=84) were unable to be measured because of damage; most of these (>60%; n=51) belonged to a single species of small gudgeon. With non-gudgeons, broken skulls were matched to others of known length.

Weights were recorded for 440 of the fish caught during the survey, and another 14 that I or my partner caught during the following month. These weights were used to calculate a regression of weight (Wt) against skull length (SL) for each species. Using these equations, approximate weights were inferred from skull length for all fish that had not been weighed. If the sample of weights available from a species was not adequate for confident calculation of a regression, weights were estimated, where possible, from regressions calculated for closely related species. (For two species, no suitable alternative regression existed, and the original regression, though weak, was used.) Where skull length was not available, the fish was assigned the modal weight for its species. For three categories, where no comparative data were available, weights have been guessed on the basis of experience.

In all cases, weights recorded were for cleaned fish; the stomach and intestines had been opened and emptied, but usually not discarded. All derived estimates also refer to 'treated' weights.

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BASIS FOR RECONSTRUCTION OF MISSING WEIGHTS

<u>FORKTAILED CATFISH</u>

Arius taylori (*soigia*)

regression calculated from weighed specimens of *A. taylori*

$$Wt = 10^{-3.09} + SL^{2.87} \qquad n=186 \qquad r^2=0.96$$

Arius leptaspis (*soi*)

regression calculated from weighed specimens of *A. leptaspis*

$$Wt = 10^{-3.51} + SL^{3.09} \qquad n=48 \qquad r^2=0.97$$

Arius latirostris (*gumo*)

regression calculated from weighed specimens of *A. latirostris*

$Wt = 10^{-3.28} + SL^{2.97}$ n=26 $r^2=0.95$

Arius augustus (*ouwuahia*)

regression calculated from weighed specimens of *A. augustus*

$Wt = 10^{-3.23} + SL^{2.94}$ n=11 $r^2=0.99$

Cochlefelis spatula (*djau*)

regression calculated from weighed specimens of *C. spatula*

$Wt = 10^{-2.62} + SL^{2.58}$ n=18 $r^2=0.90$

Hemipimelodus crassilabris (*okaibo*)

regression calculated from weighed specimens of *H. crassilabris*

$Wt = 10^{-3.22} + SL^{2.84}$ n= 7 $r^2=0.99$

EELTAILED CATFISH

Plotosus papuensis (*aiōdio*)

regression calculated from weighed specimens of *P. papuensis*

$Wt = 10^{-2.6376} + SL^{2.7681}$ n=54 $r^2=0.95$

Neosilurus equinus (*twe*) and *Neosilurus* sp. (*da*)

regression calculated from weighed specimens of *N. equinus* and *N.* sp.

$Wt = 10^{-1.9788} + SL^{2.4383}$ n=16+2 $r^2=0.88$

Neosilurus ater (*yasa*)

weights calculated from regression for *P. papuensis*

Porochilus meraukensis (*aiyō*)

weights calculated from regression for *P. papuensis*

NOTE: Only two specimens of *N. ater* and no specimens of *P. meraukensis* were weighed during the survey.

PERCH

Pingalla lorentzi (*tobaga*)

regression calculated from weighed specimens of *P. lorentzi*

$$Wt = 10^{-2.8843} + SL^{2.9419} \qquad n=22 \qquad r^2=0.97$$

Parambassis gulliveri (*awasu*)

actual weights recorded for all specimens

Hephaestus habbemai (*bō*)

regression calculated from weighed specimens of *H. habbemai*

$$Wt = 10^{-2.91} + SL^{3.01} \qquad n=10 \qquad r^2=0.97$$

Hephaestus fuliginosus (*togowo*)

regression calculated from weighed specimens of *H. fuliginosus*

$$Wt = 10^{-3.65} + SL^{3.47} \qquad n=3 \qquad r^2=0.92$$

NOTE: This regression was weak ($p=0.18$) but skulls of all specimens fell outside the range represented by the closely related species *H. habbemai*, making use of the regression calculated for that species problematic. The three weighed specimens spanned the range of skull lengths recorded.

GUDGEONS

Oxyeleotris fimbriata (*sa̲*)

regression calculated from weighed specimens of *O. fimbriata*

$$Wt = 10^{-2.75} + SL^{3.00} \qquad n=9 \qquad r^2=0.93$$

Oxyeleotris herwerdenii (*sa̲bo*)

weights calculated from regression for *O. fimbriata*

Bostrichthys strigogenys (*kigi*)

weights calculated from regression for *O. fimbriata*

Morgurnda cingulata ? (*kaibo*)

actual weights recorded for all specimens

OTHERS

Crenomugil heteocheilus (*tio*)

regression calculated from weighed specimens of *C. heteocheilus*

$$Wt = 10^{-11.67} + SL^{8.18} \qquad n = 3 \qquad r^2 = 0.99$$

NOTE: This regression was not weak ($p < 0.05$) but the small sample size, and the fact that weighed specimens were all smaller than those of unknown weight, made its use problematic. None of the other species caught, however, was closely enough related to justify use of an alternative regression.

Nibea sp. (*semesio dio*)

one specimen only - weight guessed at 2000 g

Anguilla spp. (*goi*)

regression calculated from weighed specimens of *Anguilla* spp.

$$Wt = 10^{-1.52} + SL^{2.73} \qquad n = 5 \qquad r^2 = 0.85$$

Fam. Melanotaeniidae (*kaufo*)

three specimens only - weight guessed at 25 g each

APPENDIX 3

Calculations used to attribute responsibility for catching fish where details of fisher are unclear

On several occasions during the survey, people went fishing together and pooled their catch before returning to the village. On other occasions, people staying at a bush house stored the skulls of fish they caught and delivered them as a single collection. And sometimes, when many fish or skulls were brought in at once, it was simply impossible to check that all were accurately identified or correctly attributed. In such circumstances, fish have been jointly attributed to the two or more people who may have contributed to the catch. But the major fishing techniques used at Gwaimasi did not require co-operative effort; only one person will actually have fired the spear or set the line which secured the fish. When comparing the production of fish by different individuals, therefore, joint attributions are distributed among the participants on the basis of the relative probability that each was responsible for the catch. That probability, in turn, is based on known fishing performance.

BASIS OF DISTRIBUTION

Where technique used was:

LINE	-	ratio of known linefishing catch/day by each participant,
SPEAR	-	ratio of known spearfishing catch/day by each participant,
UNKNOWN	-	ratio of total known catch/day by each participant,
OTHER	-	equal shares - net and poison are co-operate techniques.

Where a visitor was implicated in the catch, no record of productivity is available; thus participants were accorded equal shares.

NUMBER of fish	-	distributed according to known NUMBER obtained per day.
WEIGHT of fish	-	distributed according to known WEIGHT obtained per day.

(NUMBER has been rounded to two decimal places; WEIGHT has been rounded to the nearest gram).

In all these calculations, known captures refer only to fish caught within the local area used for subsistence by residents of Gwaimasi. Fishing conditions elsewhere may have been different, with fishing performance varying accordingly.

Proportion of joint-attributions credited to each participant:

	TECHNIQUE USED					
	LINE		SPEAR		UNKNOWN	
	no.	wt	no.	wt	no.	wt
GUGWI-SISIGIA						
Gugwi	0.22	0.40			0.59	0.79
Sisigia	0.78	0.60			0.41	0.21
BISEIŌ-MABEI						
Biseiō	0.14	0.30			0.60	0.63
Mabei	0.86	0.70			0.40	0.37
BOWA-BOUA						
Bowa	0.41	0.67				
Boua	0.59	0.33				
MAMO-MAUBO						
Mamo			0.33	0.47	0.20	0.29
Maubo			0.67	0.53	0.80	0.71
MAUBO-GWUHO						
Maubo	0.69	0.63				
Gwuho	0.31	0.37				
SINIO-FILIFI						
Sinio	0.85	0.90	0.50	0.64		
Filifi	0.15	0.10	0.50	0.36		
FILIFI-PLUS						
Filifi			0.22	0.26		
Gugwi			0.34	0.35		
Biseiō			0.11	0.06		
Visitor			0.33	0.33		
JOSHUA-PLUS						
26 Nov.86						
Sinio			0.33	0.33		
Visitor x 2			0.67	0.67		
28 Nov.86						
Gugwi			0.61	0.56		
Hegogwa			0.06	0.11		
Visitor			0.33	0.33		
13 Apr.87						
Biseiō			0.27	0.20		
Maubo			0.24	0.38		
Simo			0.21	0.10		
Tufa			0.08	0.12		
Visitor			0.20	0.20		

SINIO-VISITOR FILIFI-VISITOR	spear		0.5	0.5
SIMO-HEGOGWA FILIFI-DOGO GWASE-MAUBO	net net poison	co-operative techniques	0.5	0.5
GWUHO-VISITOR		This category comprises seven fish brought in by Gwuho and two visitors as part of a larger catch during three weeks spent in the bush making canoes. Two of those fish were caught by Gwuho, but the precise identification of these was unclear. Gwuho has been attributed with 2/7 of each fish, the remaining 5/7 being attributed to the visitors.		
VISITOR	Up&Dn	This category comprised two fish (1942, 1943) caught in a net by two visitors, one associated with Upgabo residents, the other associated with Downgabo residents. Credit for each fish is shared equally.		

ADJUSTMENTS

When comparing the catch by different individuals, or by different sets of individuals, all records of fish with joint attributions were removed from the database and replaced with the following, which distribute ambiguous records according to the principles outlined above. For details of variables, see Appendix 1, but note that NUMBER is added to the database as a new variable, replacing SL (skull length).

NUMBER — the number of fish of the given taxon which the individual is credited with catching. Records for whole fish, those that did not need to be apportioned because of ambiguous attributions, are counted as 1; apportioned records may be more or less than 1.

WEIGHT — the weight of fish of the given taxon which the individual is credited with catching.

