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PATTERNS OF RESOURCE UTILIZATION.

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THE ST. LAWRENCE ISLANDERS OF NORTHWEST CAPE:
PATTERNS OF RESOURCE UTILIZATION

A

DISSERTATION

Presented to the Faculty of the
University of Alaska in Partial Fulfillment
of the Requirements
for the Degree of
DOCTOR OF PHILOSOPHY

by

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Fairbanks, Alaska
May 1974

THE ST. LAWRENCE ISLANDERS OF NORTHWEST CAPE:

PATTERNS OF RESOURCE UTILIZATION

RECOMMENDED:

Chairman, Advisory Committee

APPROVED:

Director, Institute of Arctic Biology

7/19/73
Date

Vice President for Research

7/20/73
Date

Dedication: To my Alaskan Masters and Colleagues

ABSTRACT

The purpose of this study is to assess the role of local food resources in the function of a small Alaskan community at the Northwest Cape of St. Lawrence Island. Historical aspects and demographic characteristics of a resident population of 310 (1972) indicate that a formerly large and dispersed pre-contact Island population nearly perished during a period (1878-1903) of famine and disease. After immigration from the nearby Siberian coast and a period of rapid growth, the population appears to be leveling at about 350 persons, due largely to an emigration rate which matches the net rate of increase of about 2% per year (1958-1972). Prominent attributes of the NW Cape habitat are directionally distinct wind-temperature patterns, unstable sea ice influenced by coastal tide currents and a simple coastline from which migratory food species are harvested at an annual rate (1971-1972) of about 1100 seals, 240 walrus, 2 whales and 6,000 birds, and at an annual net cost of $40,000 or about 10% of annual community income. A daily intake of 180 gm protein per person is estimated from this harvest excluding losses during storage and preparation (seals, 73 gm; walrus, 80 gm; whales, 16 gm; other species, 11 gm). The flow of potential energy through the community is calculated in kilocalories and three different methods of graphic display are used to describe the interaction and control of local supplies, purchased supplies and human work. The ratio of gross annual caloric inputs of local foods, purchased foods and fuels is 2.3:10:340, with an estimated per capita income of 15×10^6 kCal

and $1,300. The calculated annual NRC dietary caloric allowance accounts for no more than 20% of annual food calorie input.

ACKNOWLEDGEMENTS

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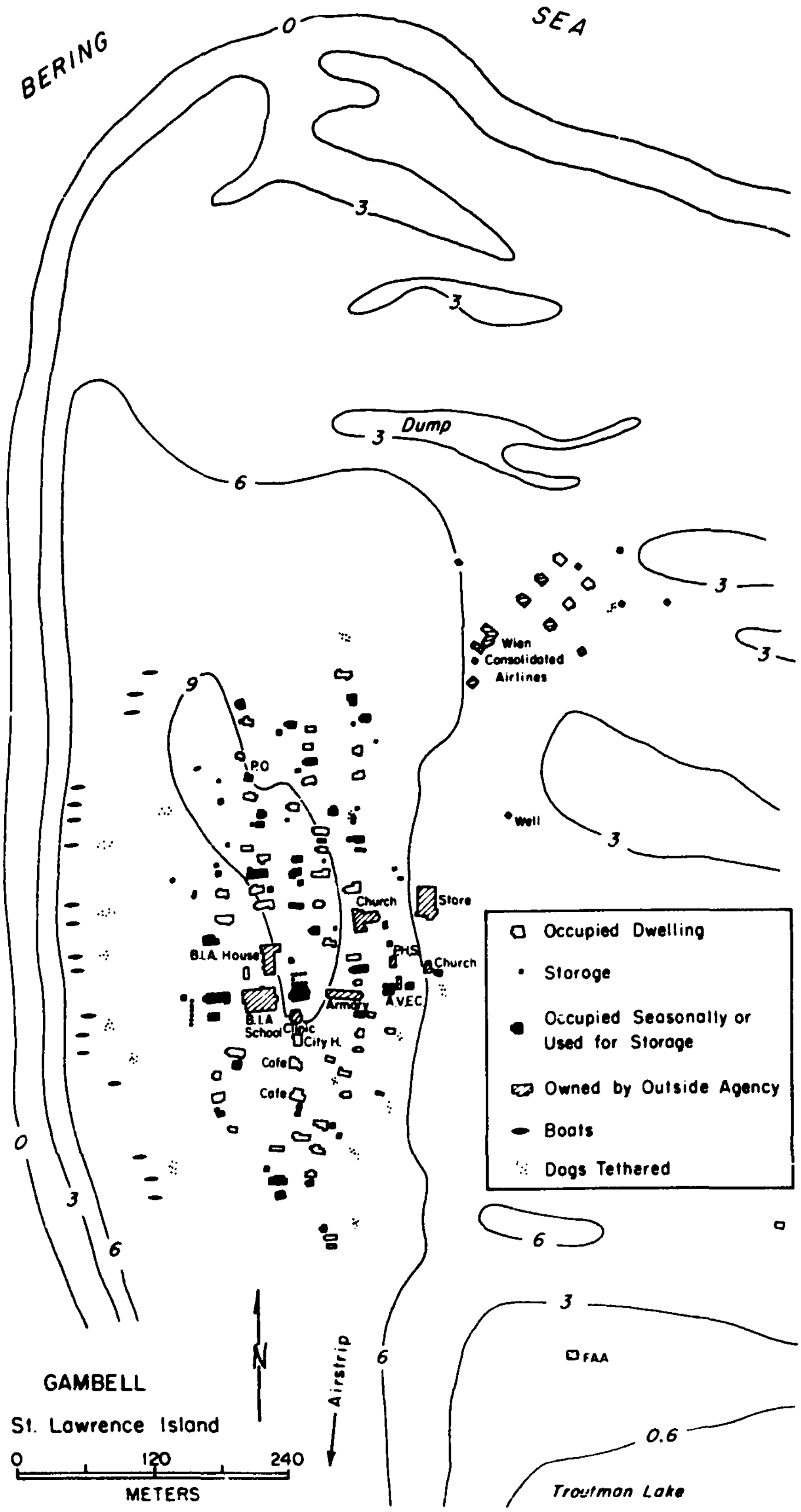
This map of the community of Gambell is taken with modifications from the "Utilities Master Plan" of the U.S. Public Health Service, surveyed January of 1972 by Harman and Isberg, Engineering Services, Anchorage, Alaska.


BERING SEA
Dump
Wien Consolidated Airlines
P.O
Well
Church
Store
B.I.A. House
P.H.S.
Church
B.I.A. School
Armory
A.V.E.C.
Clinic
City H.
Cafe
Cafe
Occupied Dwelling
Storage
Occupied Seasonally or Used for Storage
Owned by Outside Agency
Boats
Dogs Tethered
FAA
Airstrip
N
GAMBELL
St. Lawrence Island
0 120 240
METERS
0.6
Troutman Lake

INTRODUCTION AND METHODS

The purpose of this study is to assess the role of local food resources in the function of a small Siberian Eskimo community at the Northwest Cape of St. Lawrence Island, Alaska. This introduction discusses aspects of the literature particularly relevant to this study and to its general methodology. Chapter I discusses the history and current demography of the Island and Northwest Cape populations. Chapter II presents a brief areal description of the prominent physical and biological features of the Island and especially the Cape habitat. Chapter III discusses the use made of this habitat by the population of the Cape: production techniques, hunt takes and economy. Chapter IV derives patterns prominent in the use of local resources, integrating the information presented above under the assumption that the community is the focal point of a system comprised of interacting components, whose function may be understood in terms of energy flow. The conclusion of this study evaluates general characteristics of the community, the likely effects of changes and disruptions in its patterns, and the utility of the analysis.

Field research centered at the NW Cape of the Island was conducted the summer of 1970 (June through August) and the fall, winter and spring of 1971-1972 (September through May). The use of particular field techniques adopted for specific purposes are discussed in sections devoted to them. A very considerable amount of time was spent in the company of hunters. Interviewing was used only in the initial field period at which time a census, a capital goods inventory and an inventory of stored local food were accomplished for the NW Cape. An extended walking trip was taken during the month of August around the periphery of the western portion of the Island, with the exception of portions of the north coast. During the winter field period, data were collected on climate and ice conditions, the economic institutions of the community, the presence and abundance of food species, hunting practices and hunting success, local foods preparation and storage, and a few interviews were conducted on historical aspects of the settlement of the western Island. In view of the diminishing per capita supply of animal protein in many areas of the world (Cole, 1966 in Ehrlich and Ehrlich, 1970 p 86) and the present national concern for the fate of the principle food species of this community (U.S. House of Representatives, 92nd Congress, Public Law, 92-522), this study addresses -- and intends to address -- timely concerns.

Yet, this study does not address a particular problem. It is a test of a descriptive method. Two facts relating to the use of local resources have, however, served to narrow its scope: marine mammals comprise the most important sources of local foods, and these foods are harvested by the men of the community. The roles of other food species and foods obtained from off-Island sources are therefore lightly treated, as are the roles of the women and children in the function of the community. An effort has been made to build on the work of Fay (1958) and Hughes (1960) who have studied aspects of resource utilization for this community, and the work of Mann et al. (1958), Burns (1962-1973) and

Heller and Scott (1967) who provide background information for the Bering Sea region. Important to the point of view of this study is the proposition that the further the information concerning a human community is reduced and averaged and the further the diverse ways of using local resources are generalized, the further the study is taken from an understanding of the operation of the community. The information presented in the first three chapters is therefore reduced as little as possible. Reductions presented in Chapter IV evolve from the overall method of the study and may be judged by their utility.

In reviewing the work done on populations of the American North, two generations emerge from the literature: baseline ethnographies typified by those of Nelson (1899), Hrdlicka (1930), Lantis (1946), Birket-Smith (1959), Spencer (1959), Ray (1964) and, for St. Lawrence Island, Doty (1900), Moore (1923) and Hughes (1953), and studies more regionally or topically oriented, Rainey (1947), Ray (1961), Giddings (1961), Foote (1961), Van Stone (1962), Oswalt (1963), Gubser (1965), Nelson (1969) and for St. Lawrence Island, Fay (1958), Hughes (1960) and Murphy (1960). Rather than review a large collection of studies (Oswalt, 1965) with often quite different orientations, it appears more useful to review a single line of work. Reasons for chosing the work of Don C. Foote and his associates are five-fold: their studies spanned the American and Canadian North, it was the longest and most closely organized line of work dealing with the native populations of the North conceived as human ecological, it was interrupted in an untimely fashion (Baird, 1969 obituary p 168), a quantitative approach was attempted from the beginning and finally this work has had considerable influence on the course of this study. A review of published and unpublished* writings from 1958 to 1969 is therefore presented.

Detailed studies of the ecological problems arising from the relation of the native Alaskan to his environment were nonexistent even a decade ago (Lantis, 1955 p 195). Foote and his associates attempted a beginning. A list of theses, reports, articles, unpublished papers, research proposals and papers in preparation is included in the bibliography. Two aspects of these studies have proven especially useful here: the types of data collected and various field methods appropriate for its collection, and methods used for its reduction. An apparent danger in reviewing work in progress is that the direction indicated in unfinished studies may differ from realized results. These differences are often keys to the development of new questions and new approaches, especially for work which attempts to be quantitative. Many issues raised therein remain, therefore, conjectural. Major field studies were carried out in five geographic areas: Northern Norway (Hammerfest, Tromsø: fall 1953, summers 1954 and 1957; summer 1964), Northwestern Coastal Alaska (Pt. Hope, Noatak: 1959-1961, 1964, 1967), Northwestern Central Alaska (Kobuk, Shungnak, Ambler: summer 1965), the east coast of Baffin Island (Clyde Sound to Cumberland Sound: summer 1966), and the Central Canadian Arctic (Igloolik region: spring 1968). Extensive and detailed base line surveys were produced for the Pt. Hope, Kobuk

*All unpublished writings and works in progress are held by the University Archives and Manuscript Collection, of the Rasmusen Library of the University of Alaska.

and Baffin Island regions. Plans for the integration of these studies were formulated, but never carried out (Foote and Chance, 1969). Stepping back a moment to Foote's doctoral dissertation (Foote, 1965a), a rationale may be found for the choice of data collected in these base line studies. The dissertation addresses two questions: the extent and nature of geographical exploration in Northwestern Arctic Alaska before 1855 and the extent and nature of resource utilization by the Tigeraqmiut, Naupaktomiut and Noatagmiut populations before 1855 (ibid p xx-xxiv). Addressing the first question, the contributions of some 40 European exploration parties (Foote, 1964c p 2) and some 30 whaling and trading vessels (Foote, 1964a p 16) are documented from primary sources, some for the first time. Addressing the second question a theoretical harvest of animals and plants by the three populations mentioned is constructed by determining their composition and distribution, probable caloric needs and the caloric value of some 25 food species harvested. His study makes a considerable contribution to the question of the biological effects of early northern populations on their food species. Comparing the types of data collected in the base line studies, Pt. Hope may be taken as a best example. The following types of quantified data were collected: historical background of the Tigaraqmiut (size and seasonal distribution of the pre-European contact population) and current demography, standard meterological and ice observations, the biology of food species (age, sex, weight, component weights, distribution), the subsistence base of the community (capital goods, wage income, harvest figures, costs) and its seasonal activities (seal hunts, caribou hunts, whale hunts, bird hunts) (Foote, 1968b p 6). Often represented in these studies, then, are the differences in resource utilization over time, in a particular area, expressed in quantative terms within a fully developed historical context. The direction taken in the types of data collected in later studies is indicated in both the study of the Upper Kobuk River area (Foote, 1966a), especially that portion of the study dealing with the energy budgets of the Shungnak fishermen (Foote and Greer-Wootten, 1966a), and the Baffin Island studies (Foote, 1967d). In the former, the following types of data were collected: total time of fishing trips, number of miles traveled, number of minutes outboard motors were used, number of nets set, number of hours since the nets were last checked, number and weights of fish caught by species, river flow speed and level, water temperatures, value of household and hunting goods, number and types of heating stoves and others (Foote and Greer-Wootten, 1966a p 47-49); and in the latter: wind speed, wave heights, spotting range and seal shooting success (Foote, 1967d p 110-116). These examples indicate that quantifying data on more and more specialized aspects of particular kinds of hunts was becoming an important objective of this work. The rationale is summarized in several writings by statements such as the following:

> The primary purpose of the research is to identify, in quantitative terms, functional relationships between physical, biological and social-cultural subsystems. One technique employed is the development of energy flow models to describe hunting behavior in time and space (Foote, 1968b p i).

This inclusion of physical, biological and social-cultural data is ambitious, but the objectives of the research are also ambitious. The conceptual relation between these subsystems is presented in most detail, of the studies seen, by Prozesky (1969 p 9), a former member of the Environmental Systems Group at McGill University. In this proposed study of a caribou hunting system, the physical subsystem is comprised of terrain, vegetation and weather, whose attributes control the movements and work accomplished by the human population, and the spatial and temporal distribution of the caribou and their predators. The biological subsystem is comprised of the caribou and their predators. The social-cultural subsystem is comprised of man and his technology. A population balance is achieved between the biological and social-cultural subsystems. Energy flows from the physical to the biological subsystem in the form of food, and to the social-cultural from the biological subsystem in the form of food and materials. From the social-cultural subsystem energy flows to the physical subsystem in the form of expenditures to maintain survival. It appears, especially with reference to component models first presented in the Kobuk River study and later in the Baffin Island study, that these subsystems are not systems by the definition developed by Foote's authorities (Hall and Fagan, 1956 p 61) (Miller, 1965 p 193), but rather general categories of data types, or what is referred to as the "field" by Cottrell (1955 p 9):

> ...the range within which what is being observed retains its identity and affects an instrument in a manner significant to the observer.

Subsystems as they appear in the literature are either empirically derived from studies of trophic relations, important sources of energy, important material cycles, or are arbitrarily defined on an areal basis (Odum, H. T., 1971 p 58-82).

The study of energy flow has produced powerful techniques for the assessment of the role of energy sources, productivity, food chain efficiency and other basic parameters of biological systems.

> The interaction of energy and material in the ecosystem is of primary concern to ecologists. In fact, it may be said that the one-way flow of energy and the circulation of materials are the two great principles or "laws" of general ecology, since these principles apply equally to all environments and all organisms including man (Odum, E. P., 1963 p 38, emphasis author's).

Foote does not usually discuss the interaction of energy and materials in the physical and biological subsystems which support utilized food species but only within the human system under study. Often the direction is to assess the hunt take in terms of nutrient value or energy (kilocalories) and in like fashion the effort necessary to secure the nutrient (Foote, 1968b p 23). This is the energy budget approach (Juday, 1940). Foote and Greer-Wootten point out (1966a p 7-8) that the first attempt (Shungnak fishermen) to construct systems models of Eskimo hunting behavior suggests two results: there is a need for more accurate measurement of the physical environment, and sufficient functional relationships are identified to stimulate computer simulation studies. These studies progress in two directions: the seal hunting behavior of the Eskimo, and computer mapping. The Shungnak study may then be reviewed as the most thorough attempt seen to reduce and integrate the data collected to terms of energy flow.

In this study (ibid p 34-52) the authors define catch per unit effort (CPUE) as the fish caught (number, weight or nutrient value) divided by the number of nets set multiplied by the time in hours since the nets were last checked (see also McLaren, 1958 p 25, 44 for CPUE on a slightly different basis: number ringed seals/hunter/day/seal population of area/ water area within 10 miles of shoreline). He found that CPUE differed significantly from net site to net site for all fish species when the sites were classified on the basis of river speed (ibid p 37). Mean CPUE could also be differentiated according to net location on the feeder streams or the main river. Tests for the null hypothesis were made for both these relationships and rejection achieved at the .05 level of significance.

> Essentially we have made a test at an ecotone... If the fish respond in the postulated manner to inputs from the physical subsystem, and if the hunter's perception of the changes in river level are reflected in changes in net sites to locations with a higher probability of a catch so that net sites returns are differentiated, then an inference may be made that the theoretical model has withstood this first attempt at valid testing (ibid p 38).

The theoretical model referred to is far too complex to reproduce here. It was of course not possible to trace component interactions throughout the system as a whole, only that river speed influences where the fish are found which influences where the fishermen set their nets. Any familiarity with river net fishing for anadromous fishes indicates that the analysis has progressed no further than common sense. Perhaps the quantification of common sense is one of the purposes of resource utilization assessment. The application of the null hypothesis does not tell us that the relationship we have observed exists, but only that it is very unlikely that it does not exist, which is not the same thing. A final note on the methodology of this study indicates the very intentional combination of a cluster of physical scientific data which might interest a biological ecologist and the behavioral scientific data which might interest a decision theorist.

> Future field research should be undertaken as an interdisciplinary team effort with particular studies in hydrology, a detailed consideration of each net site, and the changing chemical composition of fish with time. The analysis of data should, in the second generation of model building, take into consideration a set of new parameters, especially those dealing with human motivation and environmental perception (ibid p 42).

On a basic methodological level, there is redundancy in the inclusion of behavioral elements in energy flow models. "Human needs" are included as subsystem components (social-cultural) on an equal basis with biological and environmental components (ibid p 24) (Foote, 1967d p 3). The hope of studies of energy flow in human groups has been from the beginning to discuss and perhaps understand human behavior in terms of the flow of energy surrounding it. In a word, "...energy available limits what man can do and influences what he will do" (Cottrell, 1955 p 2, emphasis author's). The Prozesky paper discusses hunting activities as operating within physical constraints of distance, terrain and effective hunting range. If decision making patterns are significantly influenced by the energetics of the hunt itself, then the inclusion of decision components is unnecessary. A clarification of this very fundamental point appears imminent as the work progresses. As is apparent in following sections and chapters, this study of the population of the Northwest Cape of St. Lawrence Island owes much to the unique body of work Foote and his associates developed.

In addition to the orientation offered by the work just reviewed, another line of development of concepts relating to the flow of energy in living systems with a slightly wider focus applies to this study. It in fact appears that there are two aspects discernable in this literature: one, a rather more coherent series of efforts to apply energy flow descriptions to the analysis of ecosystems into functional and structural components, and two, rather more isolated efforts at applying the concept of energy flow to the study of human societies. In only one instance seen have these two lines converged: the work of Howard T. Odum (1971).

The first series is reviewed by E. P. Odum (1968). He traces the chronological development of the idea of looking at nature as an energy flow system in 10 major steps and cites outstanding examples of their implementation: the qualitative description of food webs (Forbes, 1887), trophic levels and ecological pyramids (Elton, 1927), the application of thermodynamic principles (Lotka, 1925), energy budgets and the concept of primary production (Juday, 1940), trophic-dynamic concepts and energy flow by trophic levels (Lindeman, 1942), energy-flow diagrams and community metabolism (Odum, H. T., 1956, 1957; Odum, E. P., 1963; Teal, 1957), secondary production and energy flow in populations (Pearson, 1954; Phillipson, 1962), energetics of laboratory populations (Beeyers, 1963; Cooke, 1967), the energetics of ecological succession (Odum, H. T. and Pinkerton, 1955; Margalef, 1963), and systems ecology (Watt, 1966). This list is repeated here since some agreement is shown with other authors and since several of these efforts are fundamental to the point of view of this paper. There is no difficulty in constructing several specialized displays of this system which are appropriate to it but are perhaps not comparable to analyses of other systems. If biological concepts apply to the description of energy flow in a human community, then biological techniques should also apply to its analysis and display. Considerable confusion (see eg. Bennett, 1969 p 23) in the applicability of biological concepts has plagued the literature discussed below from the beginning. Its gradual resolution is a happy event, largely dependent on the willingness of biologists to turn their applications to the human community and resolve differences. An excellent example is Bennet's (ibid) confusion about the applicability of the ecosystem concept to the human community, nicely resolved by H. T. Odum's discussion (1971 p 58-59) of rates of internal circulation and boundary fluxes of energy and matter.

The work of the so-called Chicago School of Sociology, best typified by that of Hollingshead (1940), appears to have died at the hand of Milla Alihan (1958). Undoubtedly the wholesale adoption of concepts like natural area, succession and competition to describe urban areas led to blind alleys, not because such applications are wrong but because the level of comparison, the species, led to a minimization rather than an incorporation of man's major differences from other animals and because the assumption that cultural phenomena and biological phenomena were governed by the same principles led to absurd conclusions. Dice (1955) has clearly shown that the human community may be described in very much the same terms as a biological community (compare Dice, 1954) so long as an areal or perhaps biogeographical approach (Udvardy, 1969) is preserved. The areal approach has been much applied in the Canadian North (Foote, 1967) and has proven very useful. Perhaps the grandfather of these studies is that of Darling (1955) which began in 1943 and set a very high standard indeed. The problem of the relation of culture to the function of human communities when considered in the light of ecological concepts has been clarified by the discipline concerned with its study, anthropology, and especially by Julian Steward (1955). His discussions clarifying the relation of production techniques and environmental features, behavior patterns and general elements of the population such as its demography, settlement and land use patterns and kinship structure (Steward, 1955 p 40-42) have been extremely helpful to this study. There is no question of the incorporation of this approach in the literature of anthropology (eg. Vayda, 1969) and archeology (eg. McGhee, 1969-70).

From this review two studies emerge as detailed, coherent and extensive efforts at describing human groups in terms of energy flow systems: Cottrell (1955) and H. T. Odum (1971). One a sociologist and one a biologist, their approaches are surprisingly similar. Odum's component or merological approach to the analysis of energy flow patterns separates functionally similar elements (Odum, H. T., 1971 p 38-39, 310-317), which are rigorously defined, yet of general application. His first attempt at a general notation, if adopted, would render more accessible and more comparable many studies found in the literature. One great clarification of this notation is that a myriad of components need no longer be displayed. His suggestions are therefore adopted in the component analyses of Chapter IV. From Cottrell certain propositions are extracted which serve to organize appropriate discussions.

The importance of the mass-heat unit, the gram-calorie, in energy flow studies is obvious and perhaps derives from statements such as Phillipson's (1966):

> Heat is a very special form of energy... It evolves when all other forms of energy are transformed, and work is done. All work, including growth and reproduction of living organisms, represents the transformation of energy and ultimately involves heat production (ibid p 2).
>
> ...the total amount of heat produced or absorbed in a chemical reaction carried out in stages is equal to the total amound of heat evolved or consumed when the reaction occurs directly (ibid p 4).

That "all forms of energy can be converted completely to heat, but not to any other form" (ibid p 5) places the gram-calorie (or kilogram-calorie or the ton-calorie) in the respected position of the basic unit used for energy flow studies. Its various applications in this study require that the role of essential dietary components be ignored (minerals, vitamins, and etc.) and that the very considerable problem of dollar-calorie conversions be considered. Yet, many interesting features of the system are revealed by these conversions and the existence of a single common unit, in fact, allows the analysis.

The general methodology and the unit chosen for this study rest defined but the object of the study, the hunter, does not. The several attempts in the anthropological literature (Lee and Devore, 1969) are, at best, general. Here, with Plato, we define the hunter by what he does, not what he is. "The Stranger" teases Theatetus into the essential definition of a sophist by leading him to an essential definition of an angler:

Does the angler deal in art, or some other source of power?

Art.

Is it an aquisitive or a creative art?

Aquisitive.

Does he acquire by gift or conquest?

Conquest.

Is the force exerted in conquest open or secret?

Secret.

It this secretive conquest for living prey or lifeless prey?

Living.

Does this prey live on land or in the water?

In the water.

Does it fly or swim?

It swims.

Is it taken by net or by blow?

By blow.

Is it taken at night by spearing or by day by barbing?

By day.

Is the prey barbed from above or from below?

From below.

The last alternative is not a real one as all spearing done by day is also done from above. The inevitable and essential definition of an angler is achieved. Only a small modification of Plato's definition is required for our purposes:

> Is the blow laid to the head or to the body?
>
> To the head. The spearman or harpooner lays the blow to the body.
>
> Is one blow struck or many?
>
> One blow is struck.

Many blows must usually be struck by the harpooner, leaving only one alternative and the essential definition of the hunter:

> A man who, by the power of aquisitive art and by the use of secretive force of conquest, kills his living prey which swims in the water by a single blow to the head.

The hunter of the Northwest Cape of St. Lawrence Island is many things in addition to a hunter of seals and walrus, for which this definition holds. As a hunter of whales, he is a harpooner. He is also an angler and a net-man. He is also a member of a cash economy and works therefore for money. This diversity adds depth and resilience to his resource utilization system. The frontispiece map displays every element of this system of particularly human origin.

CHAPTER I

A DESCRIPTION OF THE POPULATION OF ST. LAWRENCE ISLAND FROM 1850 TO 1972

1. Introduction

The discussion of the history and current demography of the Island population which follows assembles information from early exploration, archeological investigations and various enumerations of the population during the period 1830 to 1972. In all cases the focus of the discussion is the population of Northwest Cape. This review was done after the field research period and it began in rather a desultory fashion. Intended to add to the relevant historical and demographic information already collected in standard published works by Geist and Rainey (1936), Rainey (1941), Collins (1937), Hughes (1960), and Ackerman (1961), the original impression that there was little to add (Oswalt, 1967 p xii) has since proven mistaken. Had this review not been attempted the radical effects on the population of contact with Americans during the 19th-century would have been underestimated, the present distribution of the population would have been more strongly attributed to the convenience of administrative and service institutions, the limitations of certain production techniques would not have been understood and the rate of growth of the population today would have appeared very much out of context.

Assembling scattered and often quite haphazard observations of inhabitants of lands charted by early explorers and travelers is bound to require guesswork. Seldom is an author of the accounts surveyed here interested in the few strange people met between long and dangerous voyages, their numbers, conditions and extent of habitation. Discovery was of primary interest, and almost to a man, the inhabitants were considered abject improvident savages. The opposite of this position is held by the several archeologists whose works also contribute to this review. Assembling this information is necessary, however, since for this study there is a need to establish: (1) some notion of the size and distribution of the Island population in its 'natural state' and (2) if these characteristics of the present population are very different, why. The concept of a 'natural state' (also called 'pre-European contact') may be stated specifically: the size and distribution of the population may be understood as reflecting primarily the distribution and accessibility of food species; the social system abets more than it deters the adjustment of the population to its food resources; the relations of such a population with its neighbors do not impose critical limitations on its place and size; the population has achieved a measure of stability in place and size and is not subject to wild oscillation. Steward frames the concept in almost the same terms. His "culture type" is defined on the basis of prominent resource exploitation patterns. The composite hunting band designates many unrelated families integrated to form settlements on the basis of association and cooperation in the exploitation of limited and scattered migratory food resources. It shows political autonomy, control of its hunting territory and family ownership of specific land areas (Steward, 1955 p 123-124, 143-144). The point that is important here is that larger-than-family aggregates permanently settled and cooperatively exploited bounded land areas. The needs and choices of the human population have (and do) undoubtedly determine the acceptability of the physical environment of the Island. Their welfare and fate is the best measure of its suitability for human habitation. That settlement has continued at its NW Cape from Okvik times (Johnson, 1951 p 15 dated 2300 BP) is overwhelming justification for a description of this habitat (see Chapter II). Its population patterns provide one direct means of assessment.

It is also understood that the present population has achieved a new 'natural state' (now 'post-European contact') which may be described in precisely the same terms. It may be validly argued, of course, that present relations of the population with its neighbors do impose critical limitations, but the stability of size and place has returned. A statement and, possibly, an evaluation of the magnitude and direction of change of size and distribution of the population in response to biological and social changes in the habitat requires this summary of the work of archeologists and the reports of early visitors. In terms of general conclusions, only two are possible: either the population has prospered or it has not prospered. Wealth as children, as abundant food, as leisure, as surplus, and as acclaim are valid criteria (at least from the point of view of this paper) now, as in the past, and the question need not be avoided.

The unfortunate and singularly important omission in this review is the exclusion of original reports of dealings with the Island by whalers and traders during the last half of the 19th-century. As the industry followed north the migration paths of the whale populations they were exploiting, the areas of most frequent contact before the development in the 1850's of the Chukchi and Beaufort Seas fisheries were the Siberian Coast, St. Lawrence Island and the Diomede Islands (Foote, 1964 p 17). While the industry was still reaching its peak (1848-1885), something like 3,000 ships hunted and traded in arctic waters (ibid p 18). Petroff noted the importance of the Island's location "directly in the track of vessels bound to the Arctic for the purpose of whaling and trading." (Petroff, 1882 p 10). They brought rifles, ammunition, liquor, exotic diseases, exotic languages, exotic genetic material, cloth, hard bread, matches (Van Stone, 1958 p 8) -- entirely new modes of production and consumption -- in a deliberate attempt to establish good relations with the resident populations, and to obtain their baleen, ivory and furs. From Foote (1965 p 187-188):

> From June 1st to 26th, 1854, the 93-ton schooner Pheil (Captain Corwin) out of Honolulu, collected 4,000 pounds of walrus ivory, 3,000 pounds of baleen, and 200 to 300 marten and sable skins from the regions of Cape Rodney, St. Lawrence Island and Cape Chaplin. ...The Pheil sailed into the Western Arctic in 1855, 1856, 1857, 1858, and 1867.

In fact, so great was their success that supplies gained in trade by the residents became critical to their maintenance. Another important consequence was the destruction of food storage practices. Trade was especially brisk in the spring and fall. These dealings continued on a regular basis until after the turn of the century, as indicated by the repeated visits of several ships, many of them whalers and traders, known to have visited the Island from 1898 to 1900 listed in Appendix 1.

Acknowledging this omission, the following review is taken from U.S. Government document and standard sources. Its results may be stated in brief outline: before 1878 the Island supported a large and dispersed population which likely reached its peak during the "Late - Prehistoric" period (Rainey, 1941 p 564 ca. 1000-1650); permanent settlements extended around the entire periphery of the Island before 1878 and were, in addition to stored food, dependent on the seal and the walrus for winter food; during the 19th-century the Island was a center for both local and commercial trade; the strongest forces of change faced by this population were the whalers and traders who visited the Island in the 19th-century; the Great Starvation of 1878 to 1880 marked the central result of these changes; the adjustment to a new and highly changed resource system required specific changes in the characteristics of the population.

Certainly not all of these developments are fully presented here, but there is some substantiation for them nevertheless. The discussion of necessity begins *in medias res*, with the publication of an atlas.

2. The Population Before 1878

A list of explorers and travelers who reported sighting inhabitants on the Island before 1878 is included in Appendix 2. Two of these reports will be discussed here, but all may contribute to a definition of centers of Island population before 1878. Appendix 3 summarizes the archeological surveys and excavations of Island settlements and the physical size and cultural levels indicated by the investigators of these settlements. An estimate of size, distribution and centers of habitation may be made from these sources.

The first comprehensive survey of the Island and its settlements was done by Tebenkof (1852 Map XIX, dated 1849). Although the Island appears on Russian maps from at least 1725 ("Shestakof Map" from Golder, 1914 p 153) and was accurately mapped in terms of position and relative size (including five settlements: Tchupuchan, Pugun, Kukuli, Kgünan, Pujelan, and the Chukchi name for the Island, Egügün) by Ivan Kobelev in 1779 (Pallas, 1783 in Masterson and Brower, 1948 p 93), it was not until Tebenkof's cruises (1830-1833) that accurate surveys of the Island began. Then Governor of Russian America (Baker, 1906 p 52), Tebenkof laid the foundation for coast and settlement surveys for many years to come (see Petroff, 1898, endpiece map). In his manual which accompanies the atlas (1852 p 48-51) he carefully describes the physiography of the Island, off-shore ocean depths and notes four major settlements. Most informative, however, is the apparently accurate placement of a total of 13 settlements around the periphery of the Island. He did not stop at any of these settlements however (from his 1830 journal), and his comments on the inhabitants of the Island appear to be mostly hearsay. He reports that previous guesses of the population of the Island were up to 1500 souls.*

Comparing Foote's (1965) discussion of the introduction beyond the

*Assistance for translation from the Russian given by Charles Parr, Arctic Bibliographer, University of Alaska.

Bering Strait of smallpox (p 208, most serious epidemic dated 1838), influenza (p 213, dated 1854), firearms (p 164, dated late 1840's at Pt. Barrow), liquor (p 185, dated 1850), Tebenkof's visits of 1830-1833 likely occurred before serious effects of European contact were felt. The whale fishery of the Kamchatka and Chukchi Peninsula coasts developed north from the Aleutians after this time as well (Van Stone, 1958 p 1, dated 1843). It cannot be assumed that contact and trade between the Chukchi and the Island, although of early origin, was free and unrestricted. Hostilities, bondage and tribute were common (Foote, 1965 p 105-108, Doty, 1899 p 248), and tobacco, not liquor, was long the main Chukchi trade item.

Of the rather long list of known visitors to the Island before 1878, outstanding among them is Henry Wood Elliott. A major interest of the U. S. Government officials at the time of the Alaska Purchase was the remnant of the fur seal populations of St. Paul and St. George Islands left them by their Russian predecessors. The fur seal occurs only rarely in St. Lawrence Island waters. Elliott visited its southern coasts in 1874 (Elliott, 1875 p 220-224) to establish the northern limit of the breeding grounds of the fur seal and to study the walrus. Judging from the detail contained in his 11 available illustrations of the men, their hunting and of the environs of the Poonook Islands, Kagallegak and Poogovellyak settlements (his spellings), Elliott was an acute observer (see Elliott, 1882 p 97, 99, 101, 127). Elliott estimated the population of these three settlements at 3-400 (1896a p 546). There is some confusion in the literature about this figure (Hughes, 1960 p 12 note) and understandably so, as in previous writings he first attributes the figure to five settlements (Elliott, 1875 p 222), then later for the total population (1896a p 444), before settling on three specified as having completely perished during the famine (1896a p 546). Elliott did not visit the west or north coasts of the Island. His end-piece map (Elliott, 1896a) dated 1886 shows no features whatever for these coasts even though sources he drew from did. He is the only investigator to have visited the Island both before and after the famine, which he dates as 1879 to 1880, and his population estimates are here considered as based on the settlements he visited. From his reports of the presence of seldom-used smooth-bore muskets and of the lack of trade goods on the east side of the Island, it appears that these settlements were not visited as frequently by whalers and traders as were those of the west end and especially the NW Cape.

Information from Kobelev, Tebenkof and Elliott (and the eight other sources noted in Appendix 2) indicates a large and dispersed population around the entire periphery of the Island. This population appears to radiate from perhaps five centers, each independent from the other, the entire Island population independent from the Siberian mainland. Trade within the region occurred but was restricted, probably by factors such as the limited season of navigation, social and cultural autonomy and hostilities. Some instances of the magnitude of trade with Europeans indicate considerable wealth.

With information in hand from this brief survey another line of evidence may be summarized (Appendix 3). By 1940 a distinguished group of archeologists had more thoroughly investigated sites of previous habitation on the Island than any other single arctic area (Rainey, 1941 p 565). None hazarded a guess at the size of the population at any one cultural level but their work contributes perspective in time and helps define the centers of habitation already indicated. The importance of the Island excavations to the history of the Bering Sea region cannot be overestimated. Its cultural sequence and chronology is based almost entirely on these sites (ibid p 564). As well, Rainey notes that:

> ...the bulk of all archeological collections (of the Island) can be described on a functional basis very much as one would describe an ethnographic collection (ibid p 473).

Present residents recognized at once the use of objects exhumed and perhaps still do. For the purpose of this review, therefore, the continuity of settlement of the centers of habitation of the Island is considered unbroken as far back as the Okvik level. This unusual circumstance holds especially for its NW Cape and cannot be ignored in any consideration of its background. It is a surprise to some that objects commonly used at the Okvik cultural level* such as the baleen toboggan (ibid p 546) are in common use today.

It is of interest to compare Ackerman's map of Island sites of habitation visited during his survey in 1958 (Ackerman, 1961 p 193) with that of Tebenkof (see Fig. 1 and legend). In fact, Fig. 1 depicts a central point of this discussion: from five centers of habitation

*There is essential agreement between Rainey, Collins, Giddings and Bandi on the sequence of the cultural phases of the Island and the main elements of their chronology (Bandi, H.-G., 1969 p 192, 193, 196, 198-199 respectively.)

showing the oldest cultural levels (Northwest Cape, Southwest Cape, Kukulik Cape, Siknik Cape and the Kialegak-Punuk area) smaller outlying settlements were established during the period of highest population density. During a long period of decline from this peak, the population has progressively recentralized until at the present time two main settlements (Gambell and Savoonga) and one outlying settlement remain.

Foote (1965 p 214-228) estimates household and family size for the coastal inhabitants north of the Bering Strait from the occasional numerical reports of 11 explorers from 1778 to 1854. Joined with the more detailed early accounts of Simpson and Zagoskin, he derives the following:

Average household size:	7	
Average nuclear family size:	3-5	(nuclear: adult male, adult female and their own children)
Ratio of adult to children:	13:7	(adult: all over age 14-16 years)
Ratio of males to females:	13:12	(_ibid_ p 228)

In Appendix 4 Foote's estimates, the observations of early explorers and information extracted from archeological work are joined to derive population estimates for each Island settlement. These estimates may be summarized as follows:

Area	Population
Sevuokuk and eight outlying settlements	900
SW Cape area: four settlements	700
Kukulik and eleven outlying settlements	850
Cape Siknik area: two main settlements	400
Kialegak-Punuk area: six outlying settlements	1250
Total	4000

The events which followed the contact period (although not static before) brought radical change. The impression of a flourishing population, rich in resources, cosmopolitan in its relations with the Bering Sea region, bearers of a great tradition of strength and speed in its men, of winters and springs full of festivals and gatherings ... is unavoidable. They were brought to their knees by disease and a new technology. The demographic data alone substantiates this much.

3. The Famine of 1878-1880

The Great Starvation is undoubtedly the single most important event in the recent history of the population of the Island. It appears that the population has not yet recovered from its destructive effects: the Island has not repopulated to its former level, local food resources have never since been as efficiently used and, foretold by the event, the subjugation by and dependence on a new competitor in the habitat has continued unchanged until very recent times. The consequences of the recently acquired right to own lands (Robert R. Nathan, Assoc., 1972) are as yet unknown.

Every visitor with more than passing interest in the Island has had a comment to make or a story to tell about the famine. The reports, both first-hand and from informants, are summarized in Appendix 5. Since the first published notice of the event by Captain J. J. Nye there has been considerable confusion and hesitation about the relative roles of disease, the illicit liquor trade, the reduction of food species, the unusual weather and ice conditions which occurred and the improvidence of the

Islanders. This first report the fall of 1879 indicated that Captain Nye obtained information on the south side of the Island (Bailey, 1880 p 26):

A RUMOR OF WHOLESALE STARVATION

> Captain J. J. Nye, of the schooner "Pauline Collins", a trader from the Arctic Ocean, reported that he called at St. Lawrence Island in September of this year, on his way south, and found all the people dead at three of the settlements on the island. From information he received at another settlement, he learned that they had all died from starvation during the winter and early spring, on account of their inability to get seal, walrus, and whale-meat, the ice having broken up early, and a continuance of southerly winds having kept it packed in such quantities against the island, and for so long a time, that they were unable to get any food, and there being no land animals, except foxes and polar bear, they of consequence starved to death. In the summer these people live on fish and game, which are plentiful, but in winter they depend principally on seal and walrus, which are caught on the ice.

Bailey follows this report with a statement on the "Demoralizing Effects of Rum" in which the trade of liquor in large quantities is cited as the cause for carelessness in providing winter stores of food. This is the only first-hand report seen which mentions unusually continuous southerly winds as a contributing cause to the famine of that year. Information gathered in 1972 indicated that periods of scarcity were associated with two (and only two) uncommon weather patterns: prolonged northerly winds which keep ice leads closed on the north side of the Island and prevent the formation of shore-fast ice on the south, and prolonged southerly winds which have the reverse effect. The latter is considered the more dangerous in that warmer temperatures accompany the southerly winds, and stable ice may not form at all. It appears that both of these patterns occurred the winters of 1878-1880.

From sources listed in Appendix 5 the following events have been selected as the most probable:

Event	Reference Number Appendix 5
General famine occurred on the northside of the Island in the fall and winter of 1878. Most mortalities occurred in the spring.	3, 13
A large quantity of liquor was traded on the north side of the Island, probably in the early fall of 1878, by a vessel leaving the area. A significant item of trade was seal nets.	3, 4, 7, 11, 12
The same ship probably initiated an epidemic of measels, 'black tongue', diarrhea or all three on the north side of the Island which was responsible for many deaths.	3, 4, 5, 13
There was no famine the winter of 1878-79 on the south side of the Island, but liquor was traded to some of these villages and likely disease as well. The fate of most of these settlements was not investigated by the Revenue Service.	2, 12, 13
The weather conditions the winter of 1878-79 were unusual in that southerly winds and warmer temperatures dominated during the fall and winter and sea ice did not consolidate on the north side of the Island. The usually more open winter waters on the south side of the Island were jammed with predominately unconsolidated shore ice.	8, 13
Food species populations were significantly reduced by this time by the activities of commercial hunters. Still, resident hunting effort was great.	10, 12, 14
The weather conditions of the winter of 1879-80 were unusual in that continual northerly storms and low temperatures brought extensive shore ice and densely consolidated pack ice to the north side of the Island.	1, 6, 8
Excessive eating by a previously starved population, especially the spring of 1879, brought additional mortalities.	12
The habit of developing stores of food during the fall and spring was breaking down under the influence of the spring and fall trade with the whalers.	14

Reference Number
Appendix 5

The end of the famine at NW Cape was marked by the taking of a whale the spring of 1880 by a crew of mostly women and boys. 3, 13

The above information is based on that found in primary sources, but all the same, it is conjectural. There is notable lack of agreement among the four reports of the Revenue Service investigation of 1881 (Hooper, 1884; Muir, 1971; Rosse, 1884; Nelson, 1899). Unusual weather conditions were noted by observers at St. Michael and St. Paul for these years and famine and epidemic were also occurring on the Siberian coast (see Appendix 5, Ref. 10). There are indications that a few survivors held out at the Kialegak-Punuk Island area until about 1890 but, as there are no reports available from that area, the sequence of events remains unknown. In addition to Sevuokuk, only the settlement of Powooiliak remained viable until early in the 20th-century. Their descendents are an important segment of the Gambell population at the present time. It is in fact plausible that Gambell was repopulated by other Island settlements and the Siberian coast and that only one true Sivuqaghhmiit remained in 1955 (Hughes, 1960 p 250).

There is little doubt that the story of this famine may be fully told with adequate consultation of the logs of the 36 sailing craft and 4 steamers which reported walrus ivory takes during the 1879-80 season (Petroff, 1898 p 279). And as Collins notes (1937, p 22), there is also little doubt that the importance of the preference for liquor and the improvidence of the Islanders was exaggerated. The large-scale liquor traffic on American coasts came to an abrupt halt under the surveillance of Captain Michael Healy. That it took less than a year after the end of the famine for the remnant of the Island population now collected mostly at Sevuokuk to clothe, house and feed itself back to health is remarkable (Muir, 1917 p 24-27). In the face of this fact the accusation of improvidence made by most commentors of the period is ridiculous. No supplies were landed, no relief given, no major notice taken beyond the official duties of the Revenue Marine and the interests of the travelers on board. Not only did the people not abandon the Island, they solicited immigration from the Siberian Coast.

4. The Population 1880 to 1970

Why E. E. Smith did not enumerate the Island for Petroff's classic 1880 census of Alaska is unclear. The 1880 population was estimated at both 400 and 500 (Petroff, 1882 p 10, 12).

The presence of famine, disease and the destructive effects of the remnants of liquor trade did not end with Captain Healy's optimistic report of 1884 (Appendix 5, Ref. 9). Healy completed Porter's 1890 census for the Island, with the aid of an interpreter from the Cape Chaplin area, since English was better known there. The remarkable results were (Porter, 1893 p 8, 165, and Jackson, 1893 p 1272):

NW Cape community of "Chibuckak":	270 total population
	70 "boys"
	55 "girls"
	139 native born
	128 foreign born

Assuming that "foreign born" was accurately determined by Healy's interpreter, several interesting conjectures are possible: the remnant of the Island population was reduced by at least half from 1880 to 1890; the remaining Island residents solicited immigrants from the Siberian coast (Rainey, 1941 p 463 and Collins, 1932 p 116); Siberian immigration was limited by the heavy effects of famine and disease on that coast; without this influx the survival of the population was in serious question.

With the arrival of Lieutenant Commander Charles A. Stockton of the U.S.S. Thetis in 1889 a new era of aid and protection for the Island began, which, with the exception of the new independence promised by recently granted lands, persists today. Stockton saw "desperate conditions" in NW Alaska and wrote Sheldon Jackson, who began negotiations to establish schools (Van Stone, 1964 p 23). In the fall of 1894 teachers finally arrived to staff the new school built by Jackson in 1891. These and their three successors commented repeatedly on both near-famine and near-epidemic until the establishment of the reindeer herd and the village store and until the visits of the whalers and traders became less frequent. Jackson also sought another solution: accompanying Healy on the 1890 Revenue Service cruise he encountered a great lack of food supplies over the entire region. Noting the impossibility of restocking the diminished food species populations of the sea as one might a river, the suggestion seemed natural that the methods of a Siberian group found with abundant food supply be adopted: the reindeer herders. He felt the introduction of domestic reindeer would not only produce a new food supply, but move the population a step forward in civilization: the shift from hunting to herding, the accumulation of property and so on (paraphrased from Jackson, 1898 (III) p 558-559). Jackson was astute and energetic and his contributions to the Island came at a critical time in their history. He personally saw to funds and staff for the herd and school at Sevuokuk (Jackson, 1903 p 31). His annual reports (1886-1906) of inspections contain valuable information on the progress at these stations as well as original staff reports.

The population of the Island was not reported in the 12th Census of the U.S. 1900 (Department of Interior, Census Office, 1900 p 426). But Dr. Campbell, the teacher in Gambell from 1901 to 1911 and best remembered of the early teachers, counted the population in 1901 (Reinhard, 1956 p 4, and Appendix). Age and sex information (Fig. 2) is available for only 217 of the total later reported for that year of 264. The remarkable sex ratios cannot be considered 'at birth' as in-migration is not indicated (the figure notes those born before the famine and those born after). Campbell kept rather close track of the population and the following figures have been extracted from the sources listed below:

Settlement	Year										
	1897	1899	1900	1901	1902	1903	1904	1906	1907	1908	1909
Gambell		313					255	253	252	254	237
SW Cape (Poowowaluk)		24					19	19	20	21	21
"Poropirtii"								7	9	12	15
Kookoolik											12
Total	365	334	299	264	264	261	274	279	281	287	285

Jackson, 1904 p 70
Jackson, 1905 p 94
Upedgraff, 1910 p 34-36

Two facts are reflected in these figures: the population reached its lowest point in 1903 (not 1890) and residents of Gambell, especially by 1909, began to take up residence again in areas outlying from that settlement. The U. S. Bureau of Census information for 1910 and 1920 show continued growth of the population and continued dispersal from Gambell. By 1930 (Fig. 2), another trend appeared: the leveling of the total Gambell population. By Hrdlicka's visit of 1929 (Hrdlicka, 1930 p 92-93) Savoonga was well established and is still growing at the present time.

From the preceeding discussions, four major periods of population change are discernible: 1) a period of growth occurred in the Island population culminating in the "Recent - Prehistoric" period (1000-1650 A.D.). The population for this period may be estimated at 4000 in 35 settlements; 2) just before the 'contact' period (1830), the population may be estimated at 2500 in 13 settlements; 3) a period of slow, then precipitous decline is indicated, culminating in a period of famine and epidemic 1878 to 1910, after which there was a population of about 260 in two settlements (one outlying); 4) a period of rapid increase and subsequent leveling of the NW Cape population occurred, extending to the present (Fig. 2), at which time there is a population of 736 in 3 settlements (one outlying) (Bureau of Census, 1971 (I) pt. 3). Indicated here are what may be maximum and minimum limits for the

Island population. Enough is not yet known of the social relationships, seasonal activities and commerce of the population before 1878 to confidently estimate its size.* The discussion in Section 2 of this chapter attempts to derive a reasonable maximum level for the total population. Information for the famine period clearly indicates the level at which immigration was solicited. It remains for further work to determine the size, cultural and technological relations of the Island population to the Siberian and American coasts.

5. The Population from 1958 to 1972 and a Review of its General Characteristics

In assessing the current features of the NW Cape population two enumerations are compared: the first done July 10, 1958 by Carolyn French, Public Health Nurse, Alaska Department of Health and Social Services (copy obtained from F. H. Fay, February 1971) and the second done for this study in July of 1970. Field methods followed Foote (1968 p 25-26) with the additions of names and date and place of birth of grandparents and great-grandparents. This census was updated by additions made during the field period to May 1972, and by further checks and additions contributed by Coreen Kerfoot, PHN, Gambell (Kerfoot, 1973 pers. comm.). Three separate sources of detailed information, therefore, contribute to the 1972 census. Fig. 3 presents the age and sex profile for the 1958 population (above) and the profile of those who emigrated from Gambell from 1958 to 1972. Fig. 4 presents

*Drs. Charles Hughes and Hans-George Bandi both have ethnographic studies of the Island population in progress at the present time.

the age and sex profile of the total Gambell population (above) as enumerated by the U.S. Bureau of Census in 1970 (U.S. Bureau of Census, 1973, "Second census" 93 tables) and the profile for the 1972 population enumerated for this study. As in Fig. 3 persons, not resident at the time of the count are indicated outside the shaded area.

In Table 1 the general characteristics of the population are presented for the 1958, 1970 and 1972 enumerations. The table also presents the same statistics for the Nome native population in 1960 (U.S. Bureau of Census, 1963 p 12). This information is not yet available for the 1970 census.

The following general characteristics of the NW Cape population over the 14 year period between the 1958 and 1972 counts are apparent from the profiles and table: the population has not grown, the number considered resident has diminished considerably; the segment of the population under 15 years of age has also diminished; the segments of the population between 22 and 44 years and 65 years and older have increased, the median ages of the population have increased considerably, the dependency ratio of the population (# under 20 + over 65/20-44 years) has decreased, and a large portion of the population across all age classes (33% of the 1958 total population) has emigrated.

Information pertaining to family size and structure is presented in Table 2 and Fig. 5. A considerable decrease is noted in the number of two-parent families. The slight overall increase in family size apparently masks a real decrease in family size for family heads aged 35-44 years. The remarkable excess of unmarried males over females has not changed during the 14 year period covered by the enumerations.

Since the characteristics summarized above are important to much of the discussion in following chapters of this paper, they may be considered in slightly more detail. The authority for this discussion is Bogue (1969). A total population figure is that first attempted in any discussion of the characteristics of an isolated group of people, and at the same time it is very difficult to assess. Considerable attention was given in the 1972 enumeration to defining duration of residence. Residents of NW Cape divide their time among several different places. 'Place', in fact, is the single element common to a 'population' and therefore defines it. In the 1958 census the few people (all but one over 20 years of age) hospitalized off the Island or in schools are the only 'non-residents' listed. In the 1972 census, all members of the population absent for the fall and winter season (October through April) are considered non-resident and so indicated. Among this group in 1972 are high school students, people working off the island for variable lengths of time, younger people moving from place to place, training school students and trainees for military service. There is likely an increase in participation in such opportunities since the census of 1958. Another element represented in the group defined as 'non-resident' in 1972 are those men resident off the Island who return for a few weeks or a month of hunting in the spring. Five adult males comprise this group which is not really part of the Cape population at all. But these men actively participate in the economy of the Cape during the very important spring period. It is likely that other non-residents do also, but the degree of that participation is impossible to define. Detailed information on the nature of air freight shipments or postal money orders is unavailable. The population considered resident in 1972 is 13% below that of the 1970 United States census. It is here considered the year-around resident population of the Cape, responsible for its main social and economic patterns. In dealing with such a small population the movements of even one family can greatly influence its structure. In the fall of 1970 a family moved into Gambell contributing eight males to the 0-14 year age classes (10% of the total of 79).

The age composition of a population changes only with a change in birth rate, death rate or through the effects of migration. The age compositions of 1958 and 1972 show an important change in the percent of the population under 15 years. Hughes reports live births ranging from four to 19 per year, 1940 to 1955, averaging 11.5 (Hughes, 1960 p 63). Live births recorded for the 1972 period are: 6/1970 - 6/1971: seven; 6/1971 - 6/1972: eight; 6/1972 - 3/1973: eight (Kerfoot, 1973 pers. comm.). A reduction of live births is clearly indicated. A slightly higher percentage of the population is over 65 in 1972. Since 1958, 29 individuals are known dead (2.1 per year), five of which were younger than 59 years at that time and three of which are known to be accident related. No infant deaths are included. This figure may be low, as the fate of some of the out-migrants is not known. Births minus deaths, then, are approximately six per year.

In the lower profile of Fig. 3, 157 out-migrants are shown (25 families and 17 additional individuals). By 1972, 42 had returned (7 families and 11 individuals). An estimate of emigration from 1958 to 1972 is 115 persons (33% of 349) or 8.3 per year.

A consistent property of populations is that about 35% of all age classes are between the ages of 20-44 years. Figures for all populations considered here are well below this, leading to very high dependency ratios. As part of the general picture of high live-birth rates, low death rates and little opportunity for employment and the development of careers, it is not difficult to see how the head of a family might conclude that the very difficult job of providing for a family with all that implies might be better done off the Island. It seems reasonable that many of the present non-residents in the 15-25 year age classes will take up residence off the Island. If they do not, their actions will be the product of decisions consciously made in the face of known difficulties. The strongest forces influencing such decisions are employment opportunities and the family. Table 2 shows both an increase in non-nuclear families and a decrease in nuclear families. The single fact which substantiates the importance of emigration is that whole families move out as a unit. The note which introduces Chapter II reflects the central position of the family in the value structure. No other social unit is as highly valued. A man without a wife cannot achieve even a portion of the wealth and acclaim (let alone children) open to other men. These families are the main economic unit of the community and division of labor within the family is a constant factor among them. Beyond considerations of eligibility or dependency an increase of family size cannot be taken as an increase of wealth. The extremes of wealth and poverty only become further separated. The community thereby becomes more and more strongly divided along these lines. It is to be noted that the 14 non-nuclear families in 1972 each have separate dwellings, whereas sharing is more common among the rest.

The sex ratios of the population seem to be connected in some way to the discrepancies between unmarried and eligible males and females. Eligibility is a social question. Of the 15-19 year cohort, three resident females are 17 years or older, have finished or discontinued high school and have returned to the community. They may fairly be considered eligible in the usual sense of the word. If a female has a child outside the village and returns unmarried, she is much less likely to remarry. Of seven known instances since 1947, only two have remarried. Therefore five of the nine total eligible females are apparently less eligible. There are fewer social constraints on the males and the resultant estimate of 22 eligible in 1972 may stand. This situation has changed surprisingly little since 1958.

Drawing conclusions about this population would be more comfortable if its profiles did not have the battered look typical of small populations. The variability in the female segment is especially notable. Two characteristics emerge from this review which appear very important, as well as constant, over the 14 years in question: there is a large excess of unmarried males over unmarried females, and the rate of emigration slightly outstrips the live-birth rate (1970-1973) and exceeds even more births minus deaths. Fig. 2 indicates that the population is leveling. It is proposed that the two aspects of the population just mentioned are responsible for this apparent leveling and contribute therefore to the stability of the Cape population. This population provides one more case history of the following theses: present demographic processes of island ecosystems are inherently unstable, rates of growth now preclude preservation of simpler cultures and production systems, rapid development and integration into larger economic and social systems is the alternative to demographic regression (Taeuber, 1963 p 227). Yet, these propositions are cast in terms too general to allow resolution by this study. A review at this point of the description of this population may allow these propositions to be recast in more practical terms.

As already mentioned, this study considers that the place of occupation of a population is chosen on the basis of the needs and desires of that population, and their relative fulfillment is indicated by its measurable parameters. For reasons to be discussed in following sections, the NW Cape of the Island provides the best habitat available. Only here has occupation continued since the earliest signs of habitation. There is no question that the population prospered, in the terms defined here, until 1878: independent, diverse and large. But also insular, the population lay vunerable to expansionist forces of a larger and more powerful population whose origins were far away. It is as if the Island population was exposed in a matter of years to the biological cohabitants, the technological genius and the big business of Europe, evolved over centuries. Contact was abrupt in the extreme. A population apparently adjusted to highly conservative use of resources, slow growth and the preservation of its own cultural characteristics met forces at its opposite. Some of the consequences are shown by the figures presented in this chapter: the population centralized, abandoning the south and east coasts of the Island; after nearly perishing, rapid growth began; followed by dispersal from the Island and a leveling of the Cape population.