ID	DATE	TAXON	NUMBER	WEIGHT (g)	STREAM	TECH.	FISHER(S)	CONTEXT catch	CONTEXT eat	AFF.
3010	16SEP86	SOIGIA	0.86	224	STRICKLAND	H	MABEI	V	F	Up
3011	02JUN87	TOBAGA	2.00	413	YUWENA	U	MABEI	tr.	F	Up
3012	02JUN87	BO	0.80	101	YUWENA	U	MABEI	tr.	F	Up
3013	17SEP86	SOIGIA	0.59	494	STRICKLAND	U	GUGWI	tr.	F	Up
3014	17SEP86	OWUAHIA	0.33	1275	STRICKLAND	H	GUGWI	B	R	Up
3015	17SEP86	DJAU	0.16	244	STRICKLAND	H	GUGWI	B	R	Up
3016	17SEP86	SOIGIA	0.44	123	STRICKLAND	U	GUGWI	B	R	Up
3021	28NOV86	AIODIO	3.66	2322	KOTO	S	GUGWI	V	F	Up
3022	28NOV86	TWE	2.44	917	KOTO	S	GUGWI	V	F	Up
3023	28NOV86	TOBAGA	8.54	1126	KOTO	S	GUGWI	V	F	Up
3024	28NOV86	BO	0.61	76	KOTO	S	GUGWI	V	F	Up
3017	17DEC86	SOIGIA	0.66	287	STRICKLAND	H	GUGWI	B	R	Up
3018	20APR87	SA	0.59	28	TOSU	U	GUGWI	V	F	Up
3019	11MAY87	AIODIO	1.00	1107	DEGE	O	GUGWI	V	F	Up
3025	04JUN87	GOI	0.34	2275	I	S	GUGWI	V	F	Up
3020	03SEP87	AIODIO	2.00	1960	DEGE	O	GUGWI	tr.	F	Up
3052	16NOV86	TIO	0.50	685	SIGIAHAFI	O	SIMO	V	F	Up
3053	13APR87	SOI	0.21	125	DEGE	S	SIMO	V	F	Up
3054	13APR87	KIGI	0.21	9	DOUA	S	SIMO	V	F	Up
3055	13APR87	TOBAGA	0.42	29	SOMASIO	S	SIMO	V	F	Up
3056	13APR87	TOBAGA	1.68	85	UNKNOWN	S	SIMO	V	F	Up
3057	13APR87	TWE	0.21	13	UNKNOWN	S	SIMO	V	F	Up
3035	01JAN87	SA	1.77	22	DABAGA	H	BOUA	V	F	Dn
3080	25SEP86	AIODIO	0.33	309	KOIOGO	S	MAMO	V	F	Dn
3081	25SEP86	TOBAGA	0.60	146	KOIOGO	U	MAMO	V	F	Dn
3082	25SEP86	BO	0.20	30	KOIOGO	U	MAMO	V	F	Dn
3046	23SEP86	GUMO	0.50	220	DEGE	S	SINIO	V	F	Up
3047	23SEP86	SOI	3.50	1417	DEGE	S	SINIO	V	F	Up
3048	23SEP86	AIODIO	2.50	2907	DEGE	S	SINIO	V	F	Up
3049	05OCT86	SOI	1.00	804	DEGE	S	SINIO	V	F	Up
3050	22NOV86	SOIGIA	4.25	2011	STRICKLAND	H	SINIO	V	F	Up
3051	26NOV86	TOBAGA	2.33	336	DEGE	S	SINIO	V	F	Up
3001	16SEP86	SOIGIA	0.14	96	STRICKLAND	H	BISEIO	V	F	Up
3004	13APR87	SOI	0.27	250	DEGE	S	BISEIO	V	F	Up
3005	13APR87	KIGI	0.27	19	DOUA	S	BISEIO	V	F	Up
3006	13APR87	TOBAGA	0.54	59	SOMASIO	S	BISEIO	V	F	Up
3007	13APR87	TOBAGA	2.16	169	UNKNOWN	S	BISEIO	V	F	Up
3008	13APR87	TWE	0.27	27	UNKNOWN	S	BISEIO	V	F	Up
3002	02JUN87	TOBAGA	3.00	704	YUWENA	U	BISEIO	tr.	F	Up
3003	02JUN87	BO	1.20	171	YUWENA	U	BISEIO	tr.	F	Up
3009	04JUN87	GOI	0.11	390	I	S	BISEIO	V	F	Up
3026	17SEP86	SOIGIA	0.41	131	STRICKLAND	U	SISIGIA	tr.	F	Up
3027	17SEP86	OWUAHIA	1.17	1912	STRICKLAND	H	SISIGIA	B	R	Up
3028	17SEP86	DJAU	0.58	365	STRICKLAND	H	SISIGIA	B	R	Up
3029	17SEP86	SOIGIA	0.31	32	STRICKLAND	U	SISIGIA	B	R	Up
3030	17DEC86	SOIGIA	2.34	432	STRICKLAND	H	SISIGIA	B	R	Up
3031	20APR87	SA	0.41	7	TOSU	U	SISIGIA	V	F	Up
3032	11MAY87	AIODIO	1.00	1107	DEGE	O	SISIGIA	V	F	Up
3033	03SEP87	AIODIO	2.00	1960	DEGE	O	SISIGIA	tr.	F	Up
3058	16NOV86	TIO	0.50	685	SIGIAHAFI	O	HEGOGWA	V	F	Up
3059	28NOV86	AIODIO	0.36	456	KOTO	S	HEGOGWA	V	F	Up
3060	28NOV86	TWE	0.24	180	KOTO	S	HEGOGWA	V	F	Up
3061	28NOV86	TOBAGA	0.84	221	KOTO	S	HEGOGWA	V	F	Up
3062	28NOV86	BO	0.06	15	KOTO	S	HEGOGWA	V	F	Up
3095	13APR87	SOI	0.08	150	DEGE	S	TUFA	V	F	Up
3096	13APR87	KIGI	0.08	11	DOUA	S	TUFA	V	F	Up
3097	13APR87	TOBAGA	0.16	35	SOMASIO	S	TUFA	V	F	Up
3098	13APR87	TOBAGA	0.64	102	UNKNOWN	S	TUFA	V	F	Up
3099	13APR87	TWE	0.08	16	UNKNOWN	S	TUFA	V	F	Up
3045	11JAN87	TIO	0.50	232	SIGIAHAFI	O	DOGO	V	F	Dn
3036	16SEP86	TOBAGA	0.50	110	DEGE	S	FILIFI	tr.	F	Up
3037	16SEP86	DA	0.50	118	DEGE	U	FILIFI	tr.	F	Up
3038	19SEP86	GUMO	0.50	510	AUTI	S	FILIFI	B	R	Up
3039	19SEP86	AIODIO	1.00	865	AUTI	S	FILIFI	B	R	Up
3040	19SEP86	GUMO	1.00	307	AUTI	S	FILIFI	tr.	F	Up
3041	05OCT86	SOI	1.00	452	DEGE	S	FILIFI	V	F	Up
3042	22NOV86	SOIGIA	0.75	223	STRICKLAND	H	FILIFI	V	F	Up
3043	11JAN87	TIO	0.50	232	SIGIAHAFI	O	FILIFI	V	F	Up
3044	04JUN87	GOI	0.22	1690	I	S	FILIFI	V	F	Up
3063	25SEP86	AIODIO	0.67	349	KOIOGO	S	MAUBO	V	F	Dn

ID	DATE	TAXON	NUMBER	WEIGHT (g)	STREAM	TECH.	FISHER(S)	CONTEXT catch	CONTEXT eat	AFF.
3064	25SEP86	TOBAGA	2.40	357	KOIOGO	U	MAUBO	V	F	Dn
3065	25SEP86	BO	0.80	75	KOIOGO	U	MAUBO	V	F	Dn
3066	15MAR87	SOIGIA	2.07	610	STRICKLAND	H	MAUBO	B	R	Dn
3067	15MAR87	GUMO	0.69	207	STRICKLAND	H	MAUBO	B	R	Dn
3075	13APR87	SOI	0.24	475	DEGE	S	MAUBO	V	F	Dn
3076	13APR87	KIGI	0.24	36	DOUA	S	MAUBO	V	F	Dn
3077	13APR87	TOBAGA	0.48	112	SOMASIO	S	MAUBO	V	F	Dn
3078	13APR87	TOBAGA	1.92	322	UNKNOWN	S	MAUBO	V	F	Dn
3079	13APR87	TWE	0.24	51	UNKNOWN	S	MAUBO	V	F	Dn
3068	13OCT87	AIODIO	2.00	2964	SOMASIO	O	MAUBO	B	R	Dn
3069	13OCT87	TWE	1.00	366	SOMASIO	O	MAUBO	B	R	Dn
3070	13OCT87	AIYO	2.00	64	SOMASIO	O	MAUBO	B	R	Dn
3071	13OCT87	TOBAGA	2.00	267	SOMASIO	O	MAUBO	B	R	Dn
3072	13OCT87	AIODIO	1.00	1989	SOMASIO	O	MAUBO	tr.	F	Dn
3073	13OCT87	TWE	0.50	165	SOMASIO	O	MAUBO	tr.	F	Dn
3074	13OCT87	TOBAGA	1.50	129	SOMASIO	O	MAUBO	tr.	F	Dn
3083	30OCT86	SOIGIA	0.60	265	STRICKLAND	H	GWUHO	B	R	Dn
3084	30OCT86	OWUAHIA	0.80	357	STRICKLAND	H	GWUHO	B	R	Dn
3085	30OCT86	GUMO	0.60	209	STRICKLAND	H	GWUHO	B	R	Dn
3086	15MAR87	SOIGIA	0.93	359	STRICKLAND	H	GWUHO	B	R	Dn
3087	15MAR87	GUMO	0.31	121	STRICKLAND	H	GWUHO	B	R	Dn
3088	13OCT87	AIODIO	2.00	2964	SOMASIO	O	GWASE	B	R	Dn
3089	13OCT87	TWE	1.00	366	SOMASIO	O	GWASE	B	R	Dn
3090	13OCT87	AIYO	2.00	64	SOMASIO	O	GWASE	B	R	Dn
3091	13OCT87	TOBAGA	2.00	267	SOMASIO	O	GWASE	B	R	Dn
3092	13OCT87	AIODIO	1.00	1989	SOMASIO	O	GWASE	tr.	F	Dn
3093	13OCT87	TWE	0.50	165	SOMASIO	O	GWASE	tr.	F	Dn
3094	13OCT87	TOBAGA	1.50	129	SOMASIO	O	GWASE	tr.	F	Dn
3034	01JAN87	SA	1.23	44	DABAGA	H	BOWA	V	F	Dn
3100	16SEP86	TOBAGA	0.50	110	DEGE	S	VISITOR	tr.	F	Up
3101	16SEP86	DA	0.50	118	DEGE	U	VISITOR	tr.	F	Up
3102	19SEP86	GUMO	0.50	510	AUTI	S	VISITOR	B	R	Up
3103	19SEP86	AIODIO	1.00	865	AUTI	S	VISITOR	B	R	Up
3104	19SEP86	GUMO	1.00	307	AUTI	S	VISITOR	tr.	F	Up
3105	23SEP86	GUMO	0.50	220	DEGE	S	VISITOR	V	F	Up
3106	23SEP86	SOI	3.50	1417	DEGE	S	VISITOR	V	F	Up
3107	23SEP86	AIODIO	2.50	2907	DEGE	S	VISITOR	V	F	Up
3120	30OCT86	SOIGIA	1.40	662	STRICKLAND	H	VISITOR	B	R	Dn
3121	30OCT86	OWUAHIA	2.20	892	STRICKLAND	H	VISITOR	B	R	Dn
3122	30OCT86	GUMO	1.40	522	STRICKLAND	H	VISITOR	B	R	Dn
3108	26NOV86	TOBAGA	4.67	671	DEGE	S	VISITOR	V	F	Up
3109	28NOV86	AIODIO	2.00	1369	KOTO	S	VISITOR	V	F	Up
3110	28NOV86	TWE	1.33	541	KOTO	S	VISITOR	V	F	Up
3111	28NOV86	TOBAGA	4.67	664	KOTO	S	VISITOR	V	F	Up
3112	28NOV86	BO	0.33	45	KOTO	S	VISITOR	V	F	Up
3113	13APR87	SOI	0.20	250	DEGE	S	VISITOR	V	F	Up
3114	13APR87	KIGI	0.20	19	DOUA	S	VISITOR	V	F	Up
3115	13APR87	TOBAGA	0.40	59	SOMASIO	S	VISITOR	V	F	Up
3116	13APR87	TOBAGA	1.60	169	UNKNOWN	S	VISITOR	V	F	Up
3117	13APR87	TWE	0.20	27	UNKNOWN	S	VISITOR	V	F	Up
3123	04JUN87	GOI	0.33	2145	I	S	VISITOR	V	F	Dn
3118	03SEP87	GUMO	0.50	740	KAMUHAFI	O	VISITOR	tr.	F	Up
3119	03SEP87	TIO	0.50	412	KAMUHAFI	O	VISITOR	tr.	F	Up
3124	03SEP87	GUMO	0.50	740	KAMUHAFI	O	VISITOR	tr.	F	Dn
3125	03SEP87	TIO	0.50	412	KAMUHAFI	O	VISITOR	tr.	F	Dn