The present demographic processes of the Island indeed appear unstable. Whether these processes in the past were unstable is unknown, but the Island maintained a strong connection with the Siberian coast. Nome has replaced Chaplin as its mainland contact. The population of this Island expresses the necessity of such a contact. At the turn of the century the Siberian mainland provided needed immigrants. Presently the Alaskan mainland provides a place of emigration. For this reason the present elements of the older and simpler production system may be maintained free from the pressure of overpopulation. Our theses become: the functional population unit requiring evaluation is the Island -- mainland complex, not the Island system alone; the mainland population pool buffers stresses of overpopulation or depopulation in the more unstable Island system; rapid development and integration of the Island population into a larger economic and social system then becomes a matter not of necessity but of choice for its inhabitants, protected from such pressures by the Island's insularity, and from its own instability by the mainland population.

FIGURE 1

A Map of Settlement, Exploration and Travel on
St. Lawrence Island

As the legend indicates this map displays the location of present settlements, outlying camps of the NW Cape settlement, known sites of early habitation and five former centers of population: NW Cape, SW Cape, Kookoolik Cape, Siknik Cape and the SE Cape-Punuk Islands-NE Cape area. Appendix 2 summarizes reports of explorers and travelers who reported sighting inhabitants. Appendix 3 abstracts information on place and general size from archeological investigations of the Island and Appendix 4 estimates the population size of these sites.

Commonly used trails and small boat courses are also identified. Travel distances calculated for these routes are listed following the figure.

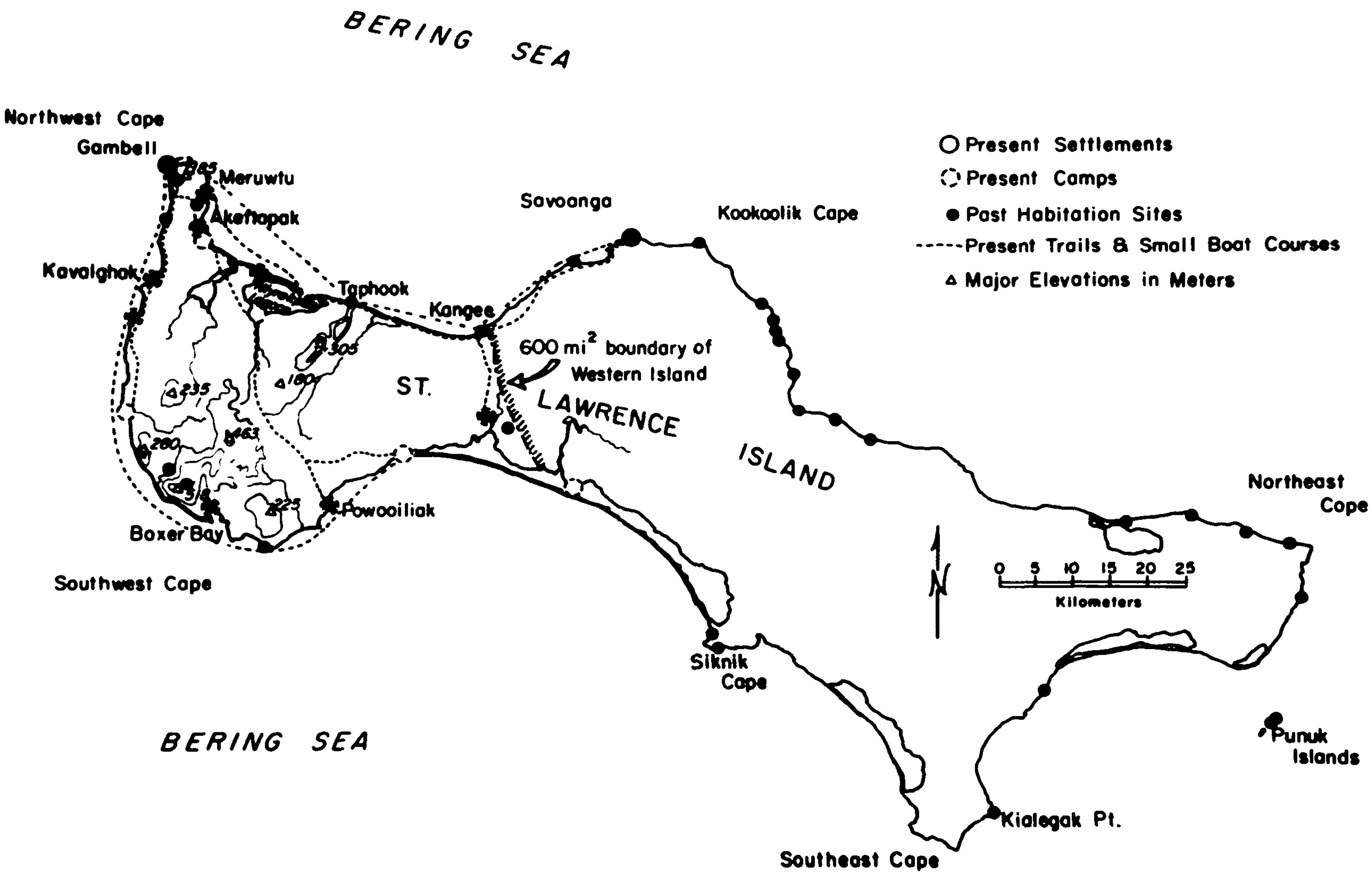

BERING SEA
Northwest Cape
Gambell
Meruwtu
Akeftapak
Kavalghak
Taphook
Kangee
Savoonga
Kookoolik Cape
Present Settlements
Present Camps
Past Habitation Sites
Present Trails & Small Boat Courses
Major Elevations in Meters
600 mi² boundary of Western Island
305
160
235
463
280
225
ST. LAWRENCE ISLAND
Powooiliak
Boxer Bay
Southwest Cape
Northeast Cape
0 5 10 15 20 25
Kilometers
N
Siknik Cape
Punuk Islands
BERING SEA
Kialegak Pt.
Southeast Cape

FIGURE 1

Map of St. Lawrence Island Travel Distances

Land and boat travel distances are derived from USGS, Alaska Topographic Series, St. Lawrence Island, scale 1:250,000, 1948, and additional sources using the Dietzgen "map measure".

As much of the coastline is irregular, map measurements at this scale (each figure given is an average of three measurements) establish minimum estimates. Distances over water are based on boat routes and distances overland on established trails.

NE Cape to Sledge Is.	~120 miles
NW Cape to NE Cape	110 "
Around entire Is.	280 "
Total Is. area	1,880 $miles^2$
	1,205,000 acres*
Western Is. area	600 $miles^2$
	384,000 acres
Coastline length of Western Is.	103.0 miles
Niyrakpak Lagoon	12.3 "
Taphok to Kitneapalok	24.1 "
Overland trail Gambell to Savoonga	48.1 "
Gambell to North Kangee	31.5 "
Gambell to Niyrakpak Lagoon	17.0 "
Gambell to Akaftapak	5.9 "
Gambell to Kyaillgit	5.5 "
Gambell to South Kangee (inland trail)	37.0 "
Kawok to North Kangee	6.7 "
Gambell to Poowoiliak	34.0 "
Gambell to Booshu Camp	22.1 "
Gambell to Kitneapalok	13.8 "
Gambell to Kavalgrak	10.2 "
Gambell to Ooynuk	5.1 "
Boat route of Gambell to Chaplino	~40.0 "
Gambell to Savoonga	45.5 "
Gambell to Niyrakpak Lagoon	17.0 "
Gambell to Boxer Bay	36.4 "
Gambell to Poowoliak	47.4 "
Gambell to South Kangee	54.5 "

*Federal Field Committee, 1968 p 465-466

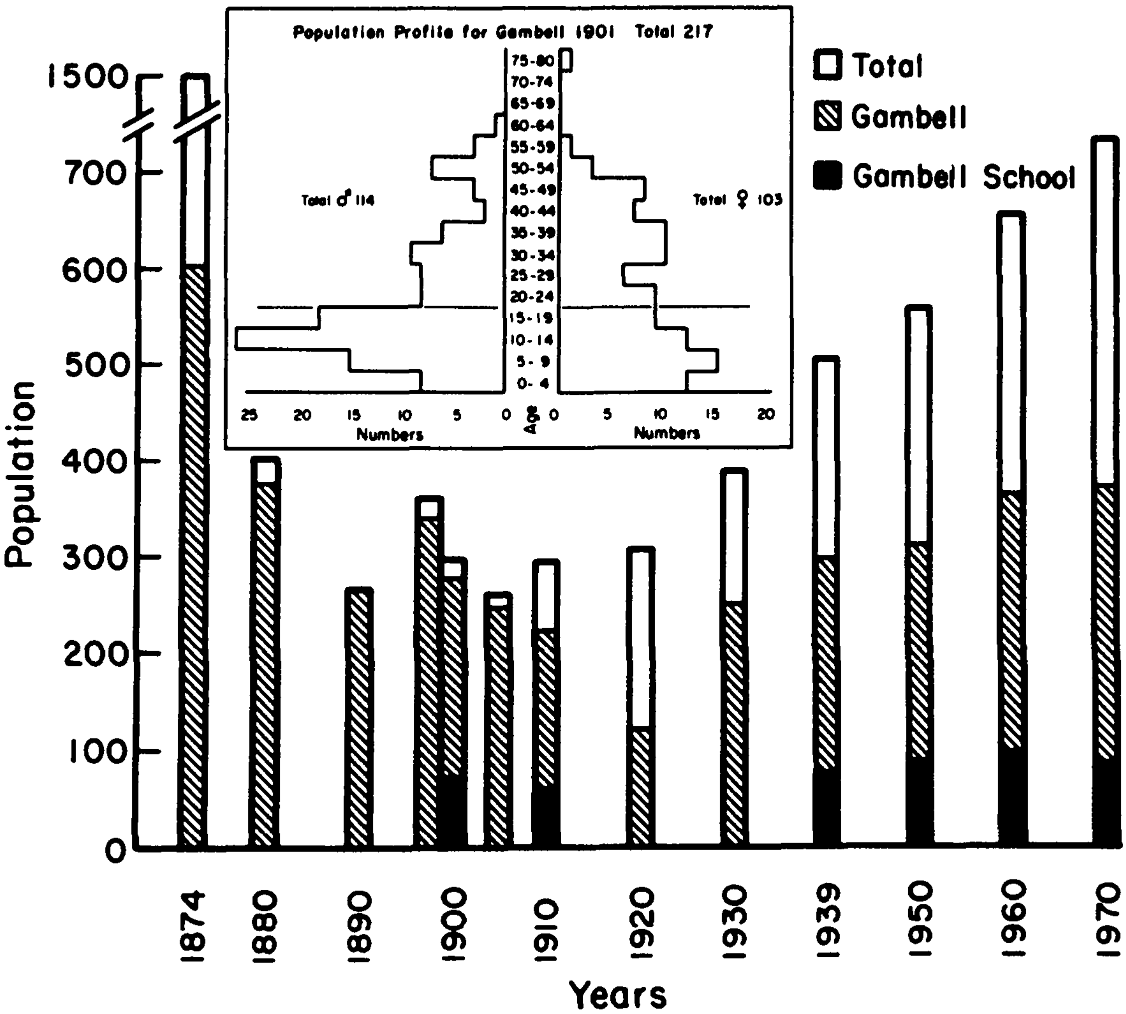
FIGURE 2

Population Profile for 1901 and

Population Changes since 1875

The population profile for Gambell in 1901 is presented in Fig. 1 (Reinhard, 1958 p 4 and Appendix). Represented are 217 persons from the total population of 264 reported in Jackson (1905 p 94). Persons at ages below midline were born after the famine.

Changes in the size of the population of St. Lawrence Island are presented in the histogram below the 1901 profile for the period 1874 to 1970. Sources of information for the years 1910 to 1970 are respective enumerations by the U.S. Bureau of Census. Gambell school enrollments were obtained from Bureau of Indian Affairs records (1973) and Jackson (1904, 1905). For other sources see text.



Population Profile for Gambell 1901 Total 217
Total ♂ 114
Total ♀ 103
Numbers
Numbers
Age
Total
Gambell
Gambell School
Population
Years
1500
700
600
500
400
300
200
100
0
1874
1880
1890
1900
1910
1920
1930
1939
1950
1960
1970

FIGURE 3

Population Profiles for 1958 and for

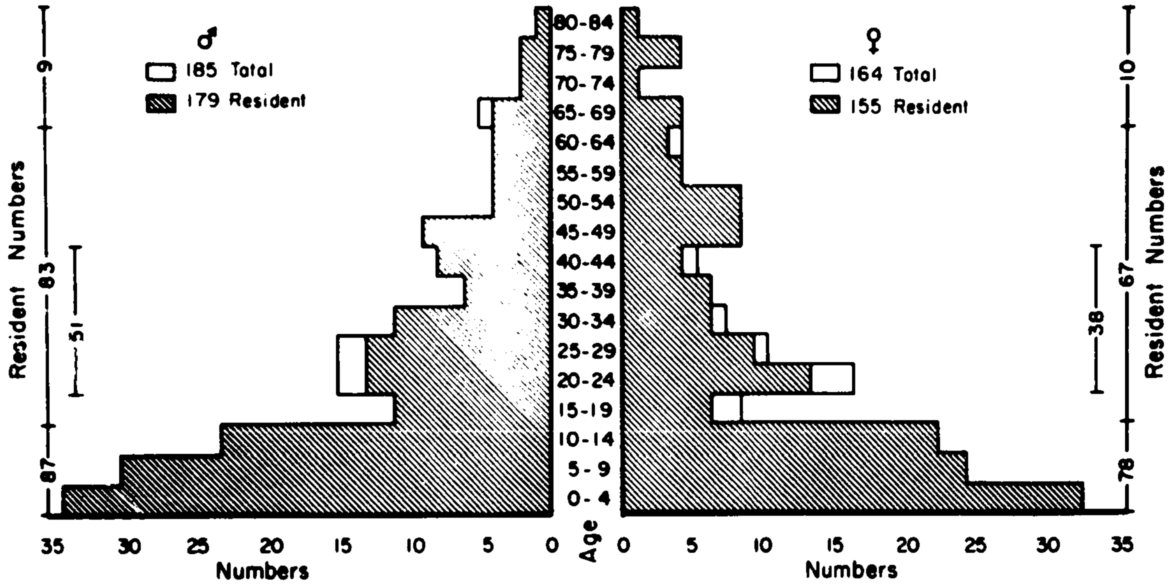
Emigrants 1958 to 1972

Fig. 3 displays the age and sex profile for the Gambell population in 1958 (above) and for that segment of the population which has emigrated between 1958 and 1972 (below) (see also Table 1). Members of the population not resident at the time of the 1958 census are indicated outside the shaded area. The size of various resident cohorts are indicated on the lines flanking each figure: first the 20-44 year age class, then the 0-14, 15-65 and 65+ year age classes.

Of the 157 emigrants (25 families + 17 individuals) represented in the lower profile, 42 returned by 1972 (7 families + 11 individuals). Net emigration is therefore 115 (33% of 349) or 8.3 per year. Births less deaths approach 6 per year 1970-73.

Population Profile for Gambell 1958

Total 349 Resident 334



Age and Sex Profile of Gambell Emigrants 1958-1972

Total 157

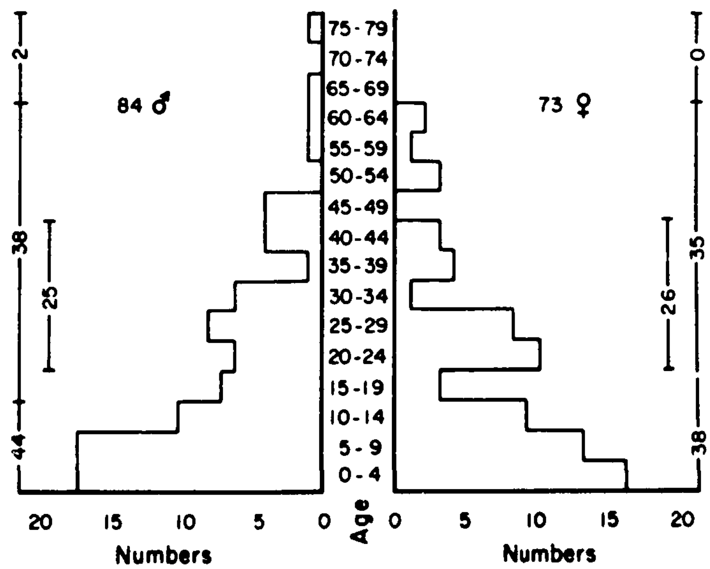
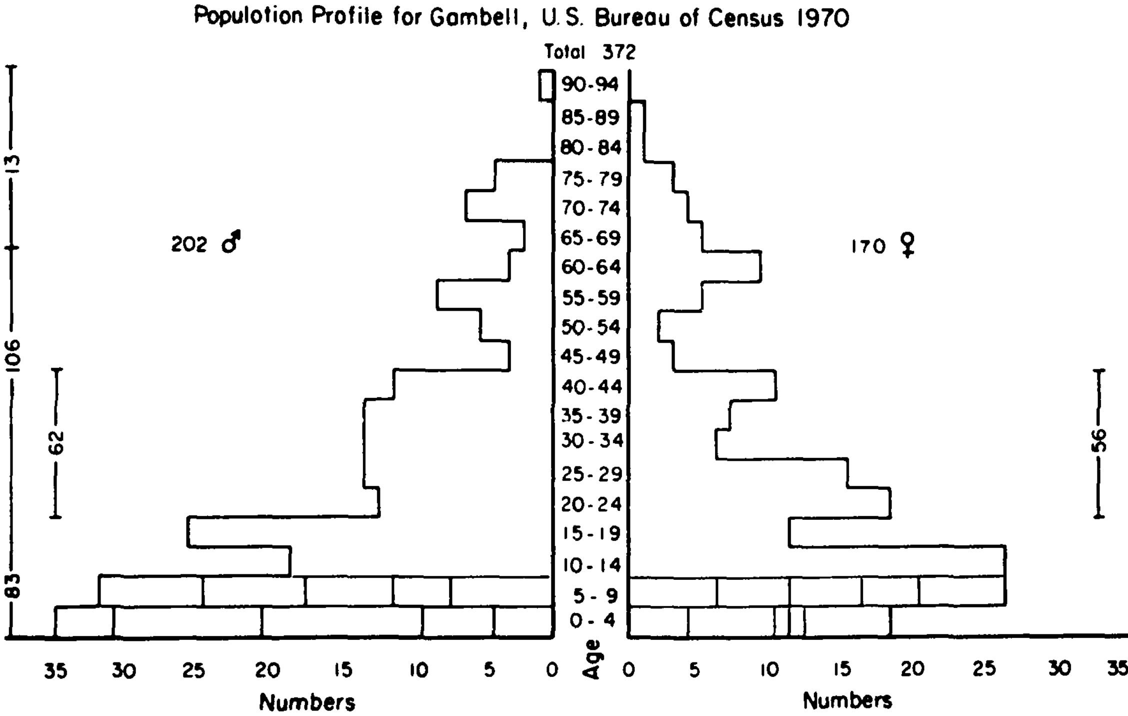


FIGURE 4

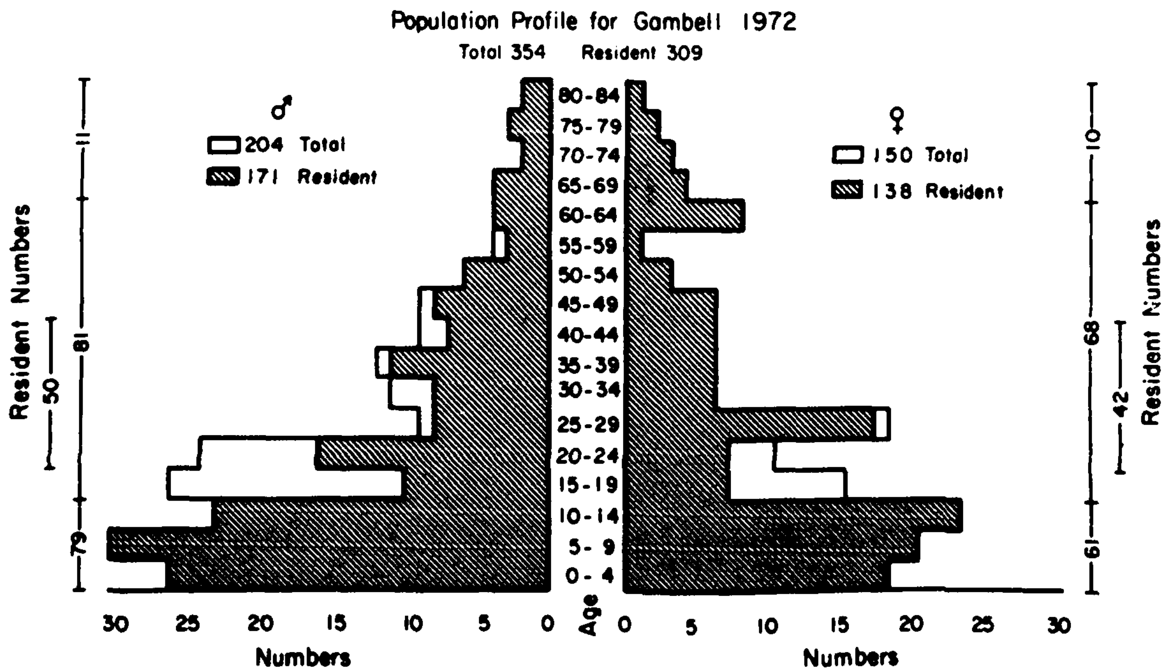
Population Profiles for Gambell 1970 and 1972

Fig. 4 displays the age and sex profile for Gambell in 1970 as taken from the U.S. Census (1973, Table 2), and the age and sex profile for the 1972 population as enumerated for this study (see also Table 1). Members of the population not resident during the winter months (October through April) are indicated outside the shaded area. Sizes of the resident cohorts are represented as in Fig. 3.

In the 1970 profile the age classes 0-4 and 5-9 are subdivided into one year age classes, progressing from the youngest to the oldest from the center of the figure to the outside.



Population Profile for Gambell, U.S. Bureau of Census 1970
Total 372
202 ♂
170 ♀
90-94
85-89
80-84
75-79
70-74
65-69
60-64
55-59
50-54
45-49
40-44
35-39
30-34
25-29
20-24
15-19
10-14
5-9
0-4
Age
13
106
62
83
14
86
56
70
35 30 25 20 15 10 5 0
0 5 10 15 20 25 30 35
Numbers
Numbers



Population Profile for Gambell 1972
Total 354 Resident 309
♂
204 Total
171 Resident
♀
150 Total
138 Resident
80-84
75-79
70-74
65-69
60-64
55-59
50-54
45-49
40-44
35-39
30-34
25-29
20-24
15-19
10-14
5-9
0-4
Age
Resident Numbers
11
81
50
79
10
68
42
61
Resident Numbers
30 25 20 15 10 5 0
0 5 10 15 20 25 30
Numbers
Numbers

TABLE 1

A Comparison of General Characteristics of the NW Cape Population

1958 to 1972

	Gambell "resident" pop. 1958[1]	Nome "other" pop. 1960[2]	Gambell "resident" pop. 1972[3]	Gambell total pop. 1970[4]
Total population	349	2958	354	372 (15 white) (1 other)
Resident	334	ND	308	ND
Age Composition				
%<15	49%	49%	45%	41%
%22-44	27%	29%	30%	32%
%≥65	5.7%	5.0%	6.8%	7.3%
Median Age[5]	15.2 M 13.8 F (16.5 M 16.5 M Total)	16.0 M 13.7 F	17.3 M 19.7 F (18.4 M 18.7 F Total)	22.6 M 20.1 F
Dependency ratio	2.26	2.27	1.94	1.83
Sex Ratio	1.16	1.11	1.24	1.18
Age 5-9	1.29	1.00	1.50	1.19
Age 0-4	1.06	.96	1.44	1.89

[1] French, 1958

[2] U.S. Bureau of Census, 1963 p 12

[3] This study and Kerfoot, 1973

[4] U.S. Bureau of Census, 1973 Tables 1, 2

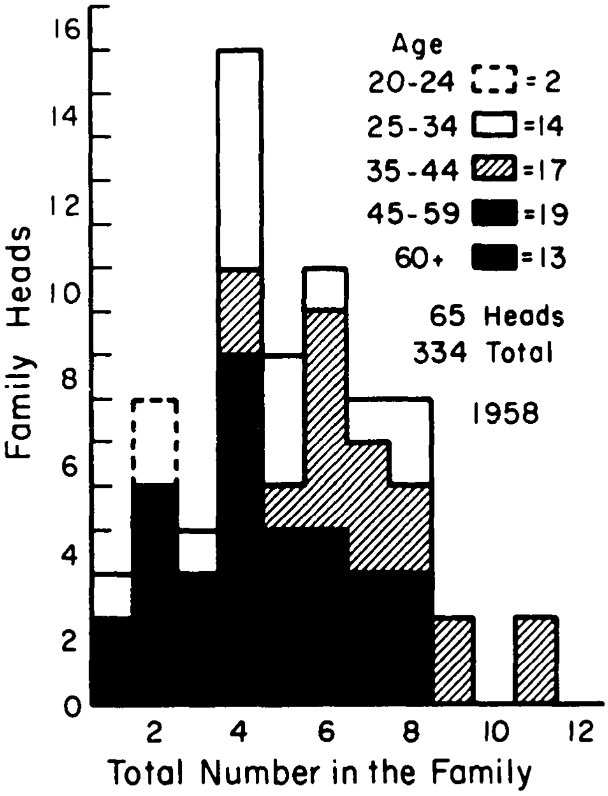
[5] Calculated by percent age class only

FIGURE 5

Family Size by Age of Head of 1958 and 1972

In Fig. 5 the size of all family units is displayed. Shaded areas indicate the age class of the head of the family (that person most responsible for its maintenance) at the time of the respective enumerations from which the information is drawn. Table 2 presents average family sizes for each age class.

Frequency of Family Size by Age of Head



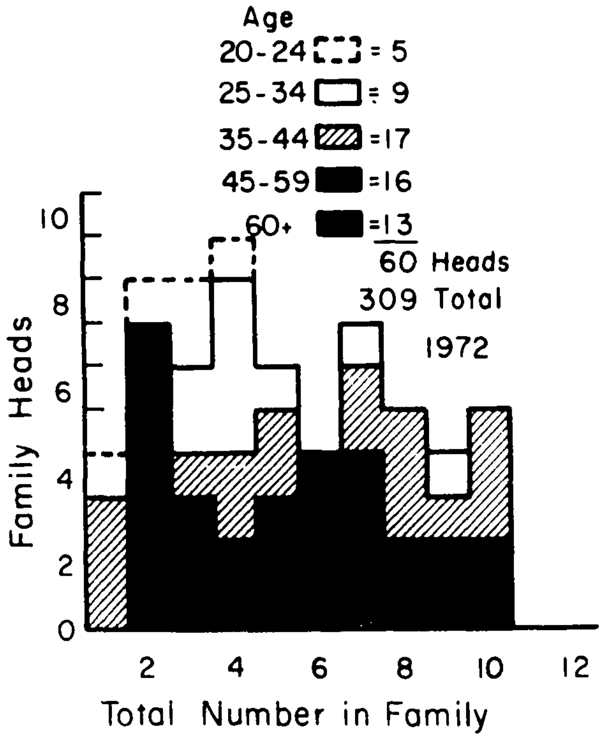


TABLE 2

Family Size and Structure

1958, 1970 and 1972

	1958	1972
Mode	4	4
Mean	5.1	5.2
Mean for heads		
Age 25-60+:	5.2	5.4
Mean for heads		
Age 25-34:	4.9	4.8
35-44:	7.1	5.7
45-59:	5.2	6.5
60+ :	3.4	3.8

	1958	1972
Family Structure:		
one-parent	11 (32 people)	14 (40 people)
two-parent	54	46
Total families:	65	60

Unmarried (eligible)	1958		1972		1970[1]	
Age	M	F	M	F	M	F
40-44	0	0	4 (1)	0	10	2
35-39	1 (1)	0	5 (2)	2 (1)		
30-34	1 (1)	0	1 (1)	1 (1)	9	7
25-29	9 (9)	0	5 (5)	5 (3)		
20-24	12 (12)	6 (6)	13 (13)	1 (0)	9	8
17-19	--	-- (3)	--	-- (3)		
	23 (23)	6 (9)	28 (22)	9 (8)	28	17
% of total in age classes:	45%	16%	54%	22%	45%	30%

[1]Total population, 1970 U.S. Census, Table 5 "never married"

APPENDIX 1

Whalers and Traders known to have Visited St. Lawrence Island from 1898 to 1900

Source: Doty, William F. 1900. Log Book, St. Lawrence Island. In Jackson, Sheldon. 1900. Ninth Annual Report on Introduction of Domestic Reindeer into Alaska...1899. Washington, Government Printing Office. p 224-256.