Calculations used to discount fish caught before the survey began

At the start of the fishing survey, several residents of Gwaimasi were staying at bush houses away from the village; they were procuring food - particularly fish - for a community feast to be held on September 20, 1986. At least some of the fish they ate while away and that were brought back for the feast, will have been caught before the survey began. But, as with most fish caught while people were based in the bush, these fish could not reliably be assigned to a particular day of capture. For the purpose of analysis, I assume that fishing activity was consistent throughout these initial absences. I included in analyses only the proportion of the catch which, on that assumption, was caught during the survey.

Many of the fish caught by people at the village in the nine days before the feast were smoked and pooled for distribution. Again, it was not possible after the feast to assign individual fish to a particular day of capture and thus identify those caught before the survey began. I have assumed that these fish, too, were the product of consistent fishing activity during the period in question, and have included in analyses only that proportion which, on this basis, were caught during the survey.

Ref. No.	DETAILS
91 617-8 666	fishers GUGWI-SISIGIA caught September 14-17, 1986 - discard 1/4 as caught before September 15, 1986
713 909-10 939	fishers UNKNOWN caught September 12-19, 1986 - discard 3/8 as caught before September 15, 1986
101 432 667-9 716 726 729-36 913 1085-6 1128-9	<u>feast fish</u> fishers UNKNOWN caught September 12-20, 1986 - discard 3/9 as caught before September 15, 1986

APPENDIX 4

Records of successful fishing episodes

(a) Village-based fishing episodes

For the purposes of analysis, a distinct fishing episode has usually been recorded each day that an individual obtained fish using a particular technique (tactics are not distinguished) or from a particular stream system (streams within a system are not distinguished) or when the fisher was known to have returned to the village for several hours between captures. On two occasions, men used more than one technique to secure fish, but the tactics used in locating fish were similar (Simo grabbed a fish by hand once while diving, and Gugwi shot fish with an arrow while moving between diving pools); in these cases, only one episode has been recorded, but the catch secured by the different techniques has been distinguished. On some occasions, definite information regarding technique used was recorded for only some of the fish an individual caught in a day; in these cases, I have distinguished the fish for which technique was unknown, but have not allowed for a distinct fishing episode. Where a technique required cooperative effort I have allowed only one episode, but have identified the different participants.

NO.	Episodes are numbered individually, in roughly chronological order; a few episodes which I decided to distinguish after initial entry into the computer have numbers out of sequence. Episodes for which fisher was unknown were numbered last and are listed at the end.
DATE	Date on which the fishing episode occurred.
RAIN	Weather conditions on the day: Dd = DRY-dry; Dw = DRY-wet; Wd = WET-dry; Ww = WET-wet. (See Section 6.2.2 for definitions of these categories.)
FISHER	Who was credited with the episode: Only residents are identified by name.
STREAM	Where the episode occurred.
TECH	Technique used: H = line; S = spear; O = other; U = unknown.
CATCH	
number	Number of fish caught: Because the catches from some fishing episodes were pooled, and have subsequently been apportioned among participants (see Appendix 3), these values are not necessarily whole numbers.
weight	Weight of fish caught.
CONTEXT	Context in which the episode occurred: V = episodes (of linefishing) near the village, which entailed little travel; D = discretionary episodes away from the village where fishing was the primary reason for going out; E = episodes away from the village where fishing was embedded in other activities.

VILLAGE-BASED FISHING EPISODES

NO.	DATE	RAIN	FISHER	STREAM	TECH	CATCH number	CATCH weight (g)	CONTEXT
1	15SEP86	Dd	SINIO	UNKNOWN	H	1	465	V
2	15SEP86	Dd	HEGOGWA	STRICKLAND	H	1	375	E
4	16SEP86	Dd	MABEI	STRICKLAND	H	0.86	224	V
5	16SEP86	Dd	SINIO	STRICKLAND	H	1	435	V
6	16SEP86	Dd	BISEIO	STRICKLAND	H	0.14	96	V
15	19SEP86	Dd	HEGOGWA	STRICKLAND	H	5	2540	D
902	19SEP86	Dd	HEGOGWA	STRICKLAND	H	1	475	V
16	19SEP86	Dd	FILIFI	STRICKLAND	H	1	217	V
19	22SEP86	Dw	MABEI	UNKNOWN	H	2	906	?
20	22SEP86	Dw	SIMO	STRICKLAND	H	1	575	V
21	23SEP86	Dw	SINIO	DEGE-main	S	6.50	4544	D
22	22SEP86	Dw	VISITOR	DEGE-main	S	7.50	4904	D
23	24SEP86	Dw	DOGO	STRICKLAND	H	2	935	D
24	25SEP86	Dw	MAMO	SIGIA	S	0.33	309	D
					U	0.80	176	
25	25SEP86	Dw	SISIGIA	STRICKLAND	H	1	475	?
26	25SEP86	Dw	DOGO	SIGIA	S	1	910	D
27	25SEP86	Dw	MAUBO	SIGIA	S	0.67	349	D
					U	3.20	432	
530	25SEP86	Dw	VISITOR	STRICKLAND	H	1	450	?
28	29SEP86	Dd	DOGO	STRICKLAND	H	1	140	V
31	01OCT86	Dd	SIMO	STRICKLAND	H	1	490	?
46	02OCT86	Dd	MABEI	UNKNOWN	O	1	16	?
47	03OCT86	Dd	SINIO	STRICKLAND	H	1	385	V
48	03OCT86	Dd	FILIFI	E FTHLLS	S	4	765	D
52	05OCT86	Dd	SINIO	DEGE-main	S	12	9693	D
53	05OCT86	Dd	GOGO	UNKNOWN	O	5	243	?
54	05OCT86	Dd	HEGOGWA	STRICKLAND	H	4	1825	D
55	05OCT86	Dd	HEGOGWA	W OTHER	O	1	27	E
56	05OCT86	Dd	HEGOGWA	E FTHLLS	O	1	39	E
57	05OCT86	Dd	FILIFI	DEGE-main	S	11	9532	D
58	08OCT86	Dd	HEGOGWA	STRICKLAND	H	1	690	?
59	10OCT86	Dd	FILIFI	STRICKLAND	H	1	309	E
60	11OCT86	Dd	HEGOGWA	DEGE-main	S	1	650	E
61	11OCT86	Dd	FILIFI	DEGE-main	S	5	2930	E
62	11OCT86	Dd	MAUBO	DEGE-main	S	1	810	E
63	13OCT86	Dd	GAWUA	STRICKLAND	H	1	205	V
64	14OCT86	Dd	GUGWI	DEGE-north	S	1	78	?
65	14OCT86	Dd	SINIO	DEGE-north	O	1	89	E
66	15OCT86	Dd	SISIGIA	STRICKLAND	H	1	435	?
69	15OCT86	Dd	MAUBO	STRICKLAND	H	2	3675	E
70	15OCT86	Dd	BOWA	STRICKLAND	H	1	1025	E
71	16OCT86	Dd	SISIGIA	STRICKLAND	H	2	2375	V
72	17OCT86	Dd	GAWUA	STRICKLAND	H	1	405	V
74	20OCT86	Dw	SINIO	STRICKLAND	H	1	515	E
76	20OCT86	Dw	WAFU	STRICKLAND	H	1	480	E
77	21OCT86	Dw	KOSE	DEGE-north	H	1	608	E
78	22OCT86	Dw	MAUBO	STRICKLAND	H	1	203	E
79	23OCT86	Dw	BOUA	STRICKLAND	H	1	317	?
80	23OCT86	Dw	SINIO	STRICKLAND	H	3	1510	D
81	23OCT86	Dw	SINIO	DEGE-north	S	1	140	D
82	23OCT86	Dw	MAUBO	STRICKLAND	H	3	910	V
83	24OCT86	Dw	GUGWI	STRICKLAND	H	1	174	E
85	24OCT86	Dw	HEGOGWA	STRICKLAND	H	3	751	D
86	24OCT86	Dw	MAUBO	STRICKLAND	H	4	805	E
88	26OCT86	Dw	SIMO	STRICKLAND	H	1	570	E
89	26OCT86	Dw	HEGOGWA	STRICKLAND	H	2	855	E
90	27OCT86	Dw	SISIGIA	STRICKLAND	H	1	1050	V
91	27OCT86	Dw	HEGOGWA	STRICKLAND	H	2	815	D
92	27OCT86	Dw	DOGO	STRICKLAND	H	3	692	D
93	28OCT86	Dw	GUGWI	STRICKLAND	H	2	1076	E
94	28OCT86	Dw	SISIGIA	STRICKLAND	H	3	2210	E
95	28OCT86	Dw	HEGOGWA	STRICKLAND	H	7	2312	D
96	29OCT86	Dw	MABEI	STRICKLAND	H	1	355	E
97	29OCT86	Dw	MABEI	UNKNOWN	O	1	35	E
98	29OCT86	Dw	GUGWI	STRICKLAND	H	2	582	E
99	29OCT86	Dw	BISEIO	STRICKLAND	H	2	890	E
100	29OCT86	Dw	BISEIO	UNKNOWN	O	1	35	E

VILLAGE-BASED FISHING EPISODES (cont...)