Date	Ship, class, remarks	Captain
August 14, 1898	Del Norte - steamer, carried U. S. Government freight	not stated
September 9	Katherine Suddons - not stated, had been in Arctic Ocean	Dickey
October 15	Alaska - not stated	Cogan
October 17	whaler passed	
May 13, 1899	Jeanette - whaler	Newth
May 13	Grampus - whaler	Leavitt
May 13	Narwhal - whaler	Comisky
May 13	Belvedere - whaler	not stated
May 14	William Baylies - not stated	Buckler, Charles E.
May 16	Thrasher - not stated	Sherman
May 22	Belvedere - whaler	Duvall
May 26	William Baylies - not stated, Buckler shot, buried on Island	Cottle, S. F.
May 28	Alexander - not stated	Tilton
May 28	Fearless - not stated	McKinney
June 18	Albion - steam schooner	Ericson
June 20	William Baylies	Cottle
June 20	Alexander	Tilton
June 27	Alaska - bark	Williams, Cogan sick
July 10	Thetis - U. S. Revenue cutter	Buhner
July 12	Bear - U. S. Revenue cutter	Jarvis, Lieu. and Berthoff, Lieu. Jackson, Sheldon

Source: Lerrigo, P. H. J. 1901. Abstract of Journal, Gambell, St. Lawrence Island, kept by... In Jackson, Sheldon. 1901. Tenth Annual Report on Introduction of Domestic Reindeer into Alaska... 1900. Washington Government Printing Office. p 114-132.

Date	Ship, class, remarks	Captain
September 1, 1899	Thetis, U. S. revenue cutter	Buhner
May 19, 1900	bark sighted	
May 25, 1900	Beluga, bark	Bodfish
May 27	Alexander	Tilton
May 28	William Bayliss	not stated
May 28	Karluk - traded by night, liquor	Mc Creegan
June 1	Alaska - bark, 8 natives shipped for the whaling season	Cogan
June 5	mall schooner	not stated
June 9	Alexander - bark	Tilton
June 10	Garonne or Roanoke - larger passenger vessel passed toward Nome	
June 16	Progress - Russian steamer out of Vladivostok British syndicate for prospecting Siberian coast	Gunderson
June 17	Corivin - trading steamer	Foster
June 21	Belvidere - steam whaler	not stated
June 23	Casco - schooner with supplies	not stated
June 30	Progress - dropped off injured Chinese servant	
August 30	Manning - U.S. Revenue cutter	Roberts
End September	Bear - U. S. Revenue cutter, delivers 40 deer and supplies	Tuttle

APPENDIX 2

Explorers and Travelers who Reached St. Lawrence Island by 1881

Explorer	Date	Remarks	Source Page
Deshnev	1648	Müller's quote from Shestakov's map: "To the first Island is half a day's voyage; upon it lives a people whom the Tschuktschi call Achjuchaljat; these speak their own language, wear clothes of duck-skins and live by catching of sea-horses and whales; and, as the Island is without forests, they boil their provisions with Train oil."	Müller, 1761 xxii
Bering	8/8/1728	"...found a few huts but no people although I twice sent the midshipman to look for them."	Golder, 1922 Vol. 1, 18
Kobelev	before 1799	mapped 5 settlements.	Masterson and Brower, 1958 18
Cook Sind	1778	mistook Island for two or more, misnamed twice	Cook, 1785 278
Billings	7-21-1791	Landed on south shore west of Siknik, shore covered with bones, tame dogs about; saw 6' scaffolds at distant habitation but no people. Then saw very large boat (baidar) with about 30 men aboard. Sailor fired warning shot, boat retreated. Then passes ESE, found all valleys occupied by buildings of natives, concluded Island very populous. Passed by Punuk Is., found north Is. replete with huts.	Sauer, 1802 240-241
Kotzebue	7-27-1816	Visited village SW coast (Poowooiliak) and bartered	Kotzebue, 1821 188-190
	7-28-1816	Bartered with second village just north of Cape, obtained over 200 rain parkas in one day.	

Explorer	Date	Remarks	Source Page
	7-29-1816	Received dog sacrifice at NW Cape.	
	7-10-1817	Visited SE Cape (Kialegak) inhabitants fled except 20 armed men. Inhabitants speak of American origins. Passes Punuk without comment.	Vol. II, 174-6
Choris	7-27-1816	Comments similar to those of Kotzebue. Noted considerable trade with Chukchi. Plates XVI "Habitans du l'île St. Laurent" XVII "Intérieur d'une maison dans l'île St. Laurent" XVIII "Bateau á rames de l'île St. Laurent"	Choris, 1822 4
Beechey	7-16-1826	Visited bay at SW angle of Island (perhaps Boxer Bay, or Powooiliak), saw several tents, stakes; natives launched four baidars, eight men and women in each. Appeared expert at barter. Noted shirts and boots resembled those of 'Oonalashka'. Traded seven dozen _Alca crestatella_ for one necklace of glass beads. Needles and scissors desired by the women, tobacco by men.	Beechey, 1831 Vol. 1, 331-4
Etholen	1830	"In 1830 the brig Chichagof was dispatched northwards in charge of midshipman Etholen, ...St. L. Is. Etholen found 5 native villages, the inhabitants of which lived...chiefly by hunting walrus."	Bancroft, 1886 547-8
Tebenkof	1830-1833	Surveyed Island, circumnavigated entire except south side. Mapped 13 settlements. Notes that population estimates are as much as 1500; that they are occupied hunting whale and walrus, except in the winter, which is filled with 'amusements'; have strong physiques and greatly love tobacco and vodka. Transliterates accurately seven native place names.	Tebenkof, 1852 48-51

Explorer	Date	Remarks	Source Page
Elliott	8-18-1874	Notes 3-400 in 5 settlements had little to barter, seldom used muskets, no iron cooking pots, large shaggy dogs, etc.	Elliott, 1875 220-224
	1881	Probably visited both SW & SE Capes, estimates nearly 300 in 3 settlements died during famine. Find in Elliott refs. and Nelson 1899, 11 drawings of area and people.	Elliott, 1896 442-458
Hooper	1880	Investigated mortalities at four villages on north coast of Island: "A: 50 total; B: 54 adult males; C: 12 adult males; D: 200 total. Estimates 500 total dead of Island population of 1000. Dates major famine in 1879-80.	Hooper, 1881 10-12
Hooper	1881	Examined 5 of 6 settlements: 3, all dead; 4th, 16 remain 5th, 200 dead 400 remain; 6th, nearly all dead. Estimates 1000 of 1500 died during famine.	Hooper, 1884 8, 100-101
Nelson	1881	Visited notably 2 villages, Poowooiliak and Kukulik. Made extensive ethnographic collection at latter. Notes 1000 died winter 1879-80, attributes whiskey as main cause.	Nelson, 1899 269-270
Rosse	1881	Reports that a whaling captain visiting Island during epidemic said every one had "measles or black tongue". [Black tongue likely refers to anemia, scarlet fever or avitaminosis (vit. B). (Milan, 5/1973. Pers. comm.)]	Rosse *in* Hooper, 1884
Muir	1881	Reports 500 of 1500 inhabitants died 7 villages wiped out, in Sevuokuk 200 of 600 died, SW Cape all but 5 of 200 died, a few survivors at east end of Island.	Muir, 1917 107-8

APPENDIX 3

Archeological Investigations on St. Lawrence Island

Investigator	Site	Cultural levels	Indication of physical size	Source,	page
Giddings	Hillside	Okvik, dates 2300 BP	1 house only	Giddings 1957	134
--	Kitnepaluk	Late Punuk or Thule but OBS style found	Excav. 1 house of several	--	133
Rainey	Punuk Is.	Okvik (type coll.)	Midden only, excav. by Geist 1931, Geist and Skarland 1934	Rainey 1941	465
Collins	Hillside	OBS (type coll.)	1 house only excav. 1930, 1931	Collins 1937	34ff
	Miyowagh	OBS (type coll.) and Punuk	several houses	ibid	
	Ievoghiyoq	Punuk	"	ibid	
	Seklowaghyaget	Punuk and Modern	"	ibid	
	Old Sevuokuk	Modern	large village	ibid	
Collins	Punuk Is.	Punuk (type coll.) and Modern	one of largest 3 modern houses excav. 1928	ibid	27-28

Investigator	Site	Cultural levels
Collins	Kialegak	Punuk, mostly
Geist and Rainey	Kukulik	OBS, Birnirk, Punuk, Recent - Prehistoric, Modern
Ackerman	Camp Kolowiyi and S'Keliyuk	Punuk and Birnirk
Bandi	Hillside Miyowagh Ievoghiyoq Punuk burials OBS burials Meruwtu in progress	all

Indication of physical size	Source,	page
1 month excav. 1929, large village	ibid	30
Large village complex excav. 1931 1932 & 1934-35. Geist also surveyed 13 other sites on Island (see Fig. 1)	Geist and Rainey, 1936	25-53
3 middens, 2 houses Surveyed 14 other sites (see Fig. 1)	Ackerman 1961	14ff
surveyed 6 other sites as part of ongoing project 1972-1974	Bandi 1967	10-13 nd

APPENDIX 4

Estimates of Age and Size of St. Lawrence Island Settlements[1] 1650-1878

Settlement	Size, Age, Remarks	Authority
Gambell (Sevuokuk)	400 is considered the optimal size of this community Occupation appears continuous since 2300 B.P. Pre-famine population estimates probably did not account for post-famine immigration from other settlements. The Old Sevuokuk "modern" site is the largest of the area. Three of five other centers of habitation have shown continuous occupation from the OBS cultural level (two have not been excavated). The same estimate of optimal population size is applied to all. The sites of Hillside (Okvik & OBS), Miyowagh (OBS & Punuk), Ievoghiyoq (Punuk), Seklowaghyaget (Punuk & modern), are here considered different periods of occupation of a single settlement.	Bur. of Census 1970:372 Giddings, 1957 p 133 Hooper, 1884 p 100 Collins, 1937 p 34 Ackerman, 1961 p 14ff Rainey, 1941 p 460 Collins, 1937 p 34
Meruwtu	No excavations but predominately "modern". Adjoined by a site called "Missaghameet". For want of better information this site is considered comparable to "village B" as found by Hooper. Population about 150.	Collins, 1937 p 191 Geist, 1936 p 31 Hooper, 1880 p 10-12
Ooynik	No excavation, small "modern" midden. This site is considered comparable to "Village C" as found by Hooper. Population about 35.	Ackerman, 1961 p 14ff Hooper, 1880

[1]For settlements outlying from centers of habitation, see Fig. 1.

Settlement	Size, Age, Remarks	Authority
Kavalghak	No excavation, 2 "modern" mounds. Probably larger than Ooynik. Population about 35.	Ackerman
Kitnepaluk	One "Late Punuk or Thule" house excavation of several known. Population about 150.	Giddings, 1957 p 133
Akaftapak and Dovelawik Bay area	No excavation, large settlement indicated on Tebenkof's map. Population about 35, probably larger. Indications of "Hillside" type habitation.	Tebenkof, 1830 Bandi, 1967 p 10-13
Naskok	Settlement indicated on Tebenkof's map. Population about 35.	Tebenkof, 1830
Taphook	Indications of "Hillside" type habitation. Settlement indicated by Tebenkof. Population about 35.	Bandi, 1967 Tebenkof, 1830
Kangee (Camp Collier)	"Modern" site surveyed by Geist, appears on Tebenkof's map, reoccupied during years of reindeer herding. Population about 35.	Geist & Rainey, 1936 Tebenkof, 1830 p 34

These eight sites are considered outlying from Gambel (Sevuokuk). There are undoubtedly other sites, particularly inland, not yet surveyed. Geist indicated 12 sites within 20 miles of Sevukuk (Geist and Rainey, 1936 p 32). A total population of about 900 is estimated for the area at peak of "Punuk-modern" expansion.

<u>Powooiliak</u>	A large unexcavated site considered predominately "Punuk-modern" by Ackerman, estimated at 200 before the famine by Muir. Probably larger. Considered a center of habitation.	
Boxer Bay	"Recent" site mostly washed out by sea action, no excavation, indications of "Hillside" type habitation in area. Cliff houses (possible fortifications) also serve area. Population about 150 for area. Habitation indicated by Tebenkof.	Ackerman Geist Bandi Tebenkof

Settlement	Size, Age, Remarks	Authority
Taveeluk Pt. to Siteeluk Bay	Large site (20 houses) unexcavated. Population about 150.	Bandi
Kongkok Bay inland	Large site (30 houses) unexcavated. Population about 200.	Bandi
	Kotzebue traded 200 rain parkas in one day while off-shore just north of SW Cape.	Kotzebue, 1821
	Total population of area estimated at 700 during peak of "late-prehistoric" period of expansion.	
<u>Kukulik</u>	400 is considered optimal size of this community. Stratigraphy indicates habitation continuous (or nearly so) from OBS. Nelson's estimate of 200 dead in 1881 is considered low for population estimate (see absence of children).	Geist and Rainey, 1936 p 225 Nelson, 1899 p 269
Old Savoonga	Hooper's "Village B", with 54 adult males. Population about 150. Habitation indicated by Tebenkof.	Hooper, 1880 Tebenkof, 1830 Foote, 1965 p 228
Eevwak	Small unexcavated "modern" site. Population 35.	Geist survey Ackerman survey
Kiwok	Small unexcavated "modern" site. Population 35.	Ackerman
	Eight sites of habitation along the coast east of Kukulik (see Fig. 1), all may be considered inhabited during "recent - prehistoric" period, during which a total population for the area is estimated at 850, 12 settlements.	Ackerman

Settlement	Size, Age, Remarks	Authority
Cape Siknik	4 middens, several house pits considered "Punuk-modern"	Geist survey Ackerman survey
East of same	1/4 mile long site of occupation, 3 deep house pits, no excavation.	Ackerman survey
	Habitation was noted here by Billings and on Tebenkof's map.	Billings, 1791 Tebenkof, 1830
	Total population estimates for this area could range very large considering the extensive sites. 400 will be taken as a conservative estimate for the entire area.	
Kialegak-Punuk Is.	Kialegak showed 2 large middens, one 18' deep, mostly "Punuk" with OBS at base. Visited by Billings, Kotzebue Elliott and Tebenkof, was undoubtedly a center of habitation until 1878. Fate of inhabitants thereafter unknown. 400 considered likely population.	Collins, 1937 p 29-30
	Punuk Is. showed one very large site which became type-site for "Punuk" culture. Another became type-site for "Okvik".	Collins, 1937 Rainey, 1941
Pukneliyak	No excavation, several middens considered "modern". Population estimated at 150.	Ackerman survey
Cape Niyaphapak	Small site considered "modern". Population 35.	Ackerman survey
Cape Kolowiyi	Three middens, excavation indicates early "Punuk" with "Birnirk" traits. Sized at about 150.	Ackerman, 1961
Locations #16, 17, 18	Untested middens considered "recent-pre-historic to modern", habitation indicated by Tebenof. Population estimated at 35 each.	Ackerman Tebenkof

Total population estimate at peak of recent - prehistoric expansion estimated for the Kialegak-Punuk centers and their six known outlying settlements at 1250.

Summary:

Five population centers are indicated by archeological investigations and by the accounts of early visitors. A total of about 4000 in 35 settlements is estimated for the peak of the "recent - prehistoric" period of expansion best documented by the Kukulik collection (Geist and Rainey, 1937 p 226-7).

APPENDIX 5

Synopses of reports of the Great Starvation of 1878-1880

First-hand reports (or nearly so)

1. Elliott, Henry W. 1882. P. 92-102: a report of his second visit to the south side of the Island, likely on a AK.C.C. vessel. The same report appears in Elliott (1896 p 546).

> Winter of 1879-80 ice closed tight around the Island, winter of exceptional rigor although unusually mild in U.S.; walrus were driven far to the south and east; residents of Poonook, Poogooviliak and Kagellegak perished; nearly 300; recalls strength of Islanders seen during visit of 1874; noted they seemed to be living on walrus nine months of the year; no alcohol mentioned.

2. Hooper, Captain C. L. 1881. P. 10-12: first Revenue Service investigation of a "Rumor of Wholesale Starvation", see Appendix 2.

> Investigated mortalities at four villages on the north side of the Island. Estimates 500 of a population of 1000 died. No mention of villages on south side of Island.

3. Hooper, Captain C. L. 1884. P. 8, 100-101: second Revenue Service investigation with Nelson, Muir and Rosse in company, spring of 1881.

> Visited six villages (probably Kukulik, a small village east of Kukulik, Old Savoonga, Kangee, Sevuokuk and Powooiliak), reported death of not less than 1000 of a population of 1500; notes that the people are looking better, have taken one whale; notes a few died winter 1879-80, but general starvation 1878-79 which people said was cold, stormy with much ice and snow; therefore could not hunt; traded with Hoopers vessel, wanted to trade for whiskey, notes Islanders have acquired a taste for whiskey; but importance to famine exaggerated; notes there was meat in the caches of some dead villages, therefore must have been epidemic; notes that few Innuits remain at East Cape, Siberia vicinity, saw walrus in water but no hunters; speculates that extensive unbroken shore ice and stormy weather cut off food supply winter of 1878-79; saw no indication of struggle or cannibalism.

4. Muir, John. 1917. P. 24-27, 85, 107-110: visited Island in company with Hooper, spring of 1881:

> Attributes starvation 2 years ago to rum, traded on Hooper's vessel obtaining excellent clothing, better dressed than any other eskimo group seen; are tall, strong, etc. and experts in buying rum (have a designated taster); interviewed 15 demoralized survivors of 200 at SW Cape; reports seven dead villages, 200 of 600 left at NW Cape and a few survivors at one of the villages on the east end of the Island (apparently not visited); found considerable walrus hide and skins of other animals at Kukulik; people never quarrel among themselves, quick to joke and quick to fall calm.

5. Rosse, I. C. (M. D.). 1884. P. 20-21: visited Island in company with Hooper, 1881.

> Notes Islanders requested liquor in trading with Hooper's vessel; adds children's corpses were found, therefore no cannibalism indicated; whaling captain visiting during famine said they all had measles or 'black tongue'; does not believe liquor to be sole cause of famine; notes services of interpreter were very imperfect at NW Cape. Contributes interesting essay on the role of liquor in the Arctic.

6. Nelson, E. W. 1884. P. 85 ff: weather observations 1887 to 1881 for St. Michael are presented in summary form; detailed auroral observations.

> Reports unusually excessive ice in St. Michael area of Norton Sound winter and spring of 1880.

7. Nelson, E. W. 1899. P. 25, etc., 258, 269-270: throughout "memoir" describes St. Lawrence Island segment of 10,000 specimen ethnographic collection of the Bering Strait Eskimo, obtained mostly at Kukulik.

> Notes St. Michael interpreter had great difficulty on Island; speculates that a "prolonged whiskey debauch" cause fall walrus migration to be missed, and famine resulted. Visited: 1 village north shore, 2 houses, 25 dead plus a few on the ground; eastward a second village with 200 dead, wonders at the total absence of children, concludes that the savages must have eaten them; another

village at "NW point" of Island (means SW Cape) found 12 survivors strongly demoralized, living in the presence of about 100 dead. Obtained a large collection of skulls subsequently analysed by Hrdlicka (1940).

8. Otis, Harrison. 1898. (1) P. 114: special agent in charge of the Fur Seal Islands:

> Reports weather conditions for the Pribilof's 1878-79 as very mild, with no ice appearing on the sea during the winter, warm temperatures; the ice limit May 25 at about 200 miles northwest. Inhabitants were short of food during late winter.
>
> Vol. 1:p. 127:
>
> Reports heavy pack ice on the shores of St. Paul, for winter of 1879-80, very cold winter temperatures and a delay in the commencement of the sealing season.

9. Healy, Captain Michael A. 1889. P. 12: report of Revenue Service visit to the Island fall 1884.

> All villages on north side abandoned except NW Cape where people are healthy of appearance and have excellent clothing. Concludes there has been no liquor trade.

10. Jackson, S. 1898 (III) P. 541 ff: a decennial report on education in Alaska in which the general reduction of populations of food species is noted in the Bering Sea region (see text p. 26); Epidemic and famine on the Siberian Coast.

11. Gambell, V. C. 1900. (4) P. 240: popularized writing by first school teacher:

> Nine years before arrival, a trading vessel sold a large quantity of whiskey in exchange for nearly everything possessed by the village; drunken orgies were constant. Nine tenths of the population died during the winter from starvation and disease. No liquor had appeared in the village for nine years then "Hoonakia" a native woman from Cape Prince of Wales or Pt. Hope was set ashore by a whaler and started home brewing liquor which she bartered to village.

Informant Reports

12. Moore, R. D. 1912. P. 356-358: first informant report obtained from Oghoolki:

> Whisky was traded at NW Cape in the summer before the famine. There was therefore little hunting thereafter and food was short by October. Little food was obtained until April of the following spring. Men were lost on the ice while hunting, being very weak. Young boys did much of the hunting. Traded whisky for food at SW Cape. Few deaths occurred until spring when many resulted from over-eating. Man visited from Punuk Is., where there was no fall famine. Some survived by trapping and eating foxes, some by eating clothes, dogs and harnesses. No cannibalism occurred, notwithstanding a whaler visiting following spring who suggested they eat their women (probably a pun).

13. Keim, Charles J. 1969. P. 117, 118-122: full quotation of notes on famine collected by Otto Geist during his stay on the Island 1926-35. Report is extensive but garbled. Only information additional to Moore is quoted here.

> Two famines occurred: 1876 and 1879-80. Kukulik and Kialegak people came to Gambell for meat. Everyone had a disease like diarrhea, and most died after famine. Traded for meat at SW Cape where they had gotten fall seals with nets. No boats touched Island in fall, but there were many in the spring. The traders Kamney or Gamney and Captains Lyre Balen or Roy Bailley or Keeley. There were earthquakes in the fall, much east, southeast and south winds and in 1879-80 the ice did not arrive before February, which was weak when it came. Ungalak caught whale in April with a crew of mostly women and boys. Okamananga, Otiyohok's grandfather came from Punuk to buy dogs. Whisky was sold to Kukulik and Kialegak.

14. Giddings, J. Louis. 1967. P. 169: informant Oittilan (Ouatalin):

> A period of slow starvation typified the time with bad weather (wind) all the time. Thin ice kept hunters ashore. There was no stored food. In a starved and reduced condition, disease overcame the people.

15. Colby, Merle. 1939. P. 382-383: Source of information unknown,

not found in any citations given for coverage of St. Lawrence Island.

> States that there exist very few narratives of trading on the Island, but one has been preserved: in 1880 a whaler stopped at SE Cape and traded grain alcohol cut with water and syrup for ivory, whale bone and furs. Also a harem of village women was selected and paid in alcohol. A prosperous village was left drunk and destitute, having even cut up and traded skin boat materials. The hunt (perhaps fall) was missed and starvation followed. About 25 survived.

16. Fay, Francis H. 1973. personal communication: notes from discussion with Jimmy Otiohuk at Gambell. The opinions occasionally expressed during the field research year concerning the famine agree closely with those expressed here.

> January 14, 1956:
>
> Jimmy says that, according to E. W. Nelson, the Kukulik and Kialegak people starved to death due to lack of food in the winter prior to his arrival, but this was not the case at all. They had been short of food, alright, the previous fall and winter, due to unusual ice movements, but very few died because of this. In January there was good hunting and they had plenty of fresh meat, but then they all got a bad case of dysentery and many died very suddenly. The survivors departed for Gambell, leaving the others behind with full meat cellars.
>
> February 8, 1961:
>
> Otiohuk says that he and Otto Geist got the full story from Soolook, father of Lloyd Oovi and Nathan Noongwook. There was a famine, alright, from November '79 to January '80. The ice came in November but was blown northward again, right away, and there was rough, open water all the time until January. The people grew very thin in those 3 months, but very few died from it. Then the ice finally came again in January and stayed. 'Lots of game when ice come late like that.' The people got plenty of game but were still very weak, and a few more died. The most died in the days after, not from lack of food but from very severe diarrhea. The Kialegak people had left their village earlier, in the fall, during the famine, leaving the dead behind.

17. Petroff, Ivan. 1898. P. 279: report on the population and resources of Alaska.

> The 15,000 lb. of ivory taken by the 36 sailing craft and 4 steamers working off the Alaskan coast in 1880 Petroff estimates as representing a kill of 10,000 walrus, and predicts hardship for the population dependent upon them.

CHAPTER II

A DESCRIPTION OF THE HABITAT AND BIOTIC COMMUNITIES OF THE NORTHWEST CAPE

1. Introduction

As stated in the introduction, the purpose of this study is to assess the role of local food resources in the function of the community at the Northwest Cape of St. Lawrence Island. The subject of study, the hunter, and the biological bias of the approach were defined. The first chapter described the changes in the size and distribution of the human population over the last one hundred years and broached the question of prosperity. It was established that the functional population unit is that of the Island and its mainland connection. Integration into the mainland social and economic systems appeared mainly dependent on the efficiency with which problems inherent in the geographical isolation of the Island are overcome. The role of the Island-mainland connection in the resource system of the NW Cape will be discussed in Chapter III. It was also established that the Cape is the only site on the Island where habitation has continued from earliest times and has been uninterrupted since European contact. The conclusion required is that this area has better fulfilled the needs and desires of the inhabitants that any other Island area. The present task, therefore, is to describe the prominent physical and biological features of the Cape area. The context of hunting activity discussed in Chapter III may then be established and the question of how the Cape happens to be the best habitat of the Island may also be addressed. Since the institutions of convenience (schools, church, store, unearned income) were inoperative at the time of the famine it is proposed here that their subsequent presence does not wholly suffice to answer this question. The universal first impression of the desolation and inclemency of the Cape environment has led visitors to conclude that the apparent relaxed atmosphere of the community would be impossible without these institutions. This discussion intends to present a different aspect of this continuity: the habitat is rich in biological forms and the community prospers thereby. Three concepts are therefore required for this discussion: habitat, community and prosperity.

The concept of habitat as used here is taken in two senses (Odum, E. P., 1971 p 243, 295). The first describes abiotic elements of the places where life forms occur. For the purpose of their description, which occupies the second part of this chapter, the life forms are set aside for the moment. The other sense of habitat used in all other discussions is that in which the functional environment (abiotic and biotic) of a single individual, species or population is described.

Community as used here designates any assemblage of populations with unity of taxonomic composition, a relatively uniform appearance, a definite trophic organization and a definite metabolic pattern (Odum, E. P., 1971 p 140). Two types of communities appear applicable to the Island: major communities, which are of sufficient size and diversity to function independently; and minor communities, which require inputs from adjacent communities. In the third section of this chapter three major communities are defined which provide inputs to the human (minor) community.

Prosperity as used here requires the consideration of human values. This study does not consider motivation, role definition, goals, sentiments or the like. It is useful, however, to establish criteria against which a judgement may be made of the question couched somewhere in every study of resource systems: is it a good system? Are the Island men good providers, are they rich or are they poor; are the hunters good conservationists, or are they thoughtless opportunists; are the people of this community content where they are with what they have, or do they remain against their wishes; do their ways express a system to be admired, encouraged and emulated, or is it just an interesting anachronism? Some authors consider hunters rich, wise, happy and admirable just because they are hunters. Others, especially older, authors consider them abject savages for the same reason. It is appreciated that such questions occupy whole disciplines of study. Their consideration here is limited to the purpose stated, even though their consideration has influenced many aspects of this study. The temptation is to hope that a biological interpretation of concepts such as adaptability, permanence or efficiency might satisfy any cultural context. They do not since the study of culture never leads to universal explanations of human behavior (Steward, 1955 p 9). The alternative is to abandon the search for objective criteria altogether and to define those of the culture studied. Such an approach seems fair to all but is also fraught with difficulties. It is perhaps more presumptuous for someone strange to the society to attempt reification of its dynamic functional principles (which undoubtedly exist!) into propositions, than to apply his own. The attempt is nevertheless made, and should be considered in the context of Hughes work on "sentiments" (see Appendix 6).

Proposition 1: The mother tongue is highly valued.

Proposition 2: Food from local sources is highly valued.

Proposition 3: Next-of-kin are highly valued.

A value is relative and in this case a hierarchy is definable:

Proposition 1: I would rather speak the dialect of my family and tribe than any other St. Lawrence Island dialect.

I would rather speak other St. Lawrence Island dialects than any dialect of the American or Siberian mainland.

I would rather speak any dialect of the American or Siberian mainland than to speak American English.

Proposition 2: I would rather eat whale than seal.

I would rather eat seal than walrus.

I would rather eat walrus than bird or fish.

I would rather eat bird or fish than imported food.

Proposition 3: I would rather associate with my wife and children than my siblings.

I would rather associate with my siblings than with other members of my clan.

I would rather associate with other members of my clan than with other clans of the community.

I would rather associate with other clans of the community than with the people of other Island communities.

I would rather associate with the people of other Island communities than with people born and raised off the Island.