NO.	DATE	RAIN	FISHER	STREAM	TECH	CATCH number	CATCH weight (g)	CONTEXT
101	29OCT86	Dw	SISIGIA	STRICKLAND	H	2	615	E
110	31OCT86	Dw	GWUHO	STRICKLAND	H	1	665	?
117	03NOV86	Dw	VISITOR	STRICKLAND	H	1	920	E
118	03NOV86	Dw	MUGWA	STRICKLAND	H	1	392	E
119	04NOV86	Dw	GOGOI	W OTHER	O	1	38	?
121	05NOV86	Dw	GAWUA	SIGIA	H	1	131	E
124	09NOV86	Dw	GOGOI	STRICKLAND	H	1	390	V
125	10NOV86	Dd	GOGOI	DEGE-north	H	2	279	E
126	10NOV86	Dd	GAWUA	DEGE-north	H	1	62	E
127	10NOV86	Dd	MUGWA	STRICKLAND	H	1	1120	E
129	11NOV86	Dd	GOGOI	STRICKLAND	H	1	1925	V
130	11NOV86	Dd	GOGO	STRICKLAND	H	3	1276	E
132	11NOV86	Dd	DOGO	STRICKLAND	H	1	285	V
134	11NOV86	Dd	MUGWA	STRICKLAND	H	1	219	E
136	12NOV86	Dd	MAUBO	STRICKLAND	H	3	994	E
137	12NOV86	Dd	MUGWA	STRICKLAND	H	1	102	E
138	12NOV86	Dd	BOWA	STRICKLAND	H	5	2002	V
139	13NOV86	Dd	GOGOI	STRICKLAND	H	1	195	V
140	13NOV86	Dd	GOGOI	W OTHER	O	2	63	E
141	13NOV86	Dd	SINIO	E SWAMP	S	8	12305	D
143	13NOV86	Dd	MAUBO	STRICKLAND	H	3	1566	E
145	15NOV86	Dd	GUGWI	STRICKLAND	H	2	1875	E
146	15NOV86	Dd	SISIGIA	STRICKLAND	H	1	860	V
147	15NOV86	Dd	GAWUA	STRICKLAND	H	2	654	E
148	15NOV86	Dd	MAUBO	STRICKLAND	H	1	389	E
149	15NOV86	Dd	MUGWA	STRICKLAND	H	1	591	E
151	16NOV86	Dd	GUGWI	STRICKLAND	H	2	860	V
152	16NOV86	Dd	SIMO HEGOGWA	STRICKLAND	O	1	1370	D
156	18NOV86	Dw	MAMO	STRICKLAND	H	1	295	V
159	18NOV86	Dw	VISITOR	STRICKLAND	H	1	280	V
903	18NOV86	Dw	VISITOR	STRICKLAND	H	1	350	E
160	18NOV86	Dw	VISITOR	E SWAMP	O	1	1450	E
161	18NOV86	Dw	VISITOR	E SWAMP	S	1	120	E
165	19NOV86	Dw	MABEI	STRICKLAND	H	2	440	E
166	19NOV86	Dw	GOGOI	STRICKLAND	H	1	550	E
167	19NOV86	Dw	DOGO	STRICKLAND	H	2	1615	V
168	20NOV86	Dw	GOGO	STRICKLAND	H	1	502	V
169	20NOV86	Dw	DOGO	STRICKLAND	H	3	845	V
170	20NOV86	Dw	GAWUA	STRICKLAND	H	2	1068	E
171	21NOV86	Dw	SISIGIA	STRICKLAND	H	1	190	E
172	21NOV86	Dw	DOGO	STRICKLAND	H	2	300	E
173	21NOV86	Dw	FILIFI	STRICKLAND	H	1	310	E
175	22NOV86	Dw	SIMO	STRICKLAND	H	1	480	V
904	22NOV86	Dw	SIMO	STRICKLAND	H	1	1150	V
176	22NOV86	Dw	SINIO	STRICKLAND	H	4.25	2011	D
177	22NOV86	Dw	SISIGIA	STRICKLAND	H	1	410	V
178	22NOV86	Dw	FILIFI	STRICKLAND	H	0.75	223	V
179	22NOV86	Dw	MAUBO	STRICKLAND	H	1	565	V
180	22NOV86	Dw	WAFU	STRICKLAND	H	1	120	E
181	23NOV86	Dw	SINIO	STRICKLAND	H	1	360	V
182	23NOV86	Dw	MAUBO	STRICKLAND	H	4	2519	V
183	23NOV86	Dw	MUGWA	STRICKLAND	H	1	248	E
184	24NOV86	Dd	SINIO	STRICKLAND	H	1	525	V
185	24NOV86	Dd	VISITOR	SIGIA	S	1	392	E
186	24NOV86	Dd	MAUBO	STRICKLAND	H	2	503	E
187	24NOV86	Dd	WAFU	STRICKLAND	H	1	255	V
188	25NOV86	Dd	SIMO	STRICKLAND	H	1	160	?
189	25NOV86	Dd	SINIO	STRICKLAND	H	1	125	V
190	25NOV86	Dd	MAUBO	STRICKLAND	H	4	2015	E
191	25NOV86	Dd	WAFU	STRICKLAND	H	1	365	V
192	26NOV86	Dd	SINIO	DEGE-main	S	2.33	336	D
193	26NOV86	Dd	VISITOR	DEGE-main	S	2.33	336	D
901	26NOV86	Dd	VISITOR	DEGE-main	S	2.33	336	D
194	26NOV86	Dd	HEGOGWA	STRICKLAND	H	1	340	V
195	26NOV86	Dd	MAUBO	STRICKLAND	H	1	502	E
196	27NOV86	Dd	SIMO	SIGIA	S	2	262	E
197	27NOV86	Dd	GOGOI	STRICKLAND	H	1	215	V

VILLAGE-BASED FISHING EPISODES (cont...)

NO.	DATE	RAIN	FISHER	STREAM	TECH	CATCH number	CATCH weight (g)	CONTEXT
198	27NOV86	Dd	VISITOR	SIGIA	S	2	195	E
199	27NOV86	Dd	MAUBO	STRICKLAND	H	3	3585	E
200	28NOV86	Dd	GUGWI	DEGE-south	S	15.25	4441	D
201	28NOV86	Dd	SINIO	STRICKLAND	H	1	611	V
202	28NOV86	Dd	VISITOR	STRICKLAND	H	4	1702	D
203	28NOV86	Dd	VISITOR	DEGE-south	S	8.33	2619	D
204	28NOV86	Dd	HEGOGWA	DEGE-south	S	1.50	872	D
205	28NOV86	Dd	MAUBO	STRICKLAND	H	1	1197	E
206	29NOV86	Dd	DOGO	STRICKLAND	H	1	510	V
207	29NOV86	Dd	DOGO	SIGIA	S	3	602	D
208	30NOV86	Dd	MAUBO	STRICKLAND	H	1	610	D
209	30NOV86	Dd	GWASE	STRICKLAND	H	4	1590	D
217	05DEC86	Dw	SISIGIA	STRICKLAND	H	1	222	?
219	07DEC86	Dw	HEGOGWA	STRICKLAND	H	1	450	E
220	09DEC86	Dd	SIMO	STRICKLAND	H	1	797	V
221	10DEC86	Dd	GUGWI	STRICKLAND	H	1	385	E
226	14DEC86	Dd	HEGOGWA	STRICKLAND	H	1	358	E
227	14DEC86	Dd	MAUBO	STRICKLAND	H	4	2676	E
228	15DEC86	Dd	SIMO	STRICKLAND	H	1	2794	V
229	16DEC86	Dd	SIMO	STRICKLAND	H	1	480	V
232	17DEC86	Dd	GUGWI	STRICKLAND	H	1	370	V
233	17DEC86	Dd	SIMO	STRICKLAND	H	1	1502	V
234	17DEC86	Dd	GOGOI	STRICKLAND	H	1	85	V
238	18DEC86	Dd	SIMO	STRICKLAND	H	1	2525	V
241	21DEC86	Dd	SIMO	STRICKLAND	H	1	1950	V
244	24DEC86	Dw	GUGWI	STRICKLAND	H	1	250	V
245	24DEC86	Dw	VISITOR	STRICKLAND	H	2	1165	D
246	24DEC86	Dw	VISITOR	STRICKLAND	H	1	355	V
247	24DEC86	Dw	HEGOGWA	STRICKLAND	H	3	1385	D
248	24DEC86	Dw	HEGOGWA	STRICKLAND	H	1	105	V
249	25DEC86	Dw	GUGWI	STRICKLAND	H	1	305	E
250	26DEC86	Dw	GUGWI	DEGE-north	S	6	3435	E
254	26DEC86	Dw	KOSE	STRICKLAND	H	1	189	E
255	27DEC86	Dw	SIMO	STRICKLAND	H	1	1480	V
257	29DEC86	Wd	HEGOGWA	STRICKLAND	H	4	1030	D
258	30DEC86	Wd	FILIFI	SIGIA	S	1	225	E
259	31DEC86	Wd	GUGWI	STRICKLAND	H	1	104	V
260	31DEC86	Wd	GUGWI	DEGE-north	S	4	572	?
261	31DEC86	Wd	GWASE	STRICKLAND	H	1	1700	V
262	01JAN87	Wd	GUGWI	DEGE-north	S	3	279	E
					U	1	2200	
264	01JAN87	Wd	BOUA	E FTHLLS	H	1.77	22	E
266	01JAN87	Wd	BOWA	E FTHLLS	H	7.23	309	E
267	02JAN87	Wd	GUGWI	STRICKLAND	H	1	94	V
269	06JAN87	Ww	VISITOR	STRICKLAND	H	1	395	V
270	10JAN87	Ww	VISITOR	STRICKLAND	H	1	395	V
271	11JAN87	Ww	GUGWI	DEGE-north	S	2	209	?
272	11JAN87	Ww	DOGO	STRICKLAND	H	1	495	V
273	11JAN87	Ww	DOGO FILIFI	STRICKLAND	O	1	464	D
274	12JAN87	Ww	MAUBO	STRICKLAND	H	1	2173	E
278	17JAN87	Ww	KOSE	STRICKLAND	H	2	1992	D
280	18JAN87	Ww	VISITOR	STRICKLAND	H	1	154	V
283	23JAN87	Ww	GOGOI	STRICKLAND	H	1	298	E
284	23JAN87	Ww	MUGWA	STRICKLAND	H	1	510	E
285	23JAN87	Ww	BOWA	STRICKLAND	H	1	425	E
286	24JAN87	Ww	SISIGIA	STRICKLAND	H	1	506	E
287	25JAN87	Ww	SISIGIA	STRICKLAND	H	1	505	V
289	25JAN87	Ww	KOSE	STRICKLAND	H	1	1450	?
290	26JAN87	Ww	MUGWA	STRICKLAND	H	1	162	E
291	29JAN87	Ww	MUGWA	STRICKLAND	H	1	1150	D
292	31JAN87	Ww	MABEI	STRICKLAND	H	1	490	V
296	03FEB87	Wd	KOSE	STRICKLAND	H	1	460	E
905	03FEB87	Wd	KOSE	STRICKLAND	H	1	1010	E
297	15FEB87	Ww	GOGOI	STRICKLAND	H	1	300	V
299	19FEB87	Ww	GUGWI	STRICKLAND	H	1	91	V
300	19FEB87	Ww	MAUBO	STRICKLAND	H	1	745	?
301	20FEB87	Ww	MABEI	STRICKLAND	H	1	240	V

VILLAGE-BASED FISHING EPISODES (cont...)