It is of course true that for individuals at given times none of these behaviors hold any value at all, even of the older generations: English is spoken at home, imported foods are eaten as often as possible, families are abandoned. But behaviors which touch these propositions appear continuous from what is known of the history of this population and were constantly encountered during this study. For individuals who find much to value where they are, these propositions ramify widely. These are the individuals this study is most concerned with. For others, they can be of no significance whatever. Any judgement, then, of the system at any point in time may be based (with this interpretation) on the following statement, made by a male head of family:

> The best that I can do is to provide an ample supply of fresh and varied food to my family and to as many of my next-of-kin who will accept it.

This statement is not simplistic. It connotes a participating wife, a warm house, admired clothing, good hunting implements, a family with members across a wide range of ages, efficiency in hunting, respect from the community. It is the continuity of the family, rather than the growth and proliferation of the society, that is supported. Those people sharing the same house, with its sleeping rooms, storage rooms, work rooms and kitchen comprise the production unit of the economy. It is around the family that economic elements integrate. It is from the devaluation of the family, of the physical support it requires and the diverse social elements it offers, that devaluation of one another and of the society as a whole derives.

In the discussions of habitat and the biological communities which follow, the areal focus is the western Island and waters, and especially the NW Cape. Considerable difference exist between north side and south, between west side and east, and this discussion does not apply to those areas unless specified. The role of prepared commercial foods is not considered for the moment. Withall, the basic criteria for inclusion derive from the food habits of the human population.

2. The Habitat

In the following description of prominent physical features of the NW Cape area attention is given to land forms, surrounding waters, weather and climate, and sea ice. The areal limits for each are extended to unique features which appear important to the biotic communities discussed in the following section.

A. Land area

The name given a place often provides a clue tc its outstanding physical quality or useful characteristic. Divisions of a land area in terms of geology, ground features, land forms, vegetation patterns, faunal habitats or the like may or may not be useful depending on the interests of the human population the area serves. If the land area is conceived as useful for agriculture or for domestic animal grazing, for mineral resource development or as a recreational areas, or for all of these, quite different methods of classification apply. Planning for land use development may be a task already before the councils of the Island settlements. Geologic reconnaissance and stream-bed sediment analysis was completed for the western Island in 1970 (Patton and Csejtey, 1971) and commercial mineral exploration took place the summers of 1971 and 1972. For this discussion the primary interest is in what purposes the Island land area serves the hunter.

That currently used place names bear a relation to the uses an area serves is indicated both by the meanings of some of the names themselves and by the existence of a much more extensive toponymic vocabulary among reindeer herders. About 200 place names for the western Island were collected from two informants during the course of this study. A small selection of these is presented in Fig. 6 and legend for the NW Cape.

Of immediate interest is that no translation could be found for marine areas such as "ocean", "sea", "bay" or "sound", as well as no proper names. In contrast to this, land areas are named in detail, down to the smallest feature, although large and important land forms often do not receive a proper name. Aatneq (point), tapghaq (beach), nayvaq (lake), nygaing (the mountains) apparently suffice. This parsimony may be taken to indicate a very practical approach to place naming, in contrast to the more ephemeral purposes names served early explorers of the north. That these descriptive names are repeated for important land forms of the western Island does not indicate an off-handedness, but rather that each tribal area had its principle beach, mountain, lake or lagoon and point (Ray, 1971 p 1). Tribal land divisions are well known for the Island.

There is some indication (Kotzebue, 1821 (1) p 187 and Elliott, 1875 p 222) that the Island itself had not one name but two: Sevuokuk, the western part and Kialegak, the eastern part. The meaning of Sevuokuk (a place wrung out dry) gives direct indication of the primary use of the land for the hunter: it is a place to dry out. Periodic drying is required for the maintenance of clothing and boat covers. It is a simple function but it is critical. Another critical function served is that of navigation. A land-point compass reference is especially important when the play of currents around the Island is considered. When fog is expected during the long spring boat hunts a reading from the mountain east of the community is taken as soon as the course away from the Cape is established. Land forms also serve overland navigation. Travel overland in summer presents no problems for the resident but winter travel is another matter. Here, the names given a place are often descriptive of a physical characteristic (Kangii: its corner, especially a lagoon or coastline), the distance of travel (Qavalghaq: a place to sleep, likely with reference to overland travel) or a physical oddity (Llqiilek: a thing (rock) having a visor). Another cluster of place names define a use function of an area (Kyaillgit: a place to beach kayaks) or a prominent resource (Ugghfiq: a place where walrus haul out).

Four elements, then, appear important in the traditional conception of the land: a dry place for shelter, a navigational aid and surface for travel, a place for finding food (mostly from the sea) and a designation of the area of origin and traditional use of the tribe and family. This use is often privileged use of the resources of that area, which is still respected. Place names from particularly important areas are used in naming persons of that family when names of recently deceased relatives are not available. A detailed division of lands on the basis of these elements must define tribal areas, topology and prominent resources. Such a division has been recently accomplished by the land claims filed by the families of the Cape. There is no question that the home area of the residents of the western Island is the NW Cape. Almost an Island itself (elevation at its southern limit reaches just over 50 feet) it has its own extended land point, its own beaches, its own mountain, its own rich near-shore waters and its own large lake. That its lake does not produce food resources necessitates the extension of the settlement base along the north coast of the Island to the Niyrakpak Lagoon. The Island has been divided east to west by resident petition nearly twenty years ago (Federal Field Committee, 1968 p 466) between the settlements of Gambell and Savoonga. Although not of great importance to the relationship of the settlements at the present time, the 600 square miles of the 2000 square mile Island (Patton and Csjtey, 1971 p 62, figures approximate) does delimit both what is conceived to be the land of the Gambell residents and the land most used by them. As related many times, the Cape people are all one now and the land is, in general terms, used by all. This was not so in the past as the people of Sevuokuk, Kukulik, Poowoiliak and the other major settlements had their respective land areas, even to the extent that trade was frequent between groups harvesting species during periods of abundance. For most present purposes, the 600 square mile land area with its just over 100 mile coastline (115 including the lagoon), is shared by all. Only on extended spring hunts or when under contract with visitors do Cape men work beyond this area. During the greater part of the year (all seasons except spring) the area between Taphok and Kitneapalok (24 coastal miles) is by far the most frequently used. In mid-winter, the area of frequent use does not extend much beyond the Gambell-Meruchtu area of the Cape (fox trapping excepted). Overland and boat travel distances are listed with Fig. 1.

The topology of the Island and the immediately adjacent sea floor may best be understood in terms of volcanic activity (the latest not more than a few thousand years ago; see Silook, 1970) centered in the Kookooligit Mountain area extending as far southwest as Boxer Bay, overlaying bedrock deformation. The dominant land form of the Western Island is the Poovoot range, a group of barren, rubble-covered hills extending from Ivekan Mountain in the Kongkok Basin area on the southwest coast, northeast to Taphok Mountain on the north coast, elevations about 1700 feet and 1200 feet, respectively. The range is divided by a lowland area which flanks the range on the southeast, the Putgut Plateau, which is a flat wet tundra and lake area 100-200 feet above sea level extending to the large south lagoon. A similar area flanks the range to the northwest and includes the large Aghnaghak and Niyrakpak Lagoons. Narrow boulder beaches occur on the west coast. Prominent cliffed headlands occur along the SW Cape, and on the NW Cape the single prominent headland formed by Sevuokuk Mountain (elevation 600 feet). Occurrences of minerals (molybdenum, copper, lead, zinc and silver), coal and glacial drift have also been reported (Patton and Csejtey, 1971 p C3, C5-C8).

The geology of the sea floor surrounding the Island is of great importance but is as yet not well known. Bottom features have been surveyed however:

rock outcropping:	common in the 10 fathom zone, frequent grading to none beyond
sand:	50-70% of near-shore bottom, grading less in all directions (Lisitsyn, 1969 p 9)

The general bathymetry of the Island waters is included in Fig. 8. The impression is one of an irregular bottom area east of the Island with 10 to 20 fathom depth, a large platform north of the Island at about 20 fathoms, a large platform south of the Island at about 30 fathoms and a channel grading south to north from deeper than 40 fathoms to 30 fathoms at the latitude of NW Cape. This channel is of the greatest significance to the walrus and whale migration patterns and is one of the important reasons the habitat of the NW Cape is the richest offered by the Island. In this channel occur high standing crops of whale and walrus food species, unstable ice conditions and a major south-to-north ocean current. These features and their relation to wintering herds of walrus and to the migration routes the whale, walrus and seal populations are expanded below.

B. Island Waters

Basic data on the Bering Sea and Island waters is included in Appendix 7. Features of importance to the structure of the biotic community deserve mention here. Of first importance is that the Bering

Sea is a gulf of the Pacific Ocean which is its main source of water mass. This, and the shallow depths of much of the basin, give rise to a main structural feature: an intermediate cold layer at 150-250 meters with warmer layers above and below. Deep waters are recently arrived from the Pacific Ocean and enter at warmer temperatures (1.5-3.0°C). Surface waters, 25-50 meters, are warmed by insolation during their stay in the Bering Sea. These waters comprise a portion of the Aleutian Island outflow. But summer heating does not penetrate the entire water mass cooled during the winter, which will be warmed only after mixing and upwelling occur. The effect resembles permafrost. Vertical circulation is inhibited and deep water nutrients do not mix to the surface. The limit of phytoplankton growth is therefore set by the surface nutrient supply. Rapid phytoplankton growth can occur only when this stratification is broken. The intermediate cold layer and surface thermal gradients are therefore responsible (in addition to the air temperature and insolation regime) for the two annual blooms in Bering Sea waters: the first and largest spring bloom after late winter mixing of waters, and the second smaller early fall bloom when insolation is sufficient for deep-water upwelling and the descent of depleted waters (Lisitsyn, 1969 p 86, 91). The presence of warmer deep waters is much reduced in the shelf area of the Bering Sea but thermal stratification nevertheless generally occurs. A third bloom of microalgae on the undersurface of ice presently under investigation may prove to be an important element in the productivity of these waters (McRoy, 1972 p 199). Permanent current patterns in the vicinity of St. Lawrence Island are composed of a "Transverse current" flowing southeast to northwest south of the Island, which splits into the "Lawrence current" coursing along the east side of the Island and the remainder of the Transverse current which joins with Anadyr Gulf outflow as it travels north on the west side of the Island. An anticyclonic gyre occurs off the southwest coast of the Island. A final important general characteristic of Bering Sea waters is that overall water transport south-to-north is small, about 0.6% (Lisitsyn, 1969 p 92, 95).

Like many areas of the Bering Sea coast, the Island experiences irregular semidiurnal tides. On-shore observations during the field research period indicated that these tides create coastal currents (discussed below) of the greatest significance to the sea ice hunting conditions on the west coast. The flood tide flows north to south, the ebb in the reverse direction. Tide ranges are not great except during wind tide conditions (estimated maximum spring tide 2 meters, almost 6.5 feet) and extensive shore ice shelves do not develop. Tide in itself does not seem important to the hunter but only as it relates to current changes, or perhaps as a storm indicator.

Sea swells (and waves) appear responsive to wind velocity and direction, sometimes preceeding and sometimes following their onset. North and northeast winds bring swells from the north. Southerly winds bring swells from the south or southwest along the west coast but from the east along the north coast of the Island, mixing at Gambell point (see Fig. 7a). The leeward coast of any wind has smaller swells and may have none at all when the storm is rising or subsiding. During ice-free periods swells alone define navigable waters. High winds may create troublesome capping but the swells are never far behind. The weight, draft and flexibility of the 25-30 foot skin boat limit these craft to swells less than four feet. Generally, winds of Beaufort 3-4 (13-18 mph) are their upper limit of navigation. For the Island climate, this limitation is severe. The Siberian traders traveled the northern coasts of the Bering Sea in skincraft much larger than 25 feet (Hrdlicka, 1930 p 96, photo opposite). The 15-17 foot plywood runabouts made by the hunters handle seas comparable to the skin boats. They can be forced into even heavier seas but seldom are. No larger craft were in service during 1970-72.

Coastal tide currents are certainly influenced by winds but never seem to lose their basic pattern. A close watch of water movements at the shore line during the fall season revealed the following typical pattern: currents from the south on the west coast and from the east on the north coast meet at Gambell point. Surf direction is often south to north on the west coast but tracks in both east and west directions on the north coast. Fig. 7 sketches this pattern with the accompanying winds and swells stabilized over the preceeding twelve hours. The current as sketched in Fig. 7a is the ebb tide current (south to north) called Maknuq. The flood tide current (north to south) is called Igevergaq. In its clearest form all waters except that trapped in Kittelingok Bay travel south. Only with the arrival of the first shore slush ice could the current patterns actually be observed. On November 24 the low tide to high tide change at Merughtu (1100 hrs.) was shown with clarity by a 30-50 yard strip of ice 10-15 yards offshore. As sketched in Fig. 7b, c, and d the ice trailed seaward along the current interface. As the east to west current in Akuftapak Bay is considerably slower than the south to north current on the west coast, the current change stabilizes more rapidly. At the end of the change (about 1230) a 5-10 yard strip of slush ice lay against the shoreline. After the arrival of the shore slush ice at the Gambell point area on December 1, the current patterns there could be surmised as sketched in Fig. 7. The position of the arc of slush off the point was a good indicator during this time of the current stage of the tide change. It is apparent that it is not possible to observe the tide current changes on both sides of Sevuokuk Mt. at once. This summary and the Fig. 7 are a synthesis of many observations. It was never possible to fully clarify the relation of the tide change events at Merughtu to those of the Gambell point.

It should be noted that old settlements are located just onshore of these two prominent current interfaces. When the low tide (south to north) Maknuq current is running the interface is prominent at the Gambell point throughout the middle portion of the change but absent at Merughtu. When the high tide (north to south) Igevergaq current is running interfaces are prominent early in the change off Merughtu and during the middle portion of the change at Gambell. As the currents change, their interface swings around the west shore, with Gambell point serving as its fulcrum. The interface stabilized off Merughtu during high tide but is absent during low tide. The small gyre (Angi) in

Kittelingok Bay rotates clockwise during Maknuq and is either stable or rotates slightly anti-clockwise during Igevergaq. This may be taken as the basic current pattern of the Cape.

C. Weather and climate

Weather is defined as the general atmospheric conditions of any place at any time. Climate is defined as the characteristic weather conditions of a place averaged over an extended period of time (Gates, 1972 p 3). The discussion which follows is mostly concerned with weather. Climatic averages determined during the winter field period (October-May) and compared to averages obtained by U.S. Weather Bureau and U.S. Naval stations are included to substantiate weather patterns observed and to indicate deviations from the average during the winter research period. The standard observation used included time, temperature (a common household thermometer), wind speed (hand anemometer), wind direction (eight point compass), precipitation (visual), cloud cover, sea swell heights, sea current direction at Gambell point, ice conformation and finally, the form of hunting seen during the day. Tide range, current speed, ice thickness and other useful measurements were not taken.

The fact that the following statement could be made only after some seven months of field observation is an indication of the complexity of weather patterns at the Cape.

> It is now clear that the winds bring the storm, the water and the ice. The wind, water and ice bring the hunter to the animals. The animals are there. It is also clear that the wind, water and ice follow patterns. Their effect on hunting activity is therefore patterned. (January 19, 1972).

This is perhaps another way of saying 'Every wind has its weather' (Gates, 1972 p 42). The hunter is not dependent on weather instruments to make the necessary decisions, although he may make occasional use of a barometer. No comment on the weather is taken lightly even if given in passing. Its constant observation is an integral part of life of everyone. The perceived interrelation of climatic elements of the Cape, quite apart from the theory of meteorology, give order to the descriptions presented below.

As stated, the wind brings the storm, the waters (unusual tides, swells, precipitation) and the ice -- or at least, so it seems. Storm tracks, based on sea level barometric pressure readings, lie very close to the Island for all months of the year except April, May, June and September (U.S. Navy, 1956 np). Seasonal patterns of wind directions are the following:

> November through March winds from the north and east are most common, winds from the south occur seldom; during April and May northerly winds are progressively less dominant until the summer months June, July and August when southerly winds predominate although not to the degree winds from the north and east predominate during the winter months; the north and east winds once again begin to predominate during September. Winds from the south reach their peak percentages in July. Winds from the north maintain their peak through December, January and February (ibid).

The significance of these events to the hunting alternative chosen is a constant test of skill for the hunter. It is the patterns or consistencies which must be learned and understood. Some guidance is provided by the names given wind directions which are oriented geographically. These directions do not precisely match directions of the compass.

Approximate Direction	Name	Translation
N	Quutfaq	(none)
NNE	Akiknnaq	wind southing from east
NE	Aywaaneng	wind from the north
ENE	Nakaghya	(none)
EEN	Naasqughhaaneng	wind from the point of the mountain
E	Asivaq	(none)
ESE	Lliveghneng	wind from the cemetery
SE	Ikevaghlluk	wind from the bad side of south
SSE	Nayviinaq	wind from the lake
S	Ikevaq	(none)
SW	Tapgham Ketanga	wind from seaward of big beach
W	Pakfalla	(none)
NW	Naayghiinaghmeng	wind from the mountains (of Siberia)
NWN	Kenvaq	(none)

Important observed consistencies are inherent in these names. Quite a clear correlation exists between wind direction and air temperatures, and consequently precipitation (U.S. Navy, 1956). The warmer temperatures accompany winds from the south, the colder temperatures accompany winds from the north. Warm moisture-laden air evidently cools as it moves north bringing precipitation, fog or mist-rain. Thus the name, 'bad side of south'. Ikevaghlluk is the bad weather wind. It would seem that really cold weather (i.e., good weather) simply never arrives from southerly directions. If a hunter is pressed to name the good weather winds he will usually name Quutfaq and Naayghiinaghmeng.

Little comment is made of temperatures except during a period of unusual cold (defined here as less than -10°F) and there does not seem to be a large vocabulary to define them. Cold in itself is never a deterrent to activity. It was reported that the winter of 1969-1970 had one one-week period of cold weather and 1970-71 had a two-week period. The winter of 1971-72 had temperatures less than -10°F December 16-19, January 5-14, February 11-18 and March 15-28, all associated with or following north winds. The coldest temperature recorded was -25°F on January 4 with winds from the north at Beaufort 3. These periods were accompanied by good hunting which does much to explain why cold periods are watched and remembered. Occasionally cold does occur sufficient to 'stick the eyelashes together', but not during 1971-72.

On first appearance moisture-bearing clouds arrive from any direction. Both opinion and weather data however favor the southerly winds, as already stated. Heavy rains are very unusual, drizzle, mist-rain and fog being more common. A thaw with drizzle rains may occur any winter month but is rare in February and March. Heavy rains may even occur in January. The most prevalent form of winter precipitation is not falling snow but blowing snow. Names given common precipitation types are:

eslalluk	all bad weather
eslallugughtaa	raining

aghinaq	mist, rain or snow (any weather which wets the body)
qesighaq	drizzle rain
qanik	snowflake, snowy weather
ung'avikanghaaq	small light snowflakes
umegneq	blizzard, snow storm
anigu	snow on the ground
pightuq	snow blowing low over the ground
kaftekrak	hail
kaneq	frost or rime
manuli	breath frost on parka ruff
tagituk	fog
qilawaaq	cloud
lalala	dew
pugughpak	mist from an ice lead

Cloud cover and precipitation in one form or another are almost constant at the Cape. The average number of days with clear skies is about 32 (U.S. Department of Commerce, 1952).

Summaries of wind, precipitation and temperatures appear in Table 3 and Table 4 for the seven winter months of 1971-72. A comparison of these figures with monthly averages presented in Fig. 11 (U.S. Navy, 1956) indicate that: 1) more southerly winds occurred than usual for the months of October, December, January and February, 2) more northerly winds occurred than usual for the month of March, 3) percent of winds with speeds of Beaufort 4 or greater were less frequent for all months,

4) percent of occurrence of precipitation was notably greater in January, February, March and May than average values, 5) October and March temperatures were colder than average, November and May temperatures were warmer than average. Temperatures for all other months did not greatly diverge from average values.

A concise picture of the annual climate of the Cape is presented by the 1944 to 1952 summary of data collected by the U.S. Weather Bureau (U.S. Department of Commerce, 1953):

Mean monthly wind speed ranges:	April - September:	16.9 - 12.4 mph
	October - March:	18.6 - 23.0 mph
Month of maximum wind speeds:	November:	23.0 mph
Month of minimum wind speeds:	June:	12.4 mph
Prevailing wind direction:	NE, NNE or N for all months except SW during July and August	
Precipitation:	mean annual total:	15,83 inches
Month of maximum precipitation:	August:	2.60 inches
Month of minimum precipitation:	June:	0.60 inches
Mean annual total of sleet, hail and snowfall:		79.7 inches
Maximum during December:		13.7 inches
Mean daily maximum temperature range:	all months	47.9 - 8.4°F

Mean daily minimum temperature range:	all months	40.6 - -2.4 °F

The information presented here on weather and climate for the NW Cape is sufficient to allow tentative definition of what appear to be obvious patterns. Two periods of major change in weather patterns occur in November and early December when sea ice is forming and in April and May when sea ice is receeding. When sea ice is at its maximum, the direction of winds is least variable, the majority being northerly. When ice cover is absent, wind direction is most variable, southerly winds dominating the mid-summer period. As noted in following sections the food species available also change during these fall and spring periods. Winds are stronger during the winter period but there are also more days of calm. The more consistent winds of the winter period and more days of calm weather allow more consistent exploitation of productive areas, particularly along the north coast of the Island, and a more settled period of residence for the hunter. Although not common, southerly winds can occur at any time during the winter month, resulting in open water area on the northeast and an increased assessability of food species.

'Each wind has its weather' and, as well, 'each wind has its ice', in terms of accompanying temperatures, percent occurrence of precipitation and the conformation of sea ice or sea swells. Precipitation and windy weather are very common; calm and sunny weather are very rare.

D. Sea ice:

The general ice regime of the Bering Sea is influenced by the following factors: the permanent current system presses the ice northward, the climate of the southern Bering Sea is considerably milder than that of the northern areas, areas of low water temperature and low salinity freeze first (Lisitsyn, 1969 p 98 ff). The interaction of land masses, rivers and winds creates consistent areas of unconsolidated young ice and open water south of St. Lawrence Island, south of the Chukchi Peninsula and at the mouth of the Yukon River. Centers of ice formation from which ice is dispersed by wind are Bering Straits, Gulf of Anadyr and Korf Bay. Ice mass at maximum extent is estimated at 1800 km^3: thickness of the pack is 1 - 1.5 meters (sometimes reaching 2 meters); from 95-97% of ice is of local origin; about 3% is carried south through the western Bering Straits in the fall; about 68% of the ice melts where it is at break-up; about 20% is carried north through the eastern Bering Straits in the spring. Specific drift patterns are not known. Maximum southern extent is reached in late March and April (ibid).

The formations depicted in Fig. 8 are of the greatest significance to both the local ice regime of the NW Cape and to the distribution of ice-inhabiting pinnipeds. Sea ice patterns and chronology are considered last in this description of the climate of the NW Cape since these patterns cannot be understood without reference to every other climatic element in the region. It is hardly possible to describe any one assemblage of leads, shore ice and pack as typical. A set of formations are typical and one year's observation is not sufficient time to become familiar with them. Yet, it is safe to conclude that the formations for the winter 1971-72 were not all unusual and that consistencies are indicated in Fig. 8. This information may be amplified by shore observations made during the research year.

September 30, 1971	first freezing temperatures, first snowfall
October 22	inland lake waters begin freezing
November 5	slush ice appearing at Akeftapak
November 6	young shore ice reported at South Kangee 20 to 50 feet out
November 15	shore-fast ice definite at Akeftapak, shore slush ice obstructing hunting
November 24	10-50 yard shuga at Meruwtu shoreline
November 30	Tapghaaghaq: slush ice to 50 yards out, grease ice to 1/2 mile out Aatneq: slush ice to 20 yards out, grease ice to 300 yards out Tapghaq: slush ice 10-50 yards out, grease ice to 1/2 mile out
December 1	first off-shore slush and brash ice appear at Gambell point

It was never possible to determine if first year ice of the main Bering Sea pack ever 'arrived' at the waters north of the Island, as ice formed on the eastern and southern coasts of the Chukost Pen. and ice formed locally, dominated the ice-in period).

December 3	Hunters first walk on ice at Meruwtu
December 5	Hunters first walk on ice at Kittilngook Bay
December 16	Multi-year ice reported off Uyugunat
December 19	All ice except shore-fast ice disappears
December 29	Brash ice reappears
January-February	Ice generally consolidating, variable to open pack, becoming close pack at end

	of period except under south winds
March	close pack, greatest ice stability
April-May	slow ablation begins, ice arriving from north less consolidated, open water and young ice more common as period progresses swells and bare ground first reappear at end of April, very open pack and much rotton ice well off-shore most of May

The direction and speed of the winds most strongly affect the distribution of the pack. To the leeward of land masses open water areas consistently develop so long as another factor (such as strong tide currents) do not override the effect. The open water area south of St. Lawrence Island is the largest and most consistent of the entire region. It appears that only with unusually predominant southerly winds does this large polynya close.

In attempting to establish a generalized pattern of shore and pack ice around NW Cape a mid-winter period was chosen (February 21-29), before which northerly winds predominated. During and just prior to the period, however, southerly winds freed some of the pack ice attached to shore fast ice. The resultant distribution by area and ice type is shown in Fig. 9. Generally to scale, the ice map shows maximum shore ice formation which was stable for the 1971-72 season under southerly winds, none of which were really extreme. The very considerable amount of open water shown did not exist at all immediately prior to this period. This instability of all but the most protected north and northwest shore ice during all months of the winter has four major consequences: the breeding habitat available for the ringed seal is small, walrus may be present throughout the entire winter in small numbers, boat hunting is possible periodically throughout the entire winter, the non-fast ice is never safe for the seal hunter.

When the tide currents (Fig. 7) and the relation between the moving pack and the shore-fast ice (Fig. 9) are considered, observations made during one day (February 2) become more intelligible. Fig. 10 depicts the sequence observed.

> Very small leads were visible about 3 miles off Gambell point to the northwest throughout the day (February 2) and on the day previous. Very strong northerly winds January 31 closed all leads. Current activity (winds were calm) the following day was not sufficient to open larger leads. Young ice present February 2 (A.M.) however indicated that leads had developed overnight. By 0930 the west shore lead was open opposite the north end of the lake (see Fig. 10). By 1100 open water areas developed north from the west shore lead, the point lead and the off-shore bay lead opening as well (current flow from the south). The east-to-west eddy current in Gambell north beach bay is absent. By 1300 open water occurred to the north and northwest and the Merughtu lead was open as well. Discrete flows observed from the top of Sevuokuk Mt. are sketched. By this time the direction of the current and ice flow had reversed and the maximum of open water passed. By 1700 only very small leads were apparent north and northwest of the Gambell point. These were fast closing with new ice (formed nightly). The large west shore lead was reestablished.

These events are remarkable in their speed and compexity, even in the absence of strong winds. They are patterned (however varied) by tide currents, winds, and differences in ice types. Three principle areas of occurrence of open water emerge: the west shore lead, the Gambell point-bay-mountain lead and the Merughtu lead. Although highly variable, that their location may be known in advance allows the hunter to become skilled in selecting the right place at the right time. Abstracting from the example given, the basic pattern (best seen under calm or light northerly winds) emerges: current from the south (ebb tide) closes the west shore lead, opens the point-bay-mountain lead and towards the end of its flow, the Merughtu lead. At the time of current change the leads begin to close, but the point-bay-mountain lead remains open during the strong running of the flood tide current from the north. The west shore lead begins to open as the northerly leads close. The return of the current from the south will again close the west shore lead and the whole process is repeated. It is to be expected that these leads are associated with eddys (Kittiengook Bay and west shore) or the interface of currents (Gambell point and Meruwtu).

Observations from residents provide further details: a general pressure off-shore pushes the ice shoreward when the current is changing, its flow speed reduced; the shearing of the current against the shore-fast ice when it flows southward (westward around the point of the mountain) holds the lead open; the patterns of ice movement are easier to learn under north wind conditions, different patterns occur under southerly or westerly winds. The most important relation between wind and sea ice was stated November 13: northerly winds bring the sea ice closer and closer to the Island. This is 'wintering weather' Taaghaghhta. When the ice is in, storms last longer, winds change less and longer calm periods of clear, cold weather occur between storms. There is much expectant searching of the horizon for signs of ice during wintering weather.

It has been commonly observed that sea ice bears a very important relationship to marine mammal hunting (Nelson, 1969). These animals dwell on, under and around the ice. Their habitat is not limited to its presence, with the exception of the ringed seal. The ice serves as a resting and basking platform. Ice hummocks serve for birth lairs of the ringed seal. Walrus migrate in association with the ice pack edge and at least the timing of the passage of the bowhead whale is tuned to the ice conditions. A high level of biological productivity occurs on ice surfaces and in the surrounding waters.

The outstanding importance of sea ice in rendering accessible large areas of water to the hunter is reflected in every aspect of hunting technology. Sea ice as a platform, a shelter and a surface serves the purposes of both the hunter and the marine mammals hunted. The net result is a very large increase in mutual contact.

3. The Biotic Communities

As previously defined, a biological community is first a recognizable assemblage of organisms. These assemblages certainly overlap, and a detailed description of their extent depends upon an understanding of their trophic and metabolic patterns. Information at this level is scarce for the Island area and it is not possible, therefore, to discuss niche (Odum, E. P., 1971 p 234). The recourse used here for the definition of these communities is a considerable dependence upon typical features of the place where characteristic members are found and the few facts known about their food habits. The overlap of these communities and the resulting edge effect (ibid p 157) is perhaps a special feature of their distribution, but the areas of this overlap are almost universally the areas exploited by the hunter. Walrus are shot from boats at the boundary of ice-filled and ice-free waters. Seals are shot from beaches as they feed along the rich sublittoral areas or in the coastal lagoons. Land-nesting waterfowl and cliff-bird populations are shot from boats at feeding sites. Anadromous fishes are netted as they pass through the lagoon and river communities. The increased variety and diversity of species at the edges of communities, and the apparent adjustments of hunting technologies to the demands of harvesting species of one community where it meets another (boats, seal hooks, gill nets, etc.) indicate that man as a hunter is an edge species. In an Island setting this proposition is even more inviting. Since the three communities here considered central to the support of human food species are induced from observations of food gathering activities, these communities are ectonal: the terrestrial-cliff community, the lagoon-river community and the pelagic-sublittoral community. This classification is supported by what appear to be necessary abiotic elements for the development of a center of human habitation on the Island: a land point, a beach, cliffs and a lagoon.

The second section of this chapter discussed prominent aspects of the greater habitat of the NW Cape: cliffed headlands among otherwise low elevations, a deep marine channel to the west, stratified waters and permanent and coastal tide currents, wind-and-weather patterns which appear directionally distinct and recurring sea ice instability at the Cape and in the region west and south of the Cape. These are the elements to which all biotic forms of the region adjust. The purpose of the present section is to sketch the trophic relations of the resulting assemblages. Since the species used for human food define the focus, species not apparently part of their food webs are omitted. Organisms at higher trophic levels not used by the human population are also omitted. A number of populations are therefore not treated here (see Fay and Cade, 1959; Fay, 1961; Lisitsyn, 1968; Young, 1970 for fuller discussions of respective communities). A list follows of the principle food species used by the Cape population, average weights of individuals where appropriate and authoritative sources on their taxonomy, life, history and food habits.

Species	Authority
Pacific Walrus (Odobenus rosmarus divergens) 800 kg	Walker, 1964 p 1297 Brooks, 1954 Fay, 1955 Burns, 1965
Bowhead Whale (Balaena mysticetus) 30 m tons	Walker, 1964 p 1140 Slijper, 1962 p 258
Harbor Seal (Phoca (Phoca) vitulina) 70 kg	Burns & Fay, 1970 p 390
Ringed Seal (Phoca (Pusa) hispida) 60 kg	Burns & Fay, 1970 p 390
Gray Whale (Eschrichtius robustus) 14 m tons	Rice & Wolman, 1971 p 6, 11
Bearded Seal (Erignathus barbatus) 150 kg	Burns & Fay, 1970 p 390 Burns, 1967
Arctic Fox (Alopex lagopus lagopus) 6 kg	Rausch, 1953 p 20
Murres (Uria aalga, U. lomvia) 0.9 kg	Swartz, 1966 p 667 Fay & Cade, 1959 p 84

Long-tailed Duck (*Clangula hyemalis*) 0.75 kg	Fay & Cade, 1959 p 84
Glaucous Gull (*Larus hyperboreus*) 1.5 kg	Fay & Cade, 1959 p 84
Pacific Eider Duck (*Somateria mollissima*) 3 kg	Fay, 1961 p 72
Pelagic Cormorant (*Phalacrocorax pelagicus*) 3 kg	Fay & Cade, 1959 p 84
Emperer Goose (*Philacte canagica*) 3 kg	Fay & Cade, 1959 p 84
Auklets (*Aethia cristatella*, *A. pusilla*) 0.25 kg, 0.09 kg	Bédard, 1969 p 1042
Domestic Reindeer (*Rangifer tarandus*) 70 kg (dressed)	Palmer, 1926
Sculpins (*Myoxocephalus scorpius*, *Cottus sp.*) 0.2 kg	Alverson & Wilimovsky, 1966 p 856
Salmon and grayling (*Onchorhynchus sp.*, *Salvelinus sp.* *Thymallus arcticus*) 0.05 kg (dressed)	Fay, 1958 p 27
Beach throw (*Nereocystis sp.*, a wide variety of invertebrate species)	
Tunicate (*Tethym sp.*) 0.1 kg	Buchsbaum & Milne, 1966 p 287
Tundra vegetation (*Sedum rosea*, *Rubus chamaemorus*)	Young, 1971 p 59, 61

These species comprise central points of interest in the food chain descriptions which follow. There is no intention to present exhaustive descriptions for the three communities discussed. The intention is to define prominent assemblages which support the human population.

A. The Terrestrial-Cliff Community:

Since the cliff-dwelling avian populations are predominately marine feeders their trophic relations are considered in subsection C below. Few species used by the Island population are residents of its land areas. The trophic relations of these species will be considered first.

At the Λ_1 level, some 24 plant species are used for one specialized purpose or another (Young and Hall, 1969 p 43-53) of the 238 species of vascular plants found on the Island (Young, 1971 p 76). Dominant species of the bog and wet tundra areas (50% of the total land area of the Island are:

Eriophorum angustifolium

Carex aquatilis

(Young, 1971 p 25). The salmon berry,

Rubus chamaemorus

is rare to common in these areas and is only occasionally collected by the women of the Cape, since most areas where the berry is found are located on the south side of the Island. More commonly collected are "greens",

Sedum rosea

found in drier areas and available on the west face of Sevuokuk Mountain. From a survey of stored foods taken in the summer of 1970, 16 families collected greens in storage quantities during about a four week period at the end of the summer. If a kilogram of greens is collected each of three days per week for the four week period by 16 women, 190 kg annual harvest by the community may be estimated. Greens and other perferred plants are used in a variety of traditional recipes, usually in combination with animal fats, for deserts and side dishes (Heller and Scott, 1967 p 116-119). Since these recipes appear to be of early origin, are still used and preferred by several families of the community, reveal food preference changes in their modern versions and since they require the most advanced culinary skills of any others seen, several are included in Appendix 3.

At the Λ_2 level the tundra vole,

Microtus oeconomus innuitus

is the most common of the seven indigenous land mammal species (Rausch, 1953 p 18, 25). In 1970 there was an apparent peak in abundance (and in 1971 they were very scarce) perhaps reaching the range of Walker's estimate of 12,000/acre in the bog and wet tundra areas (Walker, 1964 p 845). Microtus contributes to the support of the non-cliff inhabiting arctic fox (perhaps 80% of the total population) comprising some 85% of its summer diet (Stephenson, 1969 p 57), a dozen or so feral dogs and the parasitic cestode,

Echinococcus sibiricensis

which infests the entire indigenous mammalian terrestrial fauna (Rausch and Schiller, 1956 p 397-407) and is of considerable health significance to the Cape population.

The other Island herbivore confined to the Λ_2 level is the domesticated reindeer,

Rangifer tarandus

which feeds on sedges in the summer and on lichen and browse vegetation in the winter (Palmer, 1926 in Courtright, 1959 p 166). The alpine, fell-field vegetation of the Island covers some 30-50% of the land area

(Young, 1971 p 26). Not all of these areas are suitable for winter forage and a rather small herd is maintained by the herders of Savoonga on the eastern area of the Island. Some 200 of 1075 animals were slaughtered in 1969 (U.S. Dept. of Interior, B.I.A., 1969 p 5) and about the same number the winter of 1971. An estimated 1000 kg (8 sled loads) was delivered, dressed, to Gambell (January 19, 1972) and sold at about \$.75/kg (.35/lb). About half this weight appears edible. Several times later in the winter hunters looked for the herd, but no other reindeer meat reached the community during the year.

The only resident mammalian species at the Λ_3 level of significance to the Cape population is the white arctic fox,

<u>Alopex lagopus lagopus</u>

whose pelt is sold and the carcass used for dogfood. Abundance of the fox population fluctuates with the vole population, somewhere between one and 10 per ten square miles or 60 to 3600 for the western Island (Fay and Cade, 1959 p 81). The fox was abundant the summer of 1970 and some trappers reported 110-120 pelts for the December 1 to April 1 season. For 20 men trapping with moderate success at 50 pelts, more than 1000 were likely taken that year. About 15 men occasionally trapped 1971-72 and the maximum reported for one trapper was 15 pelts. Most secured less than ten, and 150 for the year is a maximum estimate for the harvest. Returns for these pelts range from \$5 to \$30. An average of \$20 is taken as pelts from the Island are usually of high quality, for a total income of \$3000. If the carcass weighs about 5 kg, 750 kg of meat, bone and viscera is available for dog food from the fox harvest.

In addition to *Canis* the terrestrial community has just one resident species at the Λ_4 level (also Λ_2, Λ_3): *H. sapiens*. It is clear that the role of this community in his support is not great. Its main provision is the shelter that terrestrial species and brooding birds require. The system as sketched (not only have many important species been excluded but several phyla, and the entire detritus food web) is summarized below. Cases of by-products rather than food utilization are indicated by brackets.

Habitat	Λ_1
all	_Sedum_, _Rubus_
Alpine, fell-field 30-40% land area	Sedges (summer) lichens browse (winter)
bog-wet tundra 50% land area	_Eriophorum_ _Carex_

Λ_2	Λ_3	Λ_4
Homo		
Rangifer	Homo	
Microtus (*Echinococcus*)	*Alopex* (*Echinococcus*)	[Homo] Canis
	Canis (*Echinococcus*)	[Homo]

B. The Lagoon-River Community:

The distribution of the larger faunal forms indicates that the biotic communities of the lagoons used by the NW Cape people differ widely. Salinity appears to be variable as both fresh water runoff and the nature of shore outlets differ for each lagoon. No single lagoon contains all the species discussed here, but they share a common function: provision of nursery and feeding areas for human food species.

No work has been found on lagoon phytoplankton assemblages in the Bering Sea area, although Hilliard and Tash found two algal phyla,

Diatomaceae

Desmidiacae

dominant in the nine lagoons and seven lakes surveyed in the Cape Thompson area (Hilliard and Tash, 1966 in Wilimovsky, 1966 p 365). Work on the distribution of eelgrass (*Zostera marina*) dominated lagoons shows this species does not occur in the Island (McRoy, 1968 p 508). Young notes (1971 p 28) that a true aquatic flora developes in only a small area in the south-central portion of the Island.

Surveys at the Λ_2 level are also scarce. Work at Cape Thompson may again be indicative. Crustacean zooplankters found dominant in the same lagoons mentioned above are euryhaline forms,

Daphnia sp.

Cyclops sp.

Moraria sp.

(Hilliard and Tash 1966 in Wilimovsky, 1966 p 406)

<u>Acartica bifilosa</u>

<u>Eurytemora fovela</u>

<u>Limnocalanus johanseni</u>

(Johnson, 1966 <u>in</u> Wilimovsky, 1966 p 682)

as these lagoons, although land-locked, are periodically inundated by stormy seas.

At Λ_3, small populations of the anadromous fishes,

<u>Onchorhynchus gorbuscha</u>

<u>O. nerka</u>

<u>O. keta</u>

<u>O. kisutch</u>

<u>O. tschawytscha</u>

<u>Salvelinus alpinus</u>

spawn in the rivers feeding these lagoons. The American grayling and lake herring

<u>Thymallus arcticus</u>

<u>Coreogonus sardimella</u>

is resident at the large southern lagoon (Fay, 1958 p 27). These species are netted in the lagoons and rivers, and along the coast of the western Island in small numbers except at the peak of very brief runs. Occasionally winter ice fishing trips occur. Fishing for salmonoid fishes with gill nets shows a wide range of productivity among examples of ten sets in seven different areas of the western Island. In late August, three net sets on one river produced 150 fish in a few hours. In mid-September about a dozen sets throughout one day produced three fishes.

The timing of the effort is critical for river fishing. Nets may be set and left for a week or even several months in the lagoons and along the coasts during the summer, and cleared two or three times in 24 hours. In no instance were really large quantities of fish produced as may occur on larger mainland rivers (Foote and Greer-Wootten, 1966 Appendix D) and it is unlikely that more than 1000 salmonoids and a like number of grayling and sculpin came into the community during the year. An average useable dried weight of 0.54 and 0.2, respectively, allow an estimate of 400 kg annual contribution from the resource. Only recently has it been discovered that setting nets in protected west-coastal areas could be productive. A king salmon estimated at 20 kg was taken in this area August 1970. A willingness on the part of Cape hunters to explore new resource possibilities is indicated by the development of this fishery. The lagoons with sufficient fresh water inflow serves as nursery areas for the salmonoids. Considerable care needs to be taken to avoid over-exploitation of these populations as they are small and easily netted in the small creeks where they spawn.

Very important and by far the most abundant at the Λ_3 level are the waterfowl. These lagoons also provide nursery (and molting) areas for the ducks and geese,

Somateria mollissima

Clangula hyemalis

Philacte canagica

among many other species. Fay and Cade (1961, p 71-72) conservatively estimate 500 (and 1000 eggs) Pacific eiders of its 50,000 breeding and non-breeding populations are harvested every year, more than 1000 of the huge long-tailed duck population of 500,000 and about 150 of the Emperer goose population of 20,000. Observations 1971-72 indicate that the harvest of long-tailed ducks at the Cape was about 20/day for December and January when most of these birds are taken or about 1200 birds. About half of the body weight of these birds is edible or 750 kg (100 kg eggs), 225 kg and 450 kg respectively for the year.

A species of great interest, the harbor seal

Phoca (*Phoca*) *vitulina*

is an important part of the Niyrakpak Lagoon community at the Λ_4 level. Shores of this lagoon were once a favorite haul-out area during the summer and fall and large number of seals are still taken here. Since this species feeds predominantly in the marine community it is considered below.

There is a great lack of work on lagoon microenvironments, and these comments are indicative at best. Their important role in the Island populations, as well as their accessibility, invite further study.

Habitat	Λ_1	Λ_2
lagoon-river, about 25 shoreline miles		
	phytoplankton	Daphnia
	Diatomaceae	Cyclops
	Desmidiacae	Moraria
		Acartica
		Eurytemora
		Limnocalanus

Λ_3	Λ_4	Λ_5
Somateria	Homo	
Clangula	Alopex	[Homo]
Philacte		
	Larus	Homo
Onchorhynachus	Homo	
Salvelinus	P. vitulina	Homo
Thymallus		
Coreogomus		

C. The Pelagic-Sublittoral Community:

All of the species used by the Island population (except Rangifer) are part of the marine littoral community at one time or another during the season. During the winter carnivores and scavengers are commonly found on the ice and the anatids feed from lead to lead. The reproductivity of this system is extraordinary, as demonstrated by the possibility that Island waters once supported a population of 4000 people strictly on local resources. Reasonable areal limits for a discussion of the relation of this community to the west coast of the Island may be established by a consideration of the prominent habitat elements mentioned in the second section of this chapter. The permanent Transverse current courses from the southeast of the Island through the 50 meter channel west of the Cape joined by waters from Anadyr Bay. Prevailing northerly winter winds and coastal tide currents create areas of ice instability in the same general region. Data on standing crops of species prominent in the support of the Cape population are available for this region (Lisitsyn, 1969 p 91, 118, 121, 125, 126, 291, 91-193). It is noted that for species with short generation times, measurements of turnover rates are far better indications of biological activity than measurements of standing crops. Studies of productivity (McRoy et al., 1972) are just now becoming available, but presently work is not sufficient for a reasonable review.

At the Λ_1 trophic level the rapid surface stratification of marine waters in areas of ice ablation, nutrient run-off from the bordering continents, the considerable vertical circulation in shallow and coastal areas and the low salinities common to the Bering Sea shelf contribute to the production of massive concentrations of phytoplankton ($22gm/m^2$ in the neritic zone; 1-10 million particles/gm suspension), dominated by the diatomaceous algae,

Thalassiosira nordenskioldii

in bloom areas. Coastal and shallow areas not limited to the nutrient reserves above the discontinuity layer show even higher standing crops. Near-shore waters (20-60m) with rocky bottoms are dominated by the giant brown algae,

Nerocystis sp.

reaching a biomass of 30 kg/m^2 in areas of abundance. Impressive wind-rows of this plant occur in the beach-throw of certain west-coastal areas. *Philacte* forage along these rows in the morning hours.

The Λ_2 level is dominated by the copepod zooplankters which range in density from $0.1gm/m^2$ in deeper waters to $50gm/m^2$ in the shallows and shore areas during August and September. Total benthos biomass (see species below) ranges from 1 gm/m^2 at the shoreline of the Western Island and reaches to greater than 1000 gm/m^2 south and northwest off the west coast of the Island, and 843 gm/m^2 in the Chirikof Basin (mean total). The following species, listed in descending order of density, dominate the epifaunal assemblage.

West	Southwest
Ophiura sarsi	*M. calcarea*
Macoma calcarea	*O. sarsi*
Nucula tenuis	*Maldane sarsi*

West	Southwest
Onuphis parva striata	*N. tenuis*

In the rocky bottom areas the sessile filter-feeders,

hydroids	serpulids
hydrocorals	cirripeds
bryozoans	*Ostrea sp.*
brachiopods	*Mytilidae sp.*
sponges	

are more abundant. In coastal areas of fresh water run-off and strong tidal currents the mobile filter feeders,

Cardium sp.
Serripes sp.
Mactra sp.
Astarte sp.
Echinarachnius sp.

dominate. At 10-20 fathoms (19-37 meters) around the coast of the Island bivalve biomass reaches $50gm/m^2$ and grades west to $1500gm/m^2$ in the 50 meter channel between the western Island and Cape Chaplino. Several of the mollusks,

Yoldia sp.
Leda sp.
Macoma sp.
Nucula sp.
Tellina sp.

off the south and northeast shores of the Island, are part of the detritus chains in the upper sedimentary zones of the shelf not considered here. The echiurid and polychaete amphipods are also abundant at the level of this assemblage.

At the Λ_3 trophic level marine fish forms are numerous off the north coast of the Cape, especially the bottom-feeding sculpins,

Myoxocephalus sp.

which are taken the year around. The Pacific herring, the Polar cod,

Cleupea harengus

Boreogadus saida

and several species of smelt,

Osmerus sp.

occasionally pass the Cape in large numbers or are washed ashore after storms.

At the Λ_3 and Λ_4 levels in the community reside the species of most intimate concern to this study: the alcids, the marine mammals and man.

The alcids are undoubtedly the most numerous forms, the murres,

Uria lomvia

U. aalge

and the auklets,

Aethia cristatella

A. pusilla

being the most frequently used. The pelagic cormorant, and the glaucous gull,

Phalocrocorax pelagicus

Larus hyperboreus

are other cliff-nesting species which are harvested. The murres are both pelagic and benthic feeders (Spring, 1971 p 27), while Aethia feed entirely on zooplankton forms (Bédard, 1969a p 1042) and the cormorant predominantly on pelagic fishes. Estimates on the basis of field observations 1971-72 indicate that open water boat hunting for alcids averages 10-15 birds taken per day by one crew. Only when boats pass the cliffs during nesting season are larger takes of perhaps 50-75 birds possible. Maximum take estimates may then be derived by assuming all boats of the community (16) take birds on no more than 10 open water boat hunts and on no more than two hunts at the cliffs. An annual community harvest would therefore not likely exceed 5000 alcids (3200-4800) and is almost surely less. During the 1971-72 season 16 boats were in use only once during the successful whale hunt. On the order of five or six boats are consistently active during the summer season. A minimum estimate for alcids harvested is therefore more than 1000 birds (1000-1500). Harvest estimates chosen for 1971-72 range as follows: 3,000 Uria of the estimated population of 200,000 and 500 Aethia from an estimated population of 500,000 in the colonies used by Gambell people. Murre eggs are collected (est. at 1000) in June and July and are part of the estimate above. At the present time Aethia are used very little compared to the time when oil curing practices were common. 100 P. pelagicus from an estimated population of 10,000 and 500 L. hyperboreus (two and ten per household/year respectively) are estimated 1971-72 harvests for these species.

The beach-throw is gathered with relish and families from Savoonga often send special orders to their relatives for tepuq (all algal and invertebrate species). The variety is very much appreciated and during the winter the tunicate sea peach, upa,

Tethym (*sp.*)

(Buchsbaum and Milne, 1966 p 287)

is gathered (perhaps 10 kg) in areas of abundance. These plant and invertebrate forms are often referred to as a source of "vitamins" and they provide an excellent side course for the meats eaten. The surface-feeding bowhead whale,

Balaena mysticetus

and the bottom-feeding (infauna) gray whale,

Echrichtius robustus

contribute both the most preferred food (in the former case) and the focus for the most enduring cultural institutions of the Cape populations.

The bottom-feeding (epifauna) walrus,

Odobenus rosmarus

provides the backbone on which the community rests. The place, extent and structure of the community centers around this species. The broad food platform which Λ_3 rests in the very opposite of the "barren", "depauperate" aspect of the land. If the early explorers could have seen through the turbid waters in the Island portion of the Bering Sea the image of a hostile barren arctic would never have developed.

The epifaunal feeder,

Erignathus barbatus

the bearded seal is more closely confined to the Λ_3 level than the ringed and harbor seals,

Phoca (*Pusa*) *hispida*

Phoca (*Phoca*) *vitulina*

which are more opportunistic feeders. The 8 month harvest records of this study show totals of

B. mysticetus	--	1	*E. barbatus*	--	73
E. robustus	--	1	*P. hispida*	--	443
O. rosmarus	--	240	*P. vitulina*	--	299

for the six species last mentioned. Their useable contribution to the community is discussed below.

The Pelagic-Sublittoral community trophic relations are summarized in the following table. As species are placed adjacent to known food species in the table there is some repetition. A gap in the information available on foods of all marine mammal species in the Bering Sea region (except *Odobenus*) is noticeable.

TABLE 3

Wind Observations 1971-72

Gambell, Ak.

Winds	October	November	December	January	February	March	April	May
Number of wind speed observations	24	29	31	28	29	27	26	28
Number of days of wind calm	2	2	2	1	8	9	5	6
Number of windy days	22	27	29	27	21	18	21	22
% days of wind speed greater than Beaufort 4	21	41	32	43	41	30	35	39
Average wind speeds for windy days	3.4	4.3	4.0	4.7	4.8	4.6	4.1	4.5
Maximum monthly wind speed	6	7	7	7	7	9	8	8
% northerly winds	41	36	77	55	76	100	62	68
% southerly winds	41	15	23	30	19	--	29	18
% easterly winds	--	26	--	--	--	--	--	--
% westerly winds	23	--	--	--	--	--	--	--
% days with precipitation	58	38	42	60	83	70	54	71

All wind speeds reported are in Beaufort scale units, average wind speeds are for windy days only; wind direction percentages are for three compass points northerly (NW, N, NE) and the same for southerly points, easterly and westerly winds occurred in small percentages during the months not reported. The number of readings was insufficient for percent occurrence for each Beaufort scale unit.

TABLE 4

Temperature Observations 1971-72

Gambell, Ak.

<table>
<tr><th>Temperature</th><th>October</th><th>November</th><th>December</th><th>January</th><th>February</th><th>March</th><th>April</th><th>May</th></tr>
<tr><td>Number of observations of day temperatures</td><td>24</td><td>27</td><td>30</td><td>21</td><td>22</td><td>20</td><td>19</td><td>19</td></tr>
<tr><td>Number of observations of max/min temperature</td><td>15</td><td>19</td><td>27</td><td>21</td><td>22</td><td>20</td><td>19</td><td>19</td></tr>
<tr><td>Average temperature</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Maximum:</td><td>33</td><td>27</td><td>18</td><td>17</td><td>12</td><td>8</td><td>26</td><td>43</td></tr>
<tr><td>Daily:</td><td>31</td><td>24</td><td>13</td><td>12</td><td>7</td><td>3</td><td>20</td><td>30</td></tr>
<tr><td>Minimum:</td><td>26</td><td>19</td><td>8</td><td>5</td><td>1</td><td>-7</td><td>9</td><td>24</td></tr>
<tr><td>Average temperature range</td><td>7.7</td><td>8.3</td><td>10.5</td><td>12.4</td><td>11.5</td><td>14.5</td><td>16.8</td><td>18.2</td></tr>
<tr><td>Maximum temperature range</td><td>17|40</td><td>2|36</td><td>-10|32</td><td>-25|34</td><td>-19|32</td><td>-16|20</td><td>-4|48</td><td>18|58</td></tr>
<tr><td>% days temperature <10°F</td><td>0</td><td>10</td><td>70</td><td>70</td><td>80</td><td>100</td><td>70</td><td>0</td></tr>
<tr><td>>30°F</td><td>80</td><td>40</td><td>20</td><td>30</td><td>20</td><td>0</td><td>40</td><td>80</td></tr>
</table>

TABLE 5

Trophic Relations of the Pelagic-Sublittoral Community

Λ_2	Λ_3	Λ_4
gammaridean amphipods Fam: Ampeliscidae Ampelisca macrocephalia A. eschrichti	Eschrichtius robustus[1]	Homo
amphipods Thysanoessa sp. Meganyctiphanes sp. pheropods Clio sp. Limacina sp.	Balaena mysticetus[2]	Homo
zooplankton Calanus spp. Hyperiidea Euphausiacea	Aethia spp.[3]	Homo
crabs: Hyas coarcticus Pagurus spp. clams: Serripes groenlandicus Spisula sp. Clinocardium sp. shrimp: Sclerocrangon boreas Pandalus spp. Argis spp. fish: Cottus sp.	Erignathus barbatus[4]	Homo
Mollusca: Mya truncata Clinocardium nutalli Astarte Macoma calcarea Neptuna Hiatella arctica Echinodermata: Molpodia arctica Annelida: Nephtys sp. Sipunculoidea	Odobenus rosmarus[5]	Homo

Λ_2	Λ_3	Λ_4
Priapuloidea *Priapulus candatus*		
free-swimming crustacea molluskas small fish	*P. vitulina*[6] *P. hispida*[7]	Homo Homo
amphipods Polychaetes	*Uria spp.*[8]	Homo
crustaceans	*Phalacrocorax sp.*[8]	
benthic infauna	*Boreogadus saida*[9] *Ammodytes hexapterus* *Myoxocephalus sp.* *Cottus sp.* *Oncorhynchus spp.* *Salvelinus spp.* *Clupea harengus* *Mallotus villosus* *Osmerus dentea* Homo	*Uria spp.*[8] *Phalacrocorax sp.*[8] Homo *Phoca spp.* *Histriophoca fasciata*
beach-throw	*Philacte canagica*	Homo

[1]Pike, 1962 *In* Pike, 1971 p 23

[2]Slijper, 1962 p 258

[3]Bédard, 1969 p 1042

[4]Burns, 1967 p 28-29

[5]Brooks, 1954 p 54-55

[6]Walker, 1964 p 1303

[7]*ibid*, p 1304

[8]Swartz, 1966 *In* Wilimovsky, 1966 p 667

[9]*ibid*, p 671; Alverson, 1966 *In* Wilmovsky, 1966 p 856

FIGURE 6

The Northwest Cape and Its Place Names

The selection of place names shown on this map (numbers correspond to names in legend) is taken from longer series collected for the western Island. The west coast series has only two entries, the north coast series has 18 entries and the inland series has 14 entries. Commonly used foot and snow-mobile trails are also shown, as is the location of the community buildings and air strip.

This figure is redrawn from a 1958 edition of a 1:25,000 scale Corps of Engineers map compiled from aerial photography dated August 1948 by the U.S. Coast and Geodetic Survey.