NO.	DATE	RAIN	FISHER	STREAM	TECH	CATCH number	CATCH weight (g)	CONTEXT
302	20FEB87	Ww	TUFA	STRICKLAND	H	1	1150	E
303	20FEB87	Ww	GAWUA	STRICKLAND	H	1	22D	E
304	20FEB87	Ww	MAUBO	STRICKLAND	H	2	1711	E
305	22FEB87	Ww	BOWA	DEGE-north	H	2	72	D
310	03MAR87	Wd	BOUA	DEGE-main	H	1	171	E
312	06MAR87	Wd	MABEI	STRICKLAND	H	1	1175	E
314	12MAR87	Ww	BISEIO	STRICKLAND	H	1	340	V
315	13MAR87	Ww	SIMO	STRICKLAND	H	1	308	E
316	13MAR87	Ww	GOGOI	STRICKLAND	H	1	65	V
317	14MAR87	Ww	MABEI	STRICKLAND	H	1	255	V
318	14MAR87	Ww	SISIGIA	STRICKLAND	H	1	480	V
319	14MAR87	Ww	GWASE	DEGE-north	S	1	600	D
320	15MAR87	Ww	SIMO	STRICKLAND	H	1	462	V
321	15MAR87	Ww	GOGOI	STRICKLAND	H	2	1410	V
323	15MAR87	Ww	GOGO	E FTHLLS	H	31	1285	D
324	15MAR87	Ww	DOGO	STRICKLAND	H	6	2670	D
326	16MAR87	Ww	GWUHO	STRICKLAND	H	1	215	E
327	20MAR87	Ww	GWUHO	STRICKLAND	H	1	610	E
328	21MAR87	Ww	SIMO	DEGE-north	S	2	229	E
330	25MAR87	Ww	GWASE	STRICKLAND	H	1	433	E
331	27MAR87	Ww	SISIGIA	STRICKLAND	H	1	920	E
332	01APR87	Ww	GUGWI	DEGE-north	S	2	3444	?
333	01APR87	Ww	SIMO	DEGE-north	S	2	304	E
336	06APR87	Ww	MABEI	UNKNOWN	O	2	72	E
337	06APR87	Ww	BISEIO	DEGE-north	S	3	724	?
338	07APR87	Ww	MABEI	STRICKLAND	H	1	735	E
339	13APR87	Wd	SIMO	DEGE-mix	S	2.73	261	D
340	13APR87	Wd	GOGOI	STRICKLAND	H	1	620	V
341	13APR87	Wd	BISEIO	DEGE-mix	S	3.51	524	D
343	13APR87	Wd	VISITOR	DEGE-mix	S	2.60	524	D
344	13APR87	Wd	TUFA	DEGE-mix	S	1.04	314	D
345	13APR87	Wd	MAUBO	DEGE-mix	S	3.12	996	D
346	20APR87	Wd	GUGWI	DEGE-north	O	4	2336	?
					S	1	70	
					U	0.59	28	
347	20APR87	Wd	SISIGIA	DEGE-north	U	D.41	7	?
349	21APR87	Wd	BISEIO	E SWAMP	S	2	1376	D
350	21APR87	Wd	TUFA	E SWAMP	S	2	541	D
353	24APR87	Wd	GOGOI	STRICKLAND	H	2	484	V
355	25APR87	Wd	GUGWI	STRICKLAND	H	1	770	E
356	25APR87	Wd	SIMO	STRICKLAND	H	1	206	E
9D6	25APR87	Wd	SIMO	STRICKLAND	H	1	427	V
357	25APR87	Wd	SISIGIA	STRICKLAND	H	1	415	E
359	25APR87	Wd	GWASE	STRICKLAND	H	1	440	E
360	27APR87	Wd	GOGOI	STRICKLAND	H	1	119	V
362	30APR87	Wd	VISITOR	STRICKLAND	H	1	5D5	E
363	01MAY87	Wd	MABEI	STRICKLAND	H	1	231	E
364	01MAY87	Wd	GUGWI	STRICKLAND	O	1	1250	E
367	02MAY87	Wd	MABEI	STRICKLAND	H	1	381	E
368	02MAY87	Wd	SIMO	E FTHLLS	O	1	30	E
369	03MAY87	Wd	MABEI	STRICKLAND	H	1	455	E
370	04MAY87	Ww	MABEI	STRICKLAND	H	1	162	E
371	07MAY87	Ww	GOGOI	STRICKLAND	H	1	43D	V
372	10MAY87	Ww	GUGWI	DEGE-north	S	1	97	E
373	10MAY87	Ww	SIMO	DEGE-north	S	1	110	E
374	11MAY87	Wd	GUGWI	DEGE-north	S	4	832	D
375	11MAY87	Wd	GUGWI	DEGE-main	O	2	2214	D
			SISIGIA					
381	18MAY87	Wd	GUGWI	STRICKLAND	H	1	290	V
383	21MAY87	Wd	BISEIO	DEGE-main	S	6	752	D
384	23MAY87	Wd	VISITOR	DEGE-main	S	3	464	E
385	24MAY87	Wd	VISITOR	DEGE-south	S	2	190	E
386	25MAY87	Wd	VISITOR	SIGIA	S	3	200	D
387	27MAY87	Wd	SIMO	STRICKLAND	H	1	160	E
388	29MAY87	Wd	SIMO	STRICKLAND	H	1	3068	V
389	29MAY87	Wd	SISIGIA	W OTHER	H	2	87	E
391	30MAY87	Wd	VISITOR	DEGE-mn/nth	S	3	1315	E
392	31MAY87	Wd	VISITOR	STRICKLAND	H	1	325	V

VILLAGE-BASED FISHING EPISODES (cont...)

NO.	DATE	RAIN	FISHER	STREAM	TECH	CATCH number	CATCH weight (g)	CONTEXT
403	02JUN87	Ww	SIMO	STRICKLAND	H	1	438	V
407	03JUN87	Ww	SISIGIA	STRICKLAND	H	1	342	E
408	04JUN87	Ww	GUGWI	E FTHLLS	O	1	6499	E
			BISEIO					
			FILIFI					
			VISITOR					
			VISITOR					
409	04JUN87	Ww	VISITOR	E FTHLLS	S	1	174	E
410	06JUN87	Ww	VISITOR	STRICKLAND	H	1	200	D
413	07JUN87	Ww	VISITOR	STRICKLAND	H	1	350	?
414	08JUN87	Wd	GUGWI	DEGE-north	S	1	264	E
415	10JUN87	Wd	SISIGIA	STRICKLAND	H	1	281	V
416	11JUN87	Wd	SINIO	STRICKLAND	H	1	556	V
418	23JUN87	Wd	SIMO	STRICKLAND	H	1	362	V
419	23JUN87	Wd	GOGOI	STRICKLAND	H	2	677	V
420	24JUN87	Wd	GUGWI	DEGE-north	S	2	176	?
422	29JUN87	Dw	SISIGIA	STRICKLAND	H	2	460	E
423	30JUN87	Dw	GUGWI	DEGE-main	S	3	297	?
437	01JUL87	Dw	GWASE	STRICKLAND	H	2	2690	D
438	01JUL87	Dw	GWASE	E FTHLLS	S	1	123	D
443	05JUL87	Dw	BOWA	STRICKLAND	H	2	1170	E
444	06JUL87	Dd	YASOBIDUA	STRICKLAND	H	1	250	V
446	08JUL87	Dd	BOWA	STRICKLAND	H	1	210	E
447	10JUL87	Dd	GWASE	DEGE-main	S	5	1061	E
449	13JUL87	Dd	SIMO	DEGE-main	O	1	575	E
					S	1	630	
450	15JUL87	Dd	GUGWI	DEGE-north	S	2	4050	E
453	16JUL87	Dd	GWASE	DEGE-north	S	1	118	E
455	19JUL87	Dd	MAMO	SIGIA	S	1	725	E
456	19JUL87	Dd	VISITOR	STRICKLAND	H	4	2072	D
457	19JUL87	Dd	TUFA	STRICKLAND	H	4	1455	D
458	19JUL87	Dd	DOGO	STRICKLAND	H	1	210	E
459	19JUL87	Dd	MAUBO	DEGE-main	S	3	1880	E
460	20JUL87	Dd	GUGWI	E FTHLLS	S	4	353	E
461	20JUL87	Dd	SINIO	DEGE-main	S	12	11740	D
462	20JUL87	Dd	VISITOR	DEGE-main	S	2	160	E
463	20JUL87	Dd	VISITOR	DEGE-main	S	2	142	E
464	20JUL87	Dd	DOGO	DEGE-main	S	4	785	E
465	20JUL87	Dd	GAWUA	STRICKLAND	H	1	410	?
466	23JUL87	Dd	MAUBO	STRICKLAND	H	1	86	?
475	01AUG87	Dw	SINIO	STRICKLAND	H	1	360	E
482	02AUG87	Dw	BISEIO	E FTHLLS	O	3	100	E
483	07AUG87	Wd	GOGOI	STRICKLAND	H	1	1040	E
484	07AUG87	Wd	SINIO	STRICKLAND	H	1	477	E
907	07AUG87	Wd	SINIO	STRICKLAND	H	1	420	
485	08AUG87	Wd	VISITOR	DEGE-main	S	2	328	E
486	09AUG87	Wd	SISIGIA	E FTHLLS	H	5	159	?
488	22AUG87	Wd	DOGO	STRICKLAND	H	2	770	D
489	25AUG87	Wd	SINIO	DEGE-south	S	1	3554	E
490	27AUG87	Wd	TUFA	STRICKLAND	H	1	150	?
491	28AUG87	Wd	TUFA	STRICKLAND	H	1	380	E
493	31AUG87	Wd	SIMO	STRICKLAND	O	1	1387	D
499	03SEP87	Wd	SINIO	DEGE-main	S	2	3280	D
503	03SEP87	Wd	GWASE	DEGE-main	S	3	3290	D
504	06SEP87	Wd	VISITOR	DEGE-main	O	1	28	E
505	07SEP87	Ww	VISITOR	STRICKLAND	O	1	295	D
507	08SEP87	Ww	BOWA	STRICKLAND	H	1	285	E
508	11SEP87	Ww	GOGOI	DEGE-north	H	2	108	E
510	15SEP87	Ww	WAFU	DEGE-north	H	1	25	E
511	28SEP87	Dw	GWASE	DEGE-main	S	1	550	D
512	29SEP87	Dw	GWASE	STRICKLAND	H	3	953	E
513	30SEP87	Dw	GOGOI	W OTHER	O	1	29	?
514	30SEP87	Dw	BOWA	STRICKLAND	H	1	362	E
516	04OCT87	Dw	GWASE	STRICKLAND	H	8	2425	D
517	04OCT87	Dw	BOWA	STRICKLAND	H	2	570	?
518	04OCT87	Dw	YASOBIDUA	E FTHLLS	H	1	27	D
519	11OCT87	Dd	TUFA	DEGE-main	S	3	1795	E
520	11OCT87	Dd	DOGO	DEGE-north	S	4	1810	D

VILLAGE-BASED FISHING EPISODES (cont...)