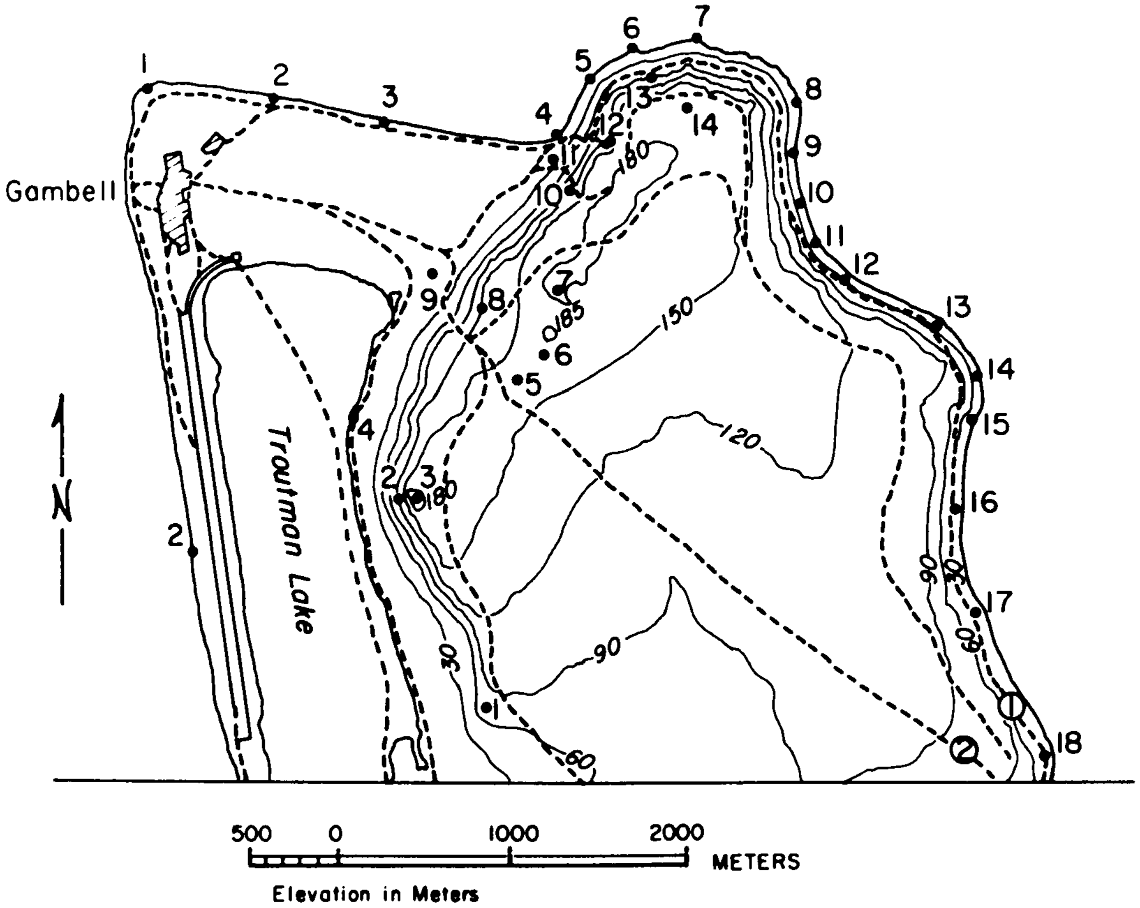

Gambell
Troutman Lake
N
30
60
90
120
150
180
185
500
0
1000
2000
METERS
Elevation in Meters

FIGURE 6

Legend

The Northwest Cape and Its Place Names

Extracts follow from three series of western St. Lawrence Island place names. All spellings are after Badten and Krauss, 1971 p 1-7. Numbers in the margin refer to numbers on the map (Fig. 6). A blank after the word indicates there is no immediately apparent meaning. Related words given are possible derivatives only.

<u>West Coast Series</u>

1 Aatneq (point):

aana: 1. to go out, to exit
2. to protrude out, advance out, bulge out

ateq: 1. to go down, from a higher place to a lower
2. place to launch boats

2 Tapghaq (coastline): 1. a rope, a thong
2. a narrow strip of land bordered on both sides by water

<u>North Coast Series</u>

1 Aatneq (point): same point as west coast series

2 Tapghaaghaq (coastline): 1. small thin rope
2. a small narrow strip of land

3 Petuqit: name for boat storage area, meaning unknown

(boat racks are called <u>Angyilghat</u>)

4 Qitelnguq (coastline bay):

qiiq: to feed a fire
-el-: morpheme added to a root making referent descriptive of root

-nguq: suffix meaning that which is

5 Kazighhaq (point on bolder beach):

Kaziva: 1. to spin, to move in a circle
2. the ancient sport of jumping around a circle of stones

-ghhaq: suffix meaning a small thing, makes root a noun

6 Iigwsima (point on boulder beach):

iggwta: 1. ebbing of tide

-sima: suffix, that which is

7 Uygunat (point on boulder beach):

uygu: 1. to link together
2. to extend as in tieing together rope

8 Pelegnaq (point on coastline):

peleq: 1. to crumble
2. to become ruined

-naq: a place to do, to become

Pennaghat (cliff and camp): small cliff (near Pelegnaq)

Pennaq: cliff

-ghat: small

9 Penailek (coastline and area): cliff area

-lek: that which possesses

10 Nenglutalek: a sod igloo place

nenglu: sod igloo

-talek: that which has

11 Sevriigek (river):

seva: 1. to sever, to split an object by cutting

-gek: the two things

-ek: dualizing ending always used for rivers

12 Akullkek (river):

akula: the middle or central part

13 Sivugnaq (camp, lookout):

sivu: 1. a front part
2. the first
sivuliq: 1. the leader
2. the foremost part

sivugta: the movement of raising the head up to look ahead

14 Tategnaq (point on coastline): a place like the ridge of the nose

tateq: ridge of the nose

-naq: place like

15 Ayvigteq (coastline from point to bay): walrus location

ayveq: walrus

-teq: suffix objectifying root

16 Aghsughaleq (coastline): a place of pallor

aghsuq: 1. pallor, pale
2. becoming white

-ghaleq: suffix, a place possessing

17 Nangupagak (small point and camp); a place of loneliness

nanguq: loneliness

-pa: morpheme denoting, after the fashion of

-gak: suffix, the place

18 Meregta (major land point, old village site): derivation unknown

Island Series

1 Ayveghat (ridge, old village site): small walruses

2 Iqellqut (rocks): little fingers

iqellquq: little finger

3 Kentuqak (peak):

kenla: the end of a thing

4 Angyaq (lake shore point): boat

5 Akelghyat (rocks):

Lliivghet (rocks):
1. graves
2. a place to lay, set, put (the dead, only)

6 Kiimatughhaq (rocks)

7 Utuqsit (peaks)

8 Mayughaaq (basin and old village): a small place to climb

mayuq: to climb, go up

-aaq: place of small size

9 Siighmiik (creek): place of clear water

siiq: clear (esp. water)

-miik: a place (dual)

10 Pekeqaaghvik (basin): a place to pick wick moss

pekeqaaq: moss used for wicks
-vik: a place to do

11 Tenguglluget (rocks): old livers

12 Kiiwek (basin): river

13 Alit (rocks): sleeve

14 Naasqwa (mountain top): its head

naasquq: head

-a: possessive

<u>Trails</u>

1 Aghviqeltat: a rough place to cross over

Aghviq: to cross over

-el-: a place where crossing is hard, crude

-tat: pl.

2 Sanivleghet: path to Mereghta above the coastal water line

FIGURE 7

Tide Current Patterns of the NW Cape

Observations on November 24, 1971 of tide current patterns were made possible by the recent information of light shore slush ice. On this particular day the low tide-to-high tide change occurred from 1100 to 1230 hours.

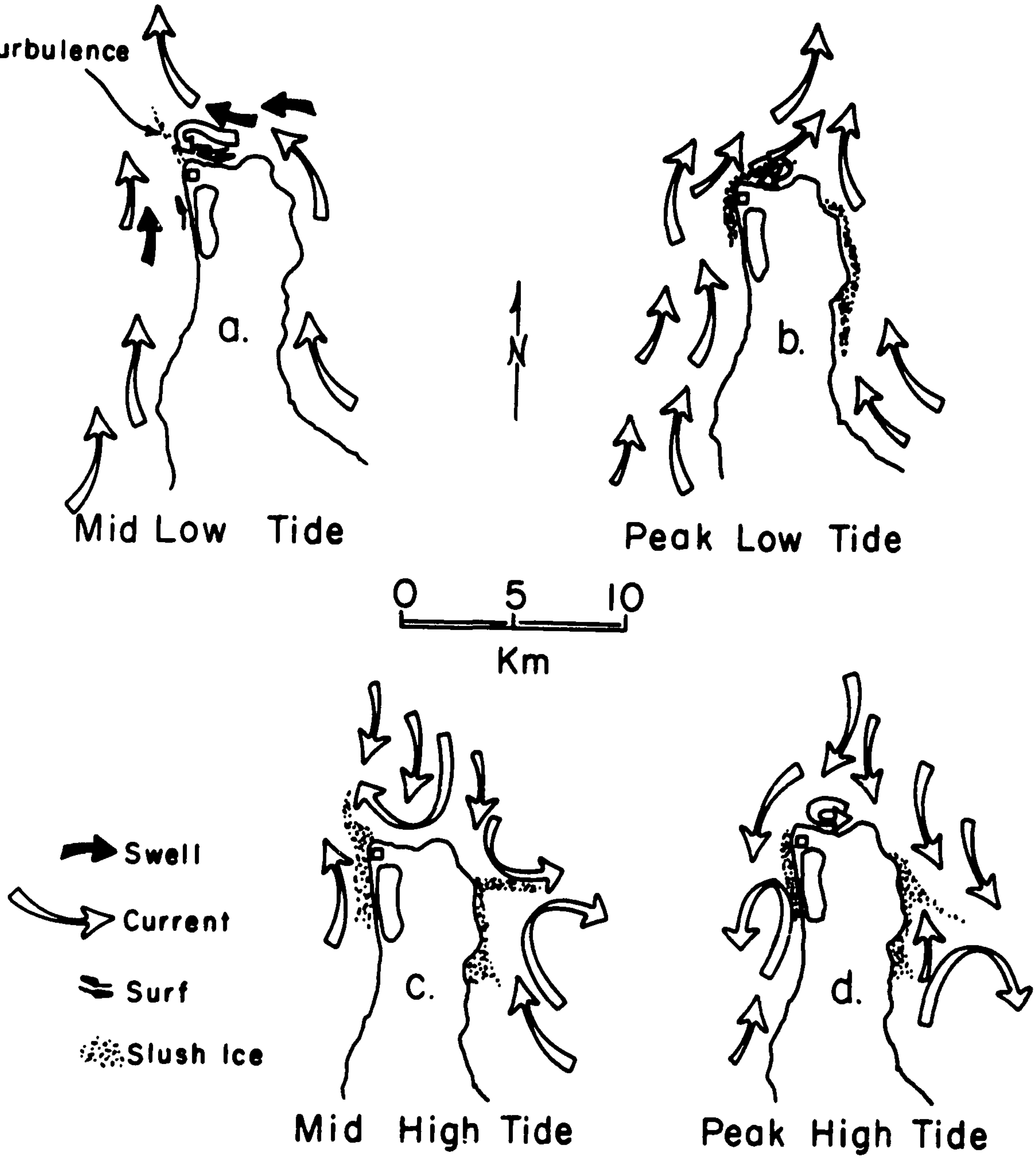
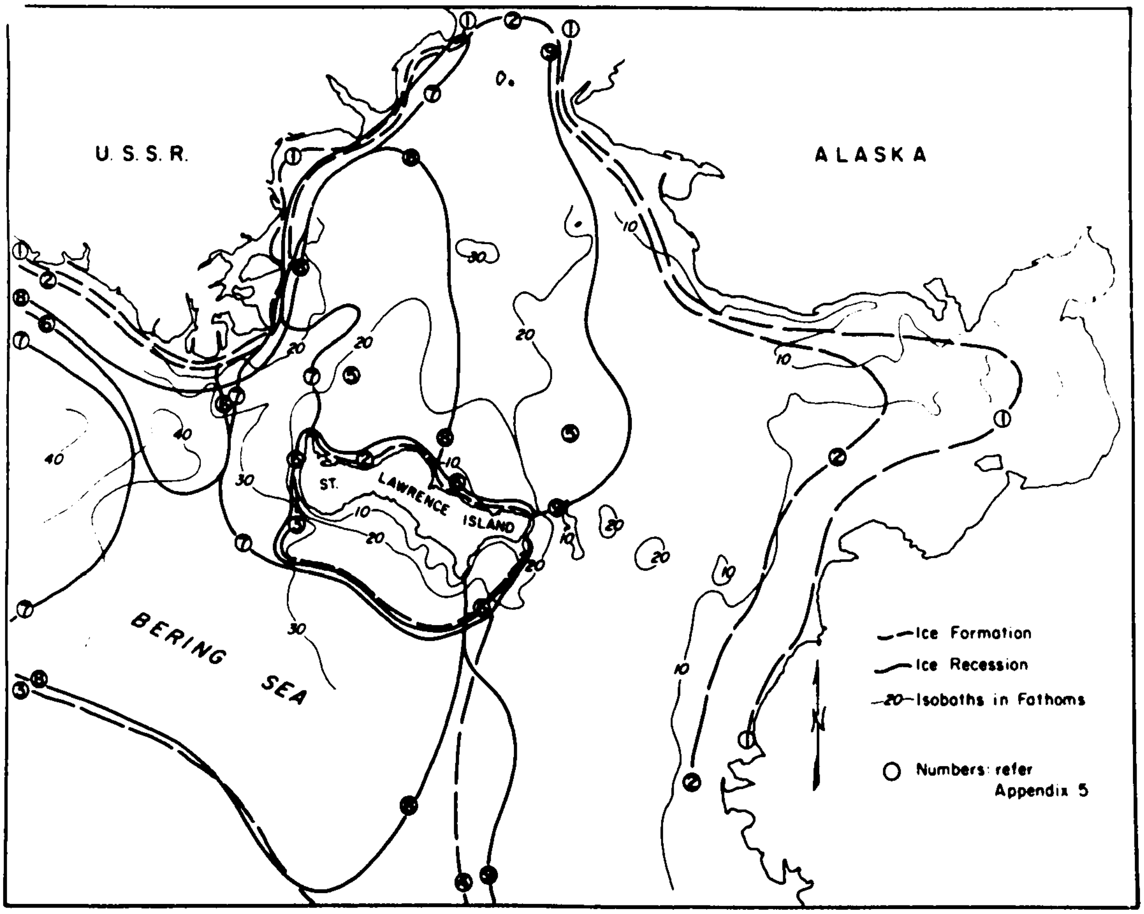

Turbulence
a.
Mid Low Tide
N
b.
Peak Low Tide
0 5 10
Km
Swell
Current
Surf
Slush Ice
c.
Mid High Tide
d.
Peak High Tide

FIGURE 8

The Waters and Ice about St. Lawrence Island

The satellite reconnaissance program of the Fleet Weather Facility of the U.S. Navy publishes weekly maps of major ice formations in all arctic maritime regions. Nine of these maps for the Bering Sea from the period of November 22 to May 8, 1971-72 are redrawn in Fig. 8. Each line drawn represents an ice-water boundary. Numbers on each line refer to the legend entry for that date. Spaced lines refer to the period of ice formation during which all ice is landward of the line, except for the large polyna south of St. Lawrence Island. Ice is generally seaward of the solid lines which represent the period of ice recession.



U. S. S. R.
ALASKA
ST. LAWRENCE ISLAND
BERING SEA
Ice Formation
Ice Recession
20 Isobaths in Fathoms
Numbers: refer Appendix 5
N

FIGURE 8

Legend

Weekly Chronology of Bering Sea Ice Pack Development,

1971-72

The numbers in the left column refer to bondaries of ice masses as displayed and keyed in Fig. 8. Some of the comments summarized here appear on the maps from which this chronology was extracted.

Source:

U.S. Department of Defense, Navy Department, U.S. Fleet Weather Facility ('FLEWEAFAC'), Suitland, Md.

	October 25, 1971	Bay fast ice forming south of Bering Straits
	November 1	Coastal fast ice forming south on Bering Straits on Chukchi Peninsula Coast only
	November 15	Coastal ice forming in Norton and Kotzebue Sounds
1	November 22	Boundary encloses 4/8 - 5/8 pancake ice cover Arch of slush ice north of Bering Straits No drifting pack in Bering Sea
2	November 29	Boundary encloses ice limit Grease and slush ice forming in open areas Coastal ice forming on north coast of Island
3	December 6	Boundary encloses ice limit, extending from Cape Navarin to Nunivak Island Lead south of Island "some ice upper Bering Sea from 12-24 inches"
	December 13	Ice limit from just south of Nunivak Island to just south of Cape Navarin "Lead south of Island will close and refreeze when winds subside"

4	December 20	First year thin ice line, "ice at 12-28 inches (N & E of boundary), new ice south of line less than 12 inches" Ice limit variable, extends slightly south from December 13
	December 27	Ice limit receeds to December 6 line
	January 3, 1972	Unchanged
	January 10	"Slow southerly expansion" Ice limit passes St. Matthew
	January 17	"Slow southerly expansion" Ice limit passes St. Matthew
	January 24	Unchanged "15-30 nm recession of ice limit"
	January 31	Ice limit receeds north of St. Matthew
	February 7	"New ice areas SW of Island in Bering Sea are usually persistent as a result of winds"
	February 14	Ice limit reaches Pribilof Islands Large refreezing areas SW of Island, south of Chukchi Pen. and on Alaskan coast
	February 21	"Ice limit recession 30-40 nm" Same refreezing areas
5	February 28	Ice limit at Pribilofs Open water areas south of Island and at Yukon Delta Number 5 refers to 2 of several areas of "easy navigation" occur north of Island Cape
	March 6	No open water areas Ice limit unchanged
	March 13	Slight recession of ice limit Small open leads at Pribilofs
	March 20	Ice limit south of Pribilofs Refreezing areas south of Island and St. Matthew Island

	March 27	Flaw leads of Island and Chukchi Pen. connect Ablation at ice limit: 1/10 - 3/10, 4/10 - 6/10 in several areas
	April 3	Ice limit recession to north of Pribilofs Patchy areas at ice limit Flaw leads open at Yukon Delta, Wales, Pt. Hope and Barrow
	April 10	Continued slow recession of ice limit
6	April 17	Flaw leads open at Island, Chukchi coast and Nunivak Island Reduced concentration at ice limit
7	April 24	Chuckchi east coastal lead open and joined with Island lead "Lesser concentration" further south of Island lead and at ice limit
	May 1	Recession of ice limit Same open water areas
8	May 8	Island and Chuckchi coastal leads join forming large open water area Smaller open water areas on Alaskan coast, at Nunivak Island and south of Bering Straits
	May 15	Rapid disentegration of pack south of Bering Straits, especially at ice limit Slow recession of ice limit Open water area same south of Island, increasing at Yukon Delta and Norton Sound
	May 22	Continued as on May 15 Open water south of Island now reaching NE Cape
	May 30	Continued slow recession of ice limit to north of Pribilofs First open water north of Bering Straits at East Cape Other open water areas increasing Main pack lies north-south on the east of the Island and in "belts" at the ice limit and on Alaska coasts

9	June 5	Ice limit and pack shows rapid disintegration Main pack as on May 30, other areas with pack: Anadyr Bay, Kotzebue Sound and belts at Bristol Bay "Occasional floes" in open water area south and west of Island
	June 13	Main pack still east of Island Floes from pack reach Savoonga area All other areas open
	June 19	6/8 floes still in Savoonga area from remnant of pack east of Island Remnants of pack still shown in western Anadyr Bay

FIGURE 9

Generalized Ice Formation about the NW Cape

Distribution by area and ice type is drawn for the period February 21-29, 1972.

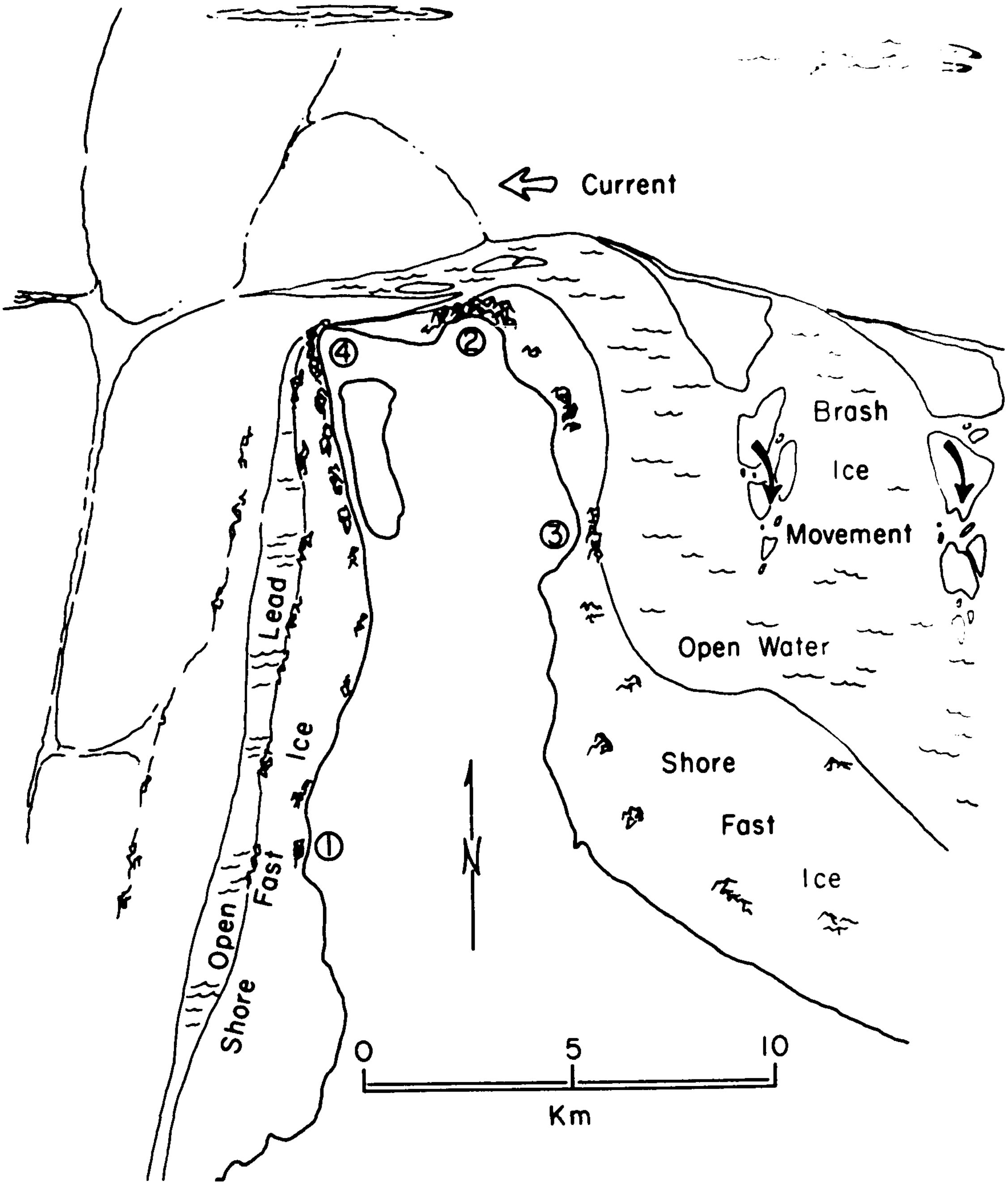
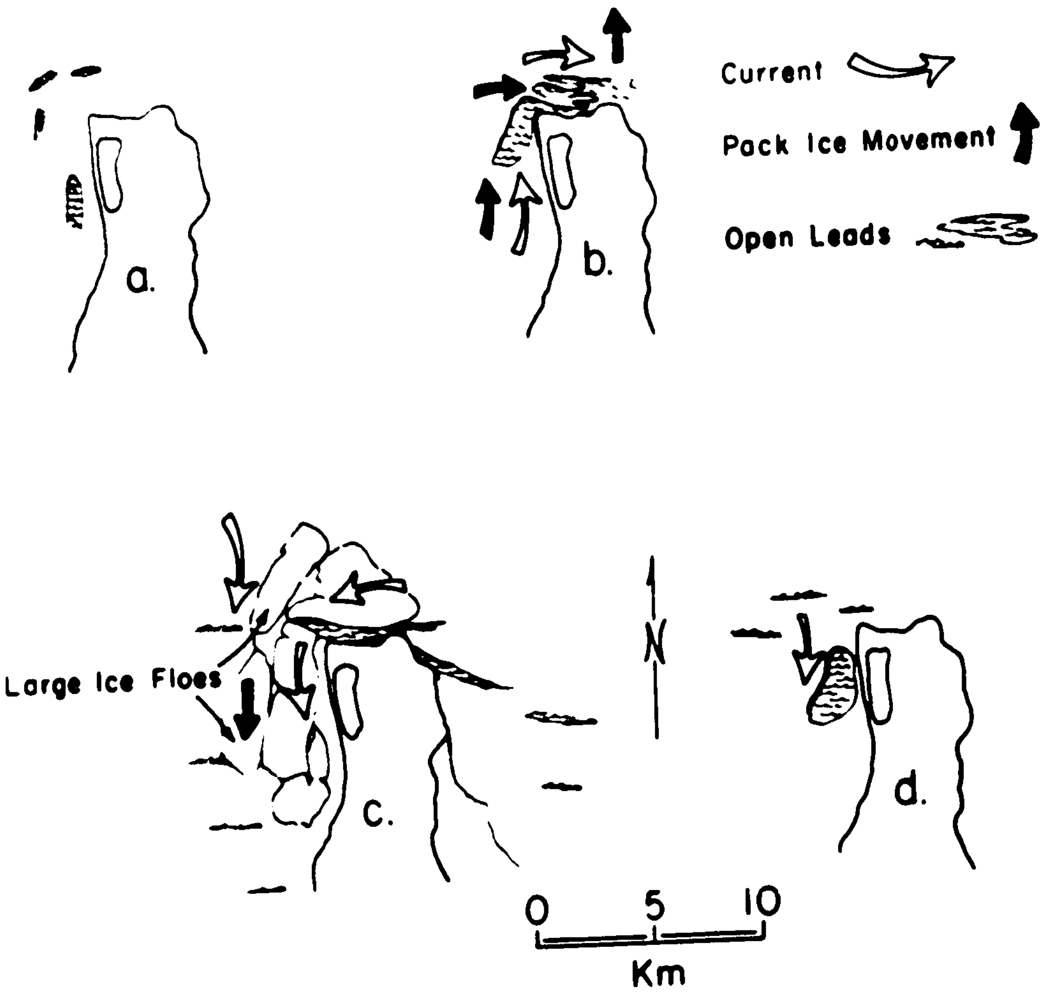

Current
Brash
Ice
Movement
Open Water
Shore
Fast
Ice
Lead
Ice
Fast
Open
Shore
0
5
10
Km
N
①
②
③
④

FIGURE 10

Tidal Ice Pack Movements about the

NW Cape February 2, 1972

Numbers below each sketch refer to the time of day the sketch was made. See text for a description of the sequence of these changes.


Current
Pack Ice Movement
Open Leads
a.
b.
Large Ice Floes
c.
N
d.
0 5 10
Km

APPENDIX 6

Selected and Summarized "Sentiments" of the Human Population of NW Cape as Documented by Charles C. Hughes (1960)

Birth:	To have many children is traditionally a woman's chief joy in life. Infanticide was never institutionalized, orphans are almost always loved and accepted, a broad array of social encouragements to fertility exist and there is a general lack of acceptance of contraceptive devices (p 64-65).
Death:	There is a certain resigned acceptance and occasional fatalism noted in sentiments around death. Belief in reincarnation occurs in these sentiments as does the need to break ties to earthly wants, as indicated by piacular mourning rites. The imminence of death is seen as real and near from a young age on. The taking of ones own life can contribute prestige, and strength to next-of-kin, if one suffers from prolonged illness, or a son or grandson suffers from illness and is in danger, or if one decides to do so to enhance a position of strength and great reputation (p 65-70, 97).
Food:	Next to kin, the highest values expressed relate to sentiments about food from local sources (p 166).
Family:	Wealth is measured in terms of a large family, especially of boys. The solidarity of the family and between brothers is important to the kinship and economic system of the community (p 235-245).
Hunting:	The approbation of hunting and the prestige given a successful hunter is strong even in the face of new job roles available from outside influences. Camping in the summer is an activity enjoyed by everyone (p 131-136).
Education:	Succeeding in school work has taken on high value in itself. Part of its attraction is the enhancement seen of personal choice. As only one person from the community (in 1955) has finished college these sentiments are mostly aspirations (p 317-318).

APPENDIX 7

Characteristics of the Bering Sea and St. Lawrence Island Waters

Source: Lisitsyn, A. P. 1969. Recent Sedimentation in the Bering Sea. Acad. of Sci. of the USSR. p 43, 92, 94, 95, 96, 97.

Annual water flux:

Bering Sea total volume	3,683,000 km^3
Pacific Ocean inflow	150,000 km^3
Aleutian Islands outflow	129,000 km^3
River and precipitation inflow	1,200 km^3
Bering Strait outflow	22,000 km^3

St. Lawrence Island lies just north of the annual 1°C isotherm

Sea surface temperatures:

July, August, October	40-45°F	(4.4 - 7.3°C)
September	50°F	(10°C)

Permanent surface summer currents:

	Nautical miles
central sea areas	0.1 - 0.3 nm
coastal areas	0.2 nm
areas of straits	1.0 nm

Tides:

amplitude in the vicinity of Island:

northeast shore	0.8 meters
Chirikof basin	0.5 meters
dateline west of Island	0.4 meters

tide current speeds: largely unknown but 10's to 100's times faster than permanent currents

Waves:

Winds at Beaufort 10 (22m/sec.):

course 200 km	4.5 meters
course 600 km	8.9 meters

APPENDIX 8

Selected Traditional Food Recipes

QAAPILLQAQ

This dish is prepared in small servings and eaten before the main meat course of the meal.

	(modern way)
3 cups frozen greens (Nunivak)	1/2 cup lard
1/2 cup seal oil	1 cup sugar
1/2 cup reindeer tallow or	

Chop the frozen greens fairly coarsely; pound the tallow and melt in a pan. Add seal oil as the tallow melts. Mix with greens and serve.

Modern way: add sugar to the chopped greens, mix in the lard and seal oil and serve.

PILLUMAGHTAQ

This dish is served in small portions before the main course of the meal.