NO.	DATE	RAIN	FISHER	STREAM	TECH	CATCH number	CATCH weight (g)	CONTEXT
524	14OCT87	Dw	GUGWI	W OTHER	O	1	10	E
539	16SEP86	Dd	UNKNOWN	STRICKLAND	H	2	750	V
540	16SEP86	Dd	UNKNOWN	UNKNOWN	U	1	522	?
541	16SEP86	Dd	UNKNOWN	UNKNOWN	U	1	131	?
542	18SEP86	Dd	UNKNOWN	UNKNOWN	U	1	375	V
543	18SEP86	Dd	UNKNOWN	UNKNOWN	U	1	394	?
544	19SEP86	Dd	UNKNOWN	DEGE-main	S	1	484	?
545	19SEP86	Dd	UNKNOWN	UNKNOWN	U	1	364	?
546	20SEP86	Dd	UNKNOWN	DEGE-north	O	1	120	?
547	20SEP86	Dd	UNKNOWN	UNKNOWN	U	15.4	22159	?
548	21SEP86	Dd	UNKNOWN	STRICKLAND	H	1	935	?
555	23SEP86	Dw	UNKNOWN	DEGE-main	S	1	2095	?

(b) Bush-based fishing episodes

Fish caught while people were based at bush houses could not reliably be assigned to a particular day of capture. In all but a few cases I have assumed that all fish caught during an absence were the product of a single episode. The exceptions were cases where details of location or technique, or the state of fish and skulls, allowed definition of separate episodes. In the following table, I have not distinguished episodes from which fish were brought back to the village.

Most variables in the following table are the same as those listed for village-based fishing. A few differences must be noted, however.

DATE — The day(s) on which the fishing episode occurred: In most cases, a range of dates is given, indicating the duration of the absence during which the fish were caught.

RAIN — Because absences often overlapped weeks, I have not specified the weather conditions at the time of the episodes; consecutive weeks often differed in pattern of rainfall.

CONTEXT — Context, in these cases, refers to the reason for absence from the village, and not specifically to fishing:
D = discretionary fishing episodes, where fishing (or, rather, procurement of meat) was the primary reason for staying in the bush;
E = episodes where fishing occurred while people were staying in the bush for some other reason.

BUSH-BASED FISHING EPISODES

NO.	DATE	FISHER	STREAM	TECH	CATCH number	CATCH weight (g)	CONTEXT
3	15-16SEP86	FILIFI	DEGE-main	S	2	608	D
528	15-16SEP86	VISITOR	DEGE-main	S	4	549	D
7	16SEP86	VISITOR	DEGE-main	S	0.50	110	D
				U	0.50	118	
8	16SEP86	FILIFI	DEGE-main	S	1.50	463	D
				U	0.50	118	
10	15-17SEP86	GUGWI	STRICKLAND	H	0.49	1519	E
				U	0.44	123	
12	15-17SEP86	SISIGIA	STRICKLAND	H	1.75	2277	E
				U	0.31	32	
9	17SEP86	GUGWI	STRICKLAND	U	0.59	494	E
11	17SEP86	SISIGIA	STRICKLAND	U	0.41	131	E
			UNKNOWN	S	1	1153	
14	17-19SEP86	VISITOR	E SWAMP	S	2.50	1682	D
17	17-19SEP86	FILIFI	E SWAMP	S	2.50	1682	D
18	17-19SEP86	FILIFI	UNKNOWN	U	1	600	D
13	18-19SEP86	SINIO	DEGE-main	S	2	1663	?
29	28-30SEP86	VISITOR	STRICKLAND	H	3	6858	E
30	28-30SEP86	WODAI	STRICKLAND	H	5	8330	E
32	27SEP-02OCT86	MAMO	SIGIA	S	3	3269	E
36	27SEP-02OCT86	MAUBO	SIGIA	S	6	989	E
33	03-05OCT86	VISITOR	DEGE-main	S	3	330	E
49	04-05OCT86	GUGWI	DEGE-south	S	12	5610	D
50	04-05OCT86	DOGO	DEGE-main	S	6	1363	D
51	04-05OCT86	GUGWI	DEGE-south	S	7	5560	D
67	15OCT86	VISITOR	STRICKLAND	H	1	515	E
68	15OCT86	VISITOR	STRICKLAND	H	3	3325	E

BUSH-BASED FISHING EPISODES (cont...)

NO.	DATE	FISHER	STREAM	TECH	CATCH number	CATCH weight (g)	CONTEXT
73	18-19OCT86	SINIO	DEGE-main	S	4	1196	E
43	08-20OCT86	GWASE	STRICKLAND	H	2	2005	E
44	08-20OCT86	GWASE	SIGIA	S	1	151	E
45	08-20OCT86	GWASE	W OTHER	S	1	3327	E
532	08-20OCT86	VISITOR	STRICKLAND	H	3	736	E
533	08-20OCT86	VISITOR	W OTHER	S	2	279	E
75	20OCT86	VISITOR	STRICKLAND	H	2	1585	E
536	20OCT86	VISITOR	STRICKLAND	H	1	781	E
534	08-22OCT86	VISITOR	UNKNOWN	U	7	3379	E
34	18-22OCT86	WODAI	STRICKLAND	H	1	3259	E
84	24OCT86	VISITOR	SIGIA	S	1	845	E
87	26-27OCT86	GUGWI	DEGE-main	S	3	556	E
38	08-30OCT86	GWUHO	STRICKLAND	H	3	2161	E
39	08-30OCT86	GWUHO	STRICKLAND	U	2	1516	E
40	08-30OCT86	GWUHO	DEGE-main	S	3	1532	E
41	08-30OCT86	GWUHO	W OTHER	O	1	74	E
105	08-30OCT86	VISITOR	STRICKLAND	H	5	2076	E
107	08-30OCT86	GWUHO	STRICKLAND	H	2	831	E
531	08-30OCT86	VISITOR	STRICKLAND	H	5	7483	E
			UNKNOWN	U	15	14142	
35	22-30OCT86	WODAI	STRICKLAND	H	3	2667	E
37	26-30OCT86	MAUBO	SIGIA	S	4	1265	E
42	26-30OCT86	MUGWA	STRICKLAND	H	1	454	E
102	26-30OCT86	MAUBO	STRICKLAND	H	2	282	E
106	26-30OCT86	MAUBO	STRICKLAND	H	1	154	E
535	26-30OCT86	VISITOR	UNKNOWN	U	1	46	E
537	26-30OCT86	VISITOR	SIGIA	S	1	1033	E
104	30OCT86	VISITOR	STRICKLAND	H	2	1190	E
527	30OCT86	VISITOR	STRICKLAND	H	3	727	E
103	30-31OCT86	SISIGIA	STRICKLAND	H	2	781	E
108	30-31OCT86	SISIGIA	STRICKLAND	H	1	826	E
109	31OCT86	VISITOR	UNKNOWN	O	1	35	E
				U	4	265	
115	01-03NOV86	GUGWI	STRICKLAND	H	2	876	E
116	01-03NOV86	SISIGIA	STRICKLAND	H	3	899	E
120	01-05NOV86	BOUA	DEGE-main	H	7	325	E
123	04-09NOV86	GUGWI	STRICKLAND	H	3	1532	E
122	08-09NOV86	HEGOGWA	E SWAMP	S	3	2934	D
128	11NOV86	GUGWI	STRICKLAND	H	1	1422	E
131	11NOV86	SISIGIA	E FTHLLS	H	7	224	E
133	11NOV86	FILIFI	DEGE-main	S	3	1065	E
111	05-12NOV86	SIMO	E FTHLLS	S	4	455	E
114	05-12NOV86	VISITOR	E FTHLLS	O	3	4937	E
135	05-12NOV86	VISITOR	E FTHLLS	S	1	361	E
144	11-13NOV86	FILIFI	DEGE-main	S	2	590	E
142	13NOV86	FILIFI	DEGE-main	S	4	3555	E
150	13-15NOV86	BOWA	STRICKLAND	H	5	2620	E
153	15-17NOV86	SINIO	STRICKLAND	H	1	682	E
154	15-17NOV86	SINIO	DEGE-main	S	1	873	E
155	18NOV86	GUGWI	STRICKLAND	H	2	905	E
157	15-18NOV86	BISEIO	DEGE-main	S	1	1065	E
112	17-18NOV86	GOGOI	UNKNOWN	O	4	197	E
113	17-18NOV86	SISIGIA	E FTHLLS	H	15	603	E
162	17-18NOV86	HEGOGWA	STRICKLAND	H	6	2677	E
163	17-18NOV86	DOGO	STRICKLAND	H	4	821	E
164	17-18NOV86	MAUBO	STRICKLAND	H	1	519	E
158	18NOV86	SISIGIA	STRICKLAND	H	1	392	E
174	21-22NOV86	GWUHO	UNKNOWN	S	1	802	E
210	01-05DEC86	GUGWI	DEGE-main	S	6	6032	E
212	01-05DEC86	GOGOI	W OTHER	H	3	153	E
214	01-05DEC86	SIMO	SIGIA	S	1	197	E
215	01-05DEC86	HEGOGWA	STRICKLAND	H	1	1271	?
216	01-05DEC86	GOGOI	STRICKLAND	H	1	1413	?
218	01-05DEC86	FILIFI	E SWAMP	S	5	2756	?
222	08-11DEC86	BOUA	DEGE-north	H	7	371	E
223	13DEC86	GUGWI	E SWAMP	U	1	6500	E
224	09-13DEC86	SINIO	DEGE-main	S	1	2420	E
225	13-14DEC86	SIMO	DEGE-main	S	1	825	E

BUSH-BASED FISHING EPISODES (cont...)

NO.	DATE	FISHER	STREAM	TECH	CATCH number	CATCH weight (g)	CONTEXT
230	08-16DEC86	DOGO	STRICKLAND	H	8	3757	E
231	08-16DEC86	MAUBO	STRICKLAND	H	1	686	E
236	08-16DEC86	GAWUA	STRICKLAND	H	1	133	E
237	08-16DEC86	GWASE	STRICKLAND	H	4	1423	E
211	14-17DEC86	GUGWI	E SWAMP	S	5	415	E
232	14-17DEC86	GUGWI	STRICKLAND	H	0.66	288	E
235	14-17DEC86	SISIGIA	STRICKLAND	H	2.34	432	E
239	18-19DEC86	MAUBO	STRICKLAND	H	3	1386	E
240	19DEC86	MAUBO	STRICKLAND	H	1	400	E
213	13-21DEC86	BOUA	DEGE-north	H	13	1515	E
242	20-21DEC86	DOGO	DEGE-main	S	3	793	E
243	13-21DEC86	MUGWA	DEGE-main	H	5	220	E
251	26-27DEC86	MAMO	STRICKLAND	H	2	741	E
252	26-27DEC86	DOGO	STRICKLAND	H	2	998	E
253	26-27DEC86	DOGO	W OTHER	S	1	990	E
256	29DEC86	GUGWI	SIGIA	S	2	1023	E
263	30DEC-01JAN87	SIMO	E SWAMP	H	1	526	E
265	01JAN87	HEGOGWA	STRICKLAND	H	1	425	E
268	01-02JAN87	VISITOR	UNKNOWN	U	1	624	E
276	13-15JAN87	BOUA	STRICKLAND	H	3	1225	?
275	13-16JAN87	GUGWI	STRICKLAND	H	1	500	?
277	13-16JAN87	SISIGIA	STRICKLAND	H	3	1150	?
538	13-16JAN87	VISITOR	STRICKLAND	H	1	228	?
281	13-18JAN87	DOGO	STRICKLAND	H	1	1437	E
282	13-18JAN87	DOGO	DEGE-main	S	1	726	E
279	17-18JAN87	MAMO	DEGE-south	H	2	2938	E
288	24-25JAN87	MAUBO	DEGE-main	S	1	272	E
293	01-03FEB87	SISIGIA	STRICKLAND	H	3	1360	E
294	03FEB87	GUGWI	STRICKLAND	H	1	401	E
295	03FEB87	SISIGIA	E FTHLLS	H	17	725	E
298	14-15FEB87	BISEIO	STRICKLAND	H	1	1612	E
311	04-05MAR87	FILIFI	DEGE-main	S	3	2742	E
306	04-06MAR87	GUGWI	DEGE-main	S	2	210	E
313	06MAR87	GUGWI	DEGE-main	S	1	1350	E
309	09-15MAR87	GWUHO	STRICKLAND	H	4.24	3856	E
325	09-15MAR87	MAUBO	STRICKLAND	H	3.76	1967	E
322	14-15MAR87	BISEIO	DEGE-main	S	1	511	E
307	14-17MAR87	GUGWI	DEGE-main	S	2	152	E
329	21MAR87	VISITOR	UNKNOWN	U	1	75	E
308	18-23MAR87	GUGWI	DEGE-main	S	2	200	E
335	31MAR-01APR87	MAUBO	SIGIA	S	2	240	E
342	13APR87	SISIGIA	E FTHLLS	H	19	849	E
348	20APR87	GWASE	DEGE-main	S	2	405	E
358	14-22APR87	FILIFI	E FTHLLS	S	1	375	E
334	21-22APR87	SISIGIA	E FTHLLS	H	4	142	E
351	22APR87	SIMO	E FTHLLS	S	8	324	E
352	24APR87	SIMO	SIGIA	S	2	316	E
354	24APR87	MAMO	SIGIA	S	1	120	E
361	29-30APR87	BISEIO	DEGE-north	S	1	356	E
365	06APR-10MAY87	BOUA	SIGIA	H	4	160	E
366	29APR-10MAY87	MAMO	SIGIA	S	4	632	E
376	12-15MAY87	SINIO	DEGE-main	S	1	1197	?
377	12-15MAY87	BISEIO	DEGE-main	S	1	864	?
379	12-15MAY87	BISEIO	DEGE-main	S	1	129	?
378	12-15MAY87	MAMO	SIGIA	S	3	1459	?
380	12-15MAY87	GOGO	E FTHLLS	H	9	375	?
382	21MAY87	SIMO	STRICKLAND	H	1	306	E
				O	1	350	
390	30-31MAY87	BISEIO	DEGE-main	S	4	539	E
402	31MAY-02JUN87	MABEI	DEGE-south	H	8	1077	E
				U	2.80	514	
404	31MAY-02JUN87	BISEIO	DEGE-south	S	10	1603	E
				U	4.2	875	
405	02JUN87	FILIFI	E SWAMP	S	4	695	E
406	31MAY-02JUN87	YASIMO	DEGE-south	H	1	48	E
411	6JUN87	MAUBO	SIGIA	S	1	4022	?
412	7JUN87	GOGOI	STRICKLAND	H	1	495	E
400	13-15JUN87	MAUBO	SIGIA	S	1	268	E

BUSH-BASED FISHING EPISODES (cont...)

NO.	DATE	FISHER	STREAM	TECH	CATCH number	CATCH weight (g)	CONTEXT
417	19-20JUN87	GUGWI	DEGE-main	S	3	299	E
393	23-25JUN87	MABEI	E SWAMP	H	1	37	E
395	23-25JUN87	VISITOR	STRICKLAND	H	2	447	E
394	23-26JUN87	SINIO	E SWAMP	S	3	950	E
401	23-26JUN87	WAFU	UNKNOWN	H	1	262	E
421	28JUN87	GWASE	SIGIA	S	1	50	E
398	26-30JUN87	VISITOR	E SWAMP	H	5	284	E
396	27-30JUN87	VISITOR	STRICKLAND	H	1	400	E
397	27-30JUN87	VISITOR	E SWAMP	S	1	3011	E
399	27-30JUN87	FILIFI	E SWAMP	S	3	924	E
440	3JUL87	GOGO	E FTHLLS	H	4	177	E
441	3JUL87	MAUBO	DEGE-south	S	4	709	E
442	04-06JUL87	GUGWI	DEGE-main	S	3	579	?
427	04-08JUL87	GOGOI	STRICKLAND	H	4	1903	E
431	04-08JUL87	BISEIO	E SWAMP	S	4	653	E
433	04-08JUL87	VISITOR	E FTHLLS	H	1	27	E
445	07-08JUL87	GWASE	SIGIA	H	7	469	E
430	10-11JUL87	SINIO	E SWAMP	S	2	1224	E
448	10-11JUL87	SINIO	E SWAMP	S	5	5148	E
425	07-12JUL87	GUGWI	DEGE-main	S	10	4914	E
434	13-16JUL87	DOGO	DEGE-main	S	2	1933	E
436	13-16JUL87	MAUBO	DEGE-main	S	4	527	E
428	14-16JUL87	GOGOI	STRICKLAND	H	3	1626	E
451	16JUL87	DOGO	DEGE-main	S	1	310	E
452	16JUL87	MAUBO	DEGE-main	S	3	725	E
426	17-18JUL87	SIMO	STRICKLAND	H	1	2750	E
454	18JUL87	VISITOR	STRICKLAND	H	2	1160	E
429	18-24JUL87	GOGOI	STRICKLAND	H	3	3554	E
467	24JUL87	GUGWI	DEGE-main	S	6	3022	?
435	26-27JUL87	MAUBO	DEGE-south	S	1	3221	?
439	24-28JUL87	GWASE	UNKNOWN	U	1	120	E
424	27-28JUL87	GUGWI	STRICKLAND	H	1	1290	?
432	27-28JUL87	SISIGIA	STRICKLAND	H	1	1122	?
468	28JUL87	FILIFI	E SWAMP	S	2	817	E
469	28-29JUL87	FILIFI	E SWAMP	S	2	2315	E
470	30JUL87	VISITOR	STRICKLAND	H	1	1300	E
471	30JUL87	VISITOR	STRICKLAND	H	1	1250	E
476	05-07AUG87	SISIGIA	DEGE-main	H	3	295	E
472	06-08AUG87	MABEI	E FTHLLS	H	3	66	E
477	09-10AUG87	VISITOR	DEGE-south	S	3	1032	E
479	11-13AUG87	MAUBO	DEGE-south	S	1	1116	E
487	14AUG87	MAUBO	DEGE-main	S	1	1689	E
480	11-15AUG87	GWASE	DEGE-main	S	4	1236	E
478	22-23AUG87	FILIFI	E SWAMP	S	1	755	E
481	24-28AUG87	GWASE	DEGE-main	S	4	1201	E
474	24-29AUG87	SIMO	STRICKLAND	H	5	1693	E
473	24-30AUG87	GUGWI	DEGE-main	S	5	2365	E
492	24-30AUG87	GUGWI	DEGE-main	S	2	714	E
494	31AUG87	DOGO	SIGIA	O	1	25	E
				U	1	25	
496	31AUG-03SEP87	GUGWI	DEGE-main	S	1	222	E
498	31AUG-03SEP87	GUGWI	DEGE-main	S	3	5119	E
500	31AUG-03SEP87	GUGWI/SISIGIA	DEGE-main	O	4	3920	E
501	03SEP87	VISITOR	STRICKLAND	O	2	2304	E
502	03SEP87	VISITOR	E SWAMP	S	2	3550	E
506	08-09SEP87	DOGO	SIGIA	S	4	860	E
495	07-10SEP87	GUGWI	DEGE-main	S	3	1980	E
509	10-11SEP87	DOGO	DEGE-south	H	1	988	E
497	16-19SEP87	DOGO	DEGE-main	S	2	1611	E
521	11OCT87	FILIFI	E SWAMP	S	3	1626	D
522	12OCT87	MAMO	DEGE-north	S	1	3115	?
523	13OCT87	MAUBO	DEGE-north	O	20	11888	D
525	16OCT87	DOGO	DEGE-south	S	3	1212	D
526	17OCT87	GUGWI	DEGE-south	S	1	2400	D
515	17-18OCT87	MAMO	SIGIA	S	1	4126	?
544	12-19SEP86	UNKNOWN	DEGE-main	S	1.86	1500	?
			UNKNOWN	U	0.62	194	
550	27SEP-03OCT86	UNKNOWN	UNKNOWN	U	1	694	?

BUSH-BASED FISHING EPISODES (cont...)

NO.	DATE	FISHER	STREAM	TECH	CATCH number	CATCH weight (g)	CONTEXT
549	30OCT86	UNKNOWN	UNKNOWN	U	3	96	?
551	01-05DEC86	UNKNOWN	STRICKLAND	H	3	1387	?
552	21-23DEC86	UNKNOWN	STRICKLAND	H	1	228	?
553	20-24JUN87	UNKNOWN	UNKNOWN	U	1	120	?
554	05-12AUG87	UNKNOWN	UNKNOWN	U	1	128	?

APPENDIX 5

Records of days available to surveyed residents for village-based fishing, and of the fish procured by those residents in different weather conditions

Detailed records of individual fishing behaviour were available for ten male and ten female long-term residents of Gwaimasi. This appendix summarizes data used in standardizing the effect of weather conditions on the production of fish by those surveyed residents. It details for each individual (a) the days available for village-based fishing in each of the four weather conditions defined in Section 6.2.2, (b) the number of successful village-based fishing episodes and the amount of fish procured in the different conditions, and (c) the catch rate (measured as weight obtained per 100 days) achieved in the different conditions.

(a) Number of days available for village-based fishing in different weather conditions - that is, days on which fishing would have entailed leaving from, and returning to the village. This number excludes days on which people returned to the village from being based elsewhere within or beyond the local subsistence zone, and is thus less than the total number of nights which people spent at the village.

	DAYS BASED AT VILLAGE			
	DRY-dry	DRY-wet	WET-dry	WET-wet
Sample days	84	77	126	112
GUGWI	56	32	72	60
SIMO	35	33	56	63
BISEIŌ	31	39	79	88
MAMO	20	29	29	36
GWASE	31	29	65	82
FILIFI	43	30	56	40
SINIO	39	35	73	39
MAUBO	49	34	68	64
DOGO	43	36	28	45
GAWUA	41	40	58	75
GOGO	31	34	69	82
KOSE	40	38	48	53
SISIGIA	56	38	78	62
MABEI	30	37	90	97
GOGOI	44	58	94	98
WAFU	46	39	73	38
BOWA	46	56	53	66
YASOBIDUA	16	19	60	74
BOUA	42	38	50	60
YASIMO	30	37	88	92

(b) The number of successful village-based fishing episodes and the amount of fish procured in the different conditions.

	CATCH FROM VILLAGE-BASED FISHING											
	DRY-dry			DRY-wet			WET-dry			WET-wet		
	eps	n	g	eps	n	g	eps	n	g	eps	n	g
GUGWI	8	28.2	12412	8	17	6129	12	26.6	10372	5	6.3	6116
SIMO	11	12.5	850	4	5	4255	7	9.7	5901	6	8	1851
BISEIÕ	1	0.1	96	3	6	1055	3	11.5	2652	3	4.1	1454
MAMO	1	1	725	2	2.1	780	-	-	-	-	-	-
GWASE	3	10	2769	5	15	6741	3	5	5430	2	2	1033
FILIFI	5	22	53	2	1.7	533	1	1	225	2	0.7	1922
SINIO	11	41.3	709	7	17.7	9440	4	6	8287	-	-	-
MAUBO	14	30	2048	6	16.9	5783	1	3.1	996	3	4	4629
DOGO	7	15	4342	6	13	5297	1	2	770	3	7.5	3397
GAWUA	5	6	1736	2	3	1199	-	-	-	1	1	220
TOTAL	66	166.2	105880	45	97.5	41182	32	64.9	34633	25	33.7	20622
GOGO	2	8	1519	1	1	502	-	-	-	1	31	1285
KOSE	-	-	-	2	2	797	1	2	1470	2	3	3442
SISIGIA	3	4	3670	8	12	5632	6	10.4	2056	5	5	2753
MABEI	2	1.9	240	4	6	1736	4	4	2242	6	7	1954
GOGOI	6	8	2762	4	4	1007	5	7	2940	6	8	2611
WAFU	2	2	620	2	2	600	-	-	-	1	1	25
BOWA	3	7	3237	3	5	2102	1	7.2	309	3	4	782
YASOBIDUA	1	1	250	1	1	27	-	-	-	-	-	-
BOUA	-	-	-	1	1	317	2	2.8	193	-	-	-
YASIMO	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	19	31.9	12298	26	34	12720	19	33.4	9210	24	59	12852

(c) Catch rate (measured as grams of fish obtained per 100 days) achieved for village-based fishing in the different conditions.

	CATCH per 100 days			
	DRY-dry	DRY-wet	WET-dry	WET-wet
GUGWI	22164	19183	14406	10212
SIMO	36714	12876	10537	2942
BISEIÕ	310	2622	3347	1649
MAMO	3625	2695	-	-
GWASE	8933	23287	8360	1264
FILIFI	31927	1779	402	4805
SINIO	93958	26971	11378	-
MAUBO	41708	16973	1462	7233
DOGO	10080	14722	2750	7552
GAWUA	4237	3005	-	293
GOGO	4901	1473	-	1572
KOSE	-	2101	3068	6484
SISIGIA	6554	14848	2643	4449
MABEI	800	4689	2491	2006
GOGOI	6280	1739	3127	2658
WAFU	1351	1535	-	66
BOWA	7052	3767	584	1187
YASOBIDUA	1562	142	-	-
BOUA	-	836	386	-
YASIMO	-	-	-	-

APPENDIX 6

Records of consumer-days and fisher-days for residents based at Gwaimasi in each week of the survey

A record was kept of all residents and visitors staying at the village on each night during the survey. Records for 16 of the 399 nights were unreliable, and have been discarded. This appendix summarizes the data for residents only.

WEEK starting	Data have been summarized by week: Weeks are identified both by number and by date of the first day in the week; weeks were taken as starting on the Monday.
RAIN	Weather conditions in the specified week: Dd = DRY-dry; Dw = DRY-wet; Wd = WET-dry; Ww = WET-wet. (See Section 6.2.2 for definitions of these categories.)
SURVEY DAYS	The number of nights in the week for which reliable residency data are available.
PERSON-DAYS	The sum of nights that individual residents spent at the village in the specified week.
CONSUMER-DAYS	
C-days	Person-days adjusted for the status of individual residents as consumers: Unweaned infants were not counted, one 2-4 year old child (Okire) was taken as equivalent to 0.5 of an adult consumer, one 6-8 year old child (Yasimo) was taken as 0.7 of an adult consumer and two 9-11 year olds (Boua and Gawua) were each taken as 0.8 of an adult consumer.
C/s-day	Consumers per survey day: the average number of adult-equivalent consumers present at the village each day in the specified week.
FISHER-DAYS	Person-days adjusted for the status of individuals as fishers: Children below the age of five were not considered capable of fishing, and have been excluded from these counts. Separate counts are provided for males and females.

RESIDENCY DATA

WEEK	starting	RAIN	SURVEY DAYS	PERSON-DAYS	CONSUMER-DAYS C-days	C/s-day	FISHER-DAYS males	females	Σ
1	SEP 15 '86	Dd	7	117	102.6	14.66	46	57	103
2	22	Dw	6	125	112.4	18.73	60	53	113
3	29	Dd	7	120	109.4	15.63	61	48	109
4	OCT 6	Dd	7	87	85.4	12.20	44	43	87
5	13	Dd	7	87	84.2	12.03	53	34	87
6	20	Dw	7	113	104.8	14.97	60	47	107
7	27	Dw	7	131	116.2	16.60	62	55	117
8	NOV 3	Dw	7	111	98.2	14.03	58	41	99
9	10	Dd	7	109	99.8	14.26	58	44	102
10	17	Dw	7	123	112.4	16.06	56	58	114
11	24	Dd	7	140	126.6	18.09	71	57	128
12	DEC 1	Dw	3	36	32.2	10.73	16	17	33
13	8	Dd	7	47	41.6	5.94	25	17	42
14	15	Dd	7	72	62.6	8.94	46	17	63
15	22	Dw	7	130	115.0	16.43	55	61	116
16	29	Wd	7	136	121.4	17.34	59	63	122
17	JAN 5 '87	Ww	7	133	118.0	16.86	63	56	119
18	12	Ww	4	75	66.2	16.55	36	31	67
19	19	Ww	7	106	90.8	12.97	31	61	92
20	26	Ww	7	124	109.4	15.63	54	57	111
21	FEB 2	Wd	7	129	113.6	16.23	56	59	115
22	9	Ww	7	112	98.2	14.03	48	52	100
23	16	Ww	7	121	105.8	15.11	53	54	107
24	23	Wd	4	84	71.2	17.80	34	38	72
25	MAR 2	Wd	7	143	122.0	17.43	62	61	123
26	9	Ww	7	110	92.5	13.21	50	42	92
27	16	Ww	7	117	104.0	14.86	53	50	103
28	23	Ww	7	113	99.2	14.17	54	45	99
29	30	Ww	7	118	103.6	14.80	56	48	104
30	APR 6	Ww	7	99	85.6	12.23	49	36	85
31	13	Wd	7	55	49.2	7.03	23	25	48
32	20	Wd	7	80	69.7	9.96	38	30	68
33	27	Wd	7	97	77.8	11.11	43	34	77
34	MAY 4	Ww	7	133	112.0	16.00	65	47	112
35	11	Wd	4	89	76.2	19.05	37	40	77
36	18	Wd	7	110	88.8	12.69	40	49	89
37	25	Wd	7	102	81.8	11.69	32	51	83
38	JUN 1	Ww	7	121	102.0	14.57	49	54	103
39	8	Wd	7	88	67.8	9.69	25	42	67
40	15	Ww	7	119	90.0	12.86	39	51	90
41	22	Wd	7	43	34.0	4.86	14	20	34
42	29	Dw	7	61	55.0	7.86	27	29	56
43	JUL 6	Dd	7	85	69.6	9.94	37	33	70
44	13	Dd	7	72	66.6	9.51	37	31	68
45	20	Dd	7	108	93.6	13.37	48	47	95
46	27	Dw	5	87	67.0	13.40	32	35	67
47	AUG 3	Wd	7	112	87.6	12.51	50	38	88
48	10	Wd	7	116	88.6	12.66	44	44	88
49	17	Wd	7	155	127.0	18.14	58	70	128
50	24	Wd	7	91	75.8	10.83	43	33	76
51	31	Wd	7	109	102.6	14.66	61	41	102
52	SEP 7	Ww	7	123	99.9	14.27	47	53	100
53	14	Ww	7	125	98.8	14.11	40	59	99
54	21	Wd	7	147	121.0	17.29	57	65	122
55	28	Dw	7	49	41.8	5.97	18	24	42
56	OCT 5	Dd	7	120	97.0	13.86	46	51	97
57	12	Dw	7	149	121.8	17.40	52	71	123

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