	(modern way) use:
3 cups frozen greens (Nunivak)	1/2 cup seal oil and walrus oil
1 cup whale oil	1/2 cup lard
1 cup soft snow	1 cup sugar

With a scraper, scrape the greens to a very fine consistency. Melt the whale blubber and mix with greens. Mix in the snow until a creamy consistency is reached (do this outdoors).

Modern way: add sugar to the chopped greens then mix in the seal/walrus/lard oils. Add snow to proper consistency as above.

AASLIQ

This soup is served before the main meat course of the meal.

water from boiled Sourdock or water from soured Nunivak
seal blood

In quantity desired, boil the water and while boiling stir in the blood. Add amount to preference to acquire a thick consistency.

ESLEVAGAQ

This delicacy is served before the main meat course of the meal. It requires skill to prepare.

salmon eggs
seal, walrus or whale oil
Pagunaghaq (small black 'crowberries')

Using only 1 egg cluster from the fish, mash them in a bowl with any implement. Mix gradually and in small amounts (2-3 tsps) the oil with the roe until stiff (or when a lump pops out). Then add the berries in the amount preferred and serve.

KUMUGHQAGHQAQ

A variation on the above is to add the chopped flesh of the fish (with the water wrung out) in place of the berries.

PUGANUQ

This dish is served before the main meat course of the meal.

1 1/2 cup minced reindeer meat	3/4 cup seal oil
1/2 cup reindeer tallow	1 cup soft snow

Pound the reindeer tallow and melt. Add seal oil to pan as melting is started. Once all tallow has melted add minced reindeer meat and a little more seal oil. Mix the whole and soft snow (outdoors) until thick and creamy and serve. (Salt can be added to taste nowadays.)

PAGUNAGHKUKAQ

A variation on the above is to substitute the small black Pagunaghaq berries for the meat.

PERARA

Another variation of Puganuq is to use finely minced reindeer meat (like finely scrapped Nunivak) in a two cup quantity, making a meatier dish.

UGGUGGQAQ

This dish is served before the main meat course of the meal.

1/4 cup willow leaves (Ququnguq), fresh, minced finely
1 tbsp seal oil
3 tsps fresh seal blood (modern: add sugar to taste)

Stuff the finely minced willow into a small piece of walrus stomach and chew to a fine consistency or grind between whale disc. Add the oil and blood to the mixture, chew until well mixed and serve.

ALLUGGQAQ

This dish is served before the main meat dish of the meal.

3 cups Sourdock (Allqughqaq) leaves
1/2 cup seal oil
1 cup water from boiled seal meat (modern way: 1 cup sugar)

Boil the greens until soft and mix with the seal oil. Boil in water from boiled seal meat. Serve as a watery greens mixture or freeze, cut into cubes and serve.

UQUGHTIQAQ

This dish is served as a dessert at the end of the meal.

2 cups salmonberries, fresh or fermented
1/2 cup seal oil or (modern way)
1/2 cup shortening (lard)
1/2 cup sugar

Mash the berries, mix in oil and freeze. Serve.

TUNGUGGHTAQ

This dish is served before the main meat course of the meal.

Iqalluwak (Tom cod) or Qaiyu (sculpin)
water from boiled fish
seal oil

Boil the fish and save the water. Mash the boiled meat and mix gradually in seal oil. After mixing add and mix enough of the boiling water to allow the mixture to freeze. Serve in cubes. (Salt to taste.)

Note: This is a miraculous mixture. If enough oil is not added the whole mixture will disappear (evaporate?). In any case the dish will certainly be clean the next morning.

CHAPTER III

A DESCRIPTION OF THE PRODUCTION TECHNIQUES AND ECONOMY OF THE NORTHWEST CAPE

1. Introduction

In the preceeding chapters of this paper elements of the population, habitat and biotic communities at NW Cape have been described. Information available in the literature and collected in the field has been reduced only in that the discussion focused on those aspects which appear important to the resource utilization system. Of the several ways men in this community make their living, the occupation of particular interest to this study is hunting. The task remains, then, to arrive at some notion of the role of this occupation in the activities of the community. The techniques of hunting walrus, whales and seals are well documented in the archeological, anthropological, social and regional literatures and therefore receive only an occasional comment. Here the approach is to determine the income of edible products and useable by-products into the community from the hunts of 1971-72 and to compare this income to that from other sources. These estimates may then be compared to estimates of the food requirements of the community. The purpose of the first comparison is to describe in economic terms the role of the Island-mainland connection, previously described in demographic terms. The purpose of the second comparison is to test the proposition that the metabolic maintenance requirement of the community is a sensible measurement of the minimum income needed to ensure its survival. It is obvious that for a community to maintain itself, its income must at least match the metabolic cost of its activities. The comparison may reveal that need does not influence income since many alternative sources exist and the possibility of going without is remote, such large surpluses of income exist that maintenance needs are but a very small component of income, or that the role of subsidiary energy sources so inflates income that a comparison with maintenance needs reveals only this inflation. In this chapter the income and requirement of one dietary component will be assessed, protein. In the next, the assessment will be made in caloric terms. Impressions from the field year indicate that for some individuals income and needs fairly well match (that is, there is no surplus) during the late fall and late winter seasons and that the analysis attempted here may therefore be appropriate.

Hinted at in the discussion of climate, waters, ice and food chains in Chapter II is the periodic nature of the resource base of the Cape community. "Periodic" concerns oscillations over time, seasons of presence and seasons of absence. That the occurrence of the food resources changes with the seasons implies climatic influences and thus, a phenology. A few comments on this phenology are appropriate then, by way of introduction.

In terms of weather and faunal changes there are two principle seasons at the NW Cape: summer and winter, or better, the season of open water and the season of ice. Climatic data extracted from the U.S. Navy Marine Climatic Atlas (1958, II) substantiates this basic two-season pattern:

	Winter (Dec. - May)	Summer (June - Nov.)
% north winds	76 - 57	60-27
% south winds	22 -<10	54-10
Temp. range	-18 - 40	5-53

Wind speeds and precipitation appear fairly constant throughout the year. Sea ice reached the Gambell point on December 1, 1971. Some said the ice was late and there was disappointment expressed that the consolidated brash preceeded the pan ice forms. The ice was gone for all practical purposes by the second week in May. An average of six months of ice-dominated seas is a fair estimate for the NW Cape but would not apply at all for other areas of the Island. Not only is the ice regime different for these areas but the composition and distribution of the biotic communities differ as well. It is apparent that the two seasons of the Cape are divided by two important periods of change: the fall ice-formation period and the spring ice-recession period. An aid to understanding the distribution of the Bering Sea fauna is the common misconception that walrus "ride" south (or north) on the pack as it moves through the Bering Straits, the whales and seals accompanying the pack as the ice limit moves south (or north) and so on. A fact essential to the discussions in this chapter is that the majority of ice formed in the Bering Sea is of local origin. The Bering Sea is not coordinated over the year by the movements and characteristics of a "pack". The pattern of ice already described is unique to the NW Cape.

In the view of several of the Cape population the seasonal cycle of activities may be divided as follows. The first of the year is marked by the conclusion of the walrus hunt, when 'everything is finished and cleaned-up and the meat cellars are full'. The whales and walrus are gone, nesting birds have arrived, hunting relaxes after a busy spring and, in earlier days, it was time to vacate the winter house. Until the fishing and harbor seal hunting starts later in the summer, it is a time of general relaxation. A variety of activities occur: equipment repair, boat recovering, entertaining tourists, hunting for cliff-birds and eggs, summer employment. Later in the summer when the fish begin to run and the harbor seals return to the shore and lagoon feeding areas, preparations for camp begin. Each camp operates on a different schedule but all enjoy a rich supply and variety of available foods. One well-used camp near SW Cape may serve as an example: during June alcids, waterfowl and larids are abundant and an occasional young bearded seal may be taken; July to mid-August the salmonoids begin to run, birds are still present but in lesser numbers and the first harbor seals may appear; August the harbor seals increase in numbers, fish are present but in reduced numbers, greens and berries are ready for picking. Many of these foods are collected in storage quantities at camp and if the area has good seal hunting in the fall and there are no children to return to school, camping may continue through October. During November and December, most usually return to the village to hunt walrus, bearded and harbor seals during the ice formation period. Considerable numbers of walrus may be taken by boat at this time. Around December 1 trappers may return to their camps for a short time to establish fox trap lines.

speed of present travel makes it unnecessary to spend long periods at camp, but some may do so to assess the prospects of success for the winter. Thereafter, the lines may be cleared during a day's travel or with an overnight stay at most. Hunting on the ice is carried on around the Cape from December through March as well as occasional boat hunting when south winds occur. Whaling begins in April, followed immediately by walrus hunting which usually extends to the last of May.

Without presuming direct casual relations between climate and the presence or absence of food species, observations of their respective changes during the year may be presented together. Fig. 11 presents annual data on five weather parameters and on the presence or absence, and numbers harvested of 19 food species used by the Cape population. As elsewhere in this study, estimates of presence or absence are based on hunting success. No independent assessment was made of the distribution of food species. Appendix 9 presents monthly summaries of climate and hunting observations October through May 1971-1972. Averaged data from the investigations of the Alaska Department of Fish and Game 1959-1971 are presented in Table 6 for the composition and chronology of the Gambell walrus harvest. Seal bounty data are also included as indications of the magnitude of the ringed and harbor seal harvests.

Three major characteristics emerge from these summaries of the phenology at the Cape: more food species are present at the two major periods of seasonal change than at any other time, during mid-winter and mid-summer food species present are the least diverse, no major food species is resident the entire year.

FIGURE 11

Phenology Rose

Two sets of data are shown on this figure. Weather summaries and ice presence appear outside the circle for each month of the year. Numbers presented represent respectively:

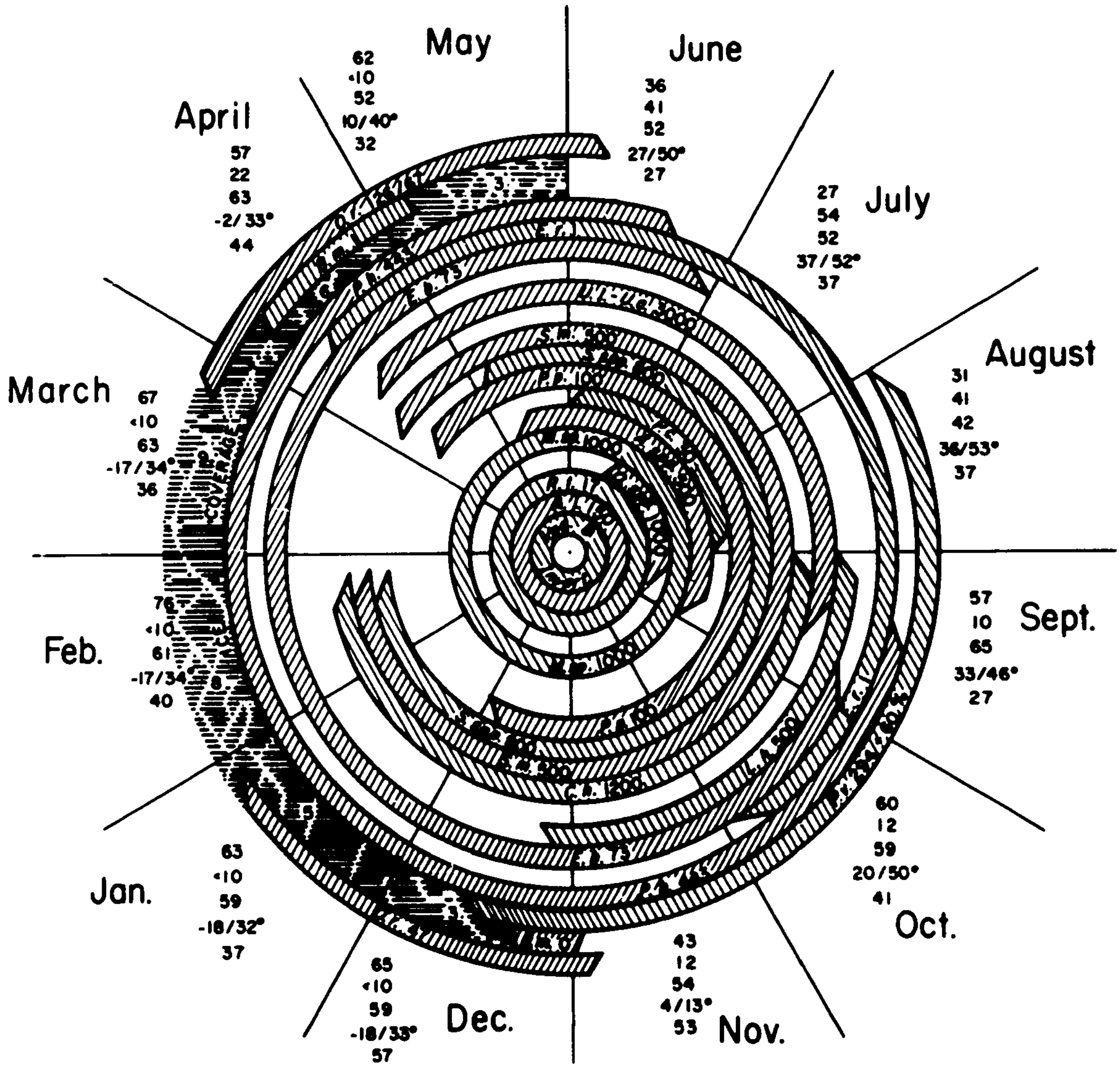
% northerly winds
% southerly winds
% winds with speed Beaufort 4 (13-18 mph) or greater
Average temperature range
% of all winds with accompanying precipitation for each month

ice coverage: average for month of range 0/10-10/10

All data is taken from U.S. Navy, 1958, II Gambell Station.

The second set of data concerning the general presence and absence of food species is represented by concentric circles. Numbers taken during the 1971-72 season follow the species named in the figure, abbreviated as follows:

O.r.	Odobenus rosmarus	C.h.	Clangula hymaelis
B.m.	Balaena mysticetus	S.m.	Somateria molissima
P.v.	Phoca vitulina	S.spp.	Somateria spp.
P.h.	Phoca hispida	P.p.	Phalacrocorax pleagicus
E.r.	Echrichtius robustus	P.c.	Philacte canagica
E.b.	Erignathus barbatus	A.spp.	Aethia spp.
L.h.	Larus hyperboreus	M.sp.	Myoxocephalus sp.
U.l.	Uria lomvia	O.spp.	Onchorynchus spp.
U.a.	Uria aalga	R.t.	Rangifer tarandus
A.l.	Alopex lagopus		


May
62
<10
52
10/40°
32
June
36
41
52
27/50°
27
July
27
54
52
37/52°
37
August
31
41
42
36/53°
37
Sept.
57
10
65
33/46°
27
Oct.
60
12
59
20/50°
41
Nov.
43
12
54
4/13°
53
Dec.
65
<10
59
-18/33°
57
Jan.
63
<10
59
-18/32°
37
Feb.
76
<10
61
-17/34°
40
March
67
<10
63
-17/34°
36
April
57
22
63
-2/33°
44

2. Hunting walrus, whales and seals

For the community as a whole, undoubtedly the most important form of hunting is boat hunting for walrus. For the individual hunter, seal hunting at the shore waters and on the winter ice occupies the bulk of hunting time when walrus are not present. But seal hunting will be discontinued and walrus sought when they are in the area. Bird hunting, fishing and fox trapping provide variety in the diet, extra income and something to do during slow seasons. These hunts serve an important function but must be considered secondary to that of marine mammals in the support of the community. Jobs, welfare grants, loans and sales of harvest by-products are of secondary interest to most men even though these sources comprise the money flow of the community. The flow of money is critical to its active sector as this flow limits that of the food species. This relationship readily emerges from the discussions below.

Walrus hunting appears to be the most productive and the most essential form of hunting for the NW Cape. The basic reasons for its important place are simple: the walrus are prevalent during certain periods, they are desired by the hunter, the skills required to make use of all parts of the animal are available, and when present they are easy to find and kill. The first reference seen to walrus hunting (Orosius, 868 A.D. in Elliott, 1882 p 100-101) states that Dane Wulfstan of Norway killed 56 walrus in two days from his boats while exploring the "country of the Beormas". Once killed, however, it may not be easy to recover a 1000 kg animal in a light boat with nothing but a few ropes and a knife. The Alaska Department of Fish and Game (Burns, 1973 p 3) estimates that in 1971 40% of the walrus killed or mortally wounded by Gambell hunters were not retrieved (50% at Savoonga, 20-60% for other areas). There are several reasons for such a large loss of animals. First, if the walrus is not killed outright, even though the shot is well placed, the animal often dives, swims and is lost. The only stop-dead shot seen for the walrus is a side shot to the brain case. Careful shooting is required for such a shot and the barrage fire common among crews of hunters achieves such accuracy on the first shot at best. A fine engraving of barrage fire against the walrus (by explorers) is included in an early record of Cook's voyages (Cook, 1785 p 262). If the walrus is killed in the water, occasionally the air in the lungs and pharyngeal pouches is expelled and the animal sinks. The only hope for recovery in this case is to land a harpoon in the animal before it is too far under the water. This was seen done once, in a spectacular fashion, the harpoon piercing the female's hind flipper, not damaging her much desired hide. One of the Department's recommendations for reducing this loss (ibid, p 10) is the establishment of a minimum caliber size for the rifles used. Fay (1958 p 39) suggests that no caliber with less than an impact power of 2000 ft. lb. at 100 yards be allowed.

Once secured, the portion of the animal butchered and processed depends very much on where the animal is located. If near the beach, the walrus is lashed to the side of the boat and towed ashore. The recovery of animals beached for butchering is greater than those secured under any other circumstance. In December of 1971, a single female and calf were killed off the Gambell point. All that remained after butchering was a section of the spine, later picked over by the dogs. Examples of this kind of recovery, which probably comprises about 10% of the annual harvest, are more common in the summer, fall and early winter, but may occasionally occur during the spring hunt when the hide of the female is desired or when the kill is near the beach. Utilization of these kills is near 100%. The more common location for a kill is on or near ice floes and pans. That ice increases the accessibility of marine animals is doubly true if the walrus shot dies on the ice pan where it was just sleeping. Even if the animal dies in the water, so long as the boat can be moored to the pan and the walrus dragged at least part way onto it, a more complete recovery is possible:

males:	head, flippers, heart, liver, lower ribs and a large strip of skin, meat and blubber from the belly and chest area or about 40% of live weight
females:	head, hide, mammary glands, heart, liver, flippers and lower ribs or about 60% of live weight

When the ice is prevalent in the early part of May the majority of the kills are at the ice floes, which is much preferred to killing an animal in open water. Table 7 presents the chronology of the May hunt (Alaska Department of Fish and Game, Nome, 1972, pers. comm.). All kills except for those of May 14 (about 2/3 of the adult kill) took place in the vicinity of the pack, especially the large kill of May 6.

Recovery of the several open water kills later in the season is considerably less. Near the end of the spring hunt a female was killed from the boat well off-shore in rough waters. All that was obtained was a small strip of the hide, meat and blubber, the liver, the heart, the flippers and the head. The main limitation was the small crew size of four. Perhaps 10% of live weight is a reasonable estimate for butchering under these circumstances, although recovery is not this low for the entire May 14 kill. Hauling the animal to an ice pan or ashore, or achieving better recovery because of a larger crew all occur. An estimate of recovery after butchering for the annual harvest is:

	% total harvest	% live weight recovery
shore butchering	10	100
ice pan butchering	70	50
water butchering	20	10

for a mean recovery of 47% (compare Fay, 1958 p 19). Reviewing the walrus harvest over the research year, these recovery estimates appear conservative. All kills occurring before May 6 were fully recovered. The 1971 harvest was lower than usual and the harvest of females was insufficient for the boats of the village which needed recovering. Perhaps the research year was unusual, but considerable care in avoiding wastage was observed, sometimes under very difficult conditions. Ironically, the example just given of 10% recovery of an open water kill late in the season is a case in point. Considerable cold and wetting was tolerated to obtain even these meager returns.

A pattern evident here is that under difficult physical conditions or when the animals are abundant and less needed, the saleable components and the favored edible portions of the walrus are selectively recovered. When the animals are accessible and have previously been scarce, recovery is complete. A few reasons for the attention paid saleable components emerge from the record of one boat during the 7 day spring hunt. Table 8 shows 49 gallons of gasoline, 9.5 pints of oil (both for the outboard motor) and 225 man-hours were expended for the four days on which 11 walrus were taken. The local rate for gasoline is $1.00 per gallon, oil is $.52 per pint and the lowest pay rate seen in the community is $2.25 per hour. These 11 walrus cost therefore around $550 or $50 each. Expenses of gasoline and oil for the snowmobiles used on shore to assist loading, launching and docking the boat, ammunition, food and expendables for these hunts are excluded. As already mentioned, a flow of animals through the community requires the flow of money. For this and closely related reasons a use is devised for nearly every component of the walrus except the bone. Nearly all portions of the animal are edible: skin, meat, blubber, stomach contents, several internal organs, flippers -- the last three being considered delicacies. Meat portions, especially ribs, may be dried, but the bulk is stored in the meat houses located shoreward of every dwelling, or sold. The preparation of balled bundles of skin, meat and blubber for storage in cellars was once very common. At no time during the field year were they seen used and the storage quantities of walrus usually remain in the meat houses and seem mostly intended for dog food. Portions of the walrus which are not edible are still very useful: ivory is sold either raw or carved, intestines are dried and used to make rain parkas which are then sold, vibrissae are used in carvings or sold, bacula are prepared and sold and some hunters prepare mounts of the head and tusks for sale as well.

The degree of utilization of any individual animal ranges widely and appears to depend on the age and sex of the animal, where the animal is killed and the abundance of the animal before the kill. Assuming no loss of materials after butchering the fate of the annual walrus harvest (and the spring harvest where indicated) is summarized in Table 9. This table states that from October 1971 to June 1972, 60 male, 109 female and 67 calf walrus were taken at the NW Cape. It is unlikely that more than one or two additional walrus were taken during the summer months. After butchering, 84,200 kg useable portion is estimated recovered from the 174,000 kg estimated weight of the harvest.* The fate of only a small portion (6,790 kg) of this harvest is immediately apparent. Some was sold to Nome in response to an order placed early in April, tusks and bacula were sold to the store raw or carved, and for the 1971-72 hunt many of the female and calf hides were needed for boat covers and rope. The fate of the remaining 77,400 kg, a high percentage of which is edible, may be estimated by the following computation, even though these possibilities were not documented during the research year which ended June 1972.

The difficulties involved in documenting these calculations are

*The Ak.D.F.&G. estimates (Burns, 1973 p 4) that 60% of the walrus meat of the animals killed in the 1971 harvest was used by the population (50% for Savoonga, 5-95% for other areas).

obvious. The walrus storage, preparation and consumption patterns of a representative sample of the community would have to be followed for an entire year. Impressions during the research year indicate that stored walrus products are not a central part of the diet throughout the year but is one of several main meat components. Another impression is that loss of unretrieved animals and portions of retrieved animals not saved is an integral part of the hunting methods as they are now practiced. Suggestions for reduction of these losses by the enforcement of regulations derive from an underestimation of the physical difficulties in preventing these losses and the difficulties in enforcing such regulations.

At this point these materials are comprised mostly of hide (about half the female and calf hides were required for boat covering), meat blubber and viscera. The bone component, except for the ribs (with meat attached) which are often saved for drying, is part of the recovery loss. If the 125 dogs in the community are fed exclusively on walrus products for the year at 0.5 kg per dog per day, 22,800 kg of walrus products would be consumed, leaving 54,600 kg of preferred portions for human consumption: skin with subcutaneous fat (manguna), meat with subcutaneous fat (not more than 10% by weight) liver, heart, kidneys and small intestines (about half the total weight of viscera). An estimate of the protein income into the community may be computed as follows:

Component	% of remaining weight	gm protein/100 gm	kg protein
manguna	50	10.0 gm[1]	2,730
meat	25	25.6 gm[2]	3,490
viscera	25	21.0 gm[3]	2,870
		Total:	9,090

[1] Protein content not known; 10.0 gm is an estimate
[2] Mann _et al_., 1962 p 72 value for walrus fresh meat
[3] Heller and Scott, 1967 p 185 value for liver

About 9,000 kg protein remain for human consumption, assuming no loss of these products during storage or preparation. The per capita daily income of protein from the annual walrus harvest is, then,

kg protein		resident population		days per year		gm protein/ person-day
9,000	x	310^{-1}	x	365^{-1}	=	80

somewhere between 60 and 100 gm, or at about the range of the NRC recommended daily protein dietary allowance of 70 gm for a 70 kg man (Heinz, 1959 p 70).

If walrus hunting is the most productive form of hunting for the men of the Cape, bowhead whale hunting is the most prestigious. Elements of technique, equipment, personal sentiments and the social institutions surrounding whaling are well documented for St. Lawrence Island (Hughes, 1960 p 111-115). Yet, an entire monograph might be devoted to this subject. For the spring hunt of 1972 boats were on the water for 9 days between April 11 and May 1, when the single whale for the season was taken west of the Cape. The number of boats hunting varied from 3 to 12 for a total of 70 boat trips for the hunt which averaged 9 hours for each of the days out. Crews varied from about 5 to 7 men. From one boat about 30 whales were sighted and from all boats 3 whales were struck before a male was killed. The whale measured 17 feet 5 inches (about 5.2 m) across the fluke and appeared about 45 feet (13.5 m) long. The tongue and the skin of the whale was butchered and distributed. For a whale of this length 45 metric tons is a reasonable weight estimate, 17% of which comprises the skin layer (Foote, 1965 p 350). The very large tongue easily comprises another 3% for an estimated 9,000 kg of high-grade edible food for 3,780 man-hours expended. The 350 baleen plates on each side of the jaw of Balaena vary from 1 to 4 meters (Walker, 1968 p 1140). Longer pieces weigh around 4 kg (8-10 lb. from field measurements). Average weight for all plates does not exceed 3 kg each or about 2,000 kg for the entire jaw. This whale was divided quite equally with the community of Savoonga which had divided the whale taken at the SW Cape several weeks earlier with Gambell. That whale was estimated at 35 feet in length and the total income for Gambell for the whaling season is estimated as follows:

Gambell Whale	Savoonga Whale
4,500 kg mangtuk	3,500 kg mangtuk
350 baleen plates (1000 kg)	3,400 kg meat[1]
	350 baleen plates (750 kg)

[1]Foote, 1965 p 350, meat at 17% body weight

A more complete recovery of the Savoonga whale was achieved and a considerable quantity of meat entered the community. It is not possible to calculate the cost of returns from the Savoonga whale as the field period was devoted to Gambell whaling. These costs were likely dominated by gas, oil and depreciation costs of snowmobile travel to and from the Cape. Since St. Lawrence Island whaling is under sail, the principle cost involved for whaling at the Cape is that of man-hours. The local sale price of baleen is $5.50 per kg ($2.50/lb in 1972). Excluding support costs for the crews and boats, cost and returns for the 1972 Gambell whale hunt are as follows:

Cost	Returns
$8,500	4,500 kg mangtuk
(3,780 man-hours at $2.25/hr)	1,000 kg baleen ($5,500)

The total protein income into the community from the spring whale harvest may be estimated in the same manner as for the walrus harvest:

8,000 kg mangtuk at 12.6 g protein/100 g[1] or 8.9 g/person/day
3,000 kg meat at 26.2 g protein/100 g[1] or 6.9 g/person/day
and
1,750 kg baleen at $5.50/kg or $9,625.

[1]Heller and Scott, 1967 p 185

Seal hunting comprises a large part of the time expended in hunting during the fall and winter. Since seals are butchered at the convenience of the household, a slightly different method is used in assessing the weight recovered from the harvest. The meat of the seal is the portion used with only a small amount (10%) of the generally 30% live weight that is blubber. Hide prices are variable from $5 to $35 usually, $15 taken here as average. Undoubtedly the estimates below represent no more than 2/3 of the harvest, annual total estimates reaching 1,120 animals at 29,000 kg and $16,800 in hide sales.

	Total Harvest	Average Weight[1]	% meat[2]	% blubber	Weight (kg) Recovered
Ringed seal	443	60	27	10	9,800
Harbor seal	299	70	27	10	7,800
Bearded seal	73	150	25	10	3,900
					21,500

Hides: 840 @ $15 = $12,600

[1]See Chapter II, 3.
[2]Foote, 1965 p 354-356

The per capita daily protein represented by 29,000 kg of seal meat (Heller and Scott, 1967 p 185: 28.4 g protein per 100 gm meat for P. hispida is 73 gm protein per person per day.

The individual character of seal hunting very much contrasts with the cooperative walrus and whale hunts. The man out earliest gets the best spots, and it is the nature of these wary animals that requires the hunt be solitary. Hunting techniques are simple: wait at the blind along the shore or at an ice lead (sometimes for hours), fire an accurate shot at the head briefly exposed above the surface of the water, hook and retrieve the seal before it sinks, or before wind and currents move it out of reach of the seal hook. More complex judgements are required in considering the season and weather conditions in an effort to predict productive areas for the day, or in securing a stable section of ice for a blind. Since seal records have seldom been collected for a given community by a resident observer (none have been seen), an important objective of the field study at Gambell was the collection of harvest records for all seal species and walrus killed and recovered by all hunters of the village for the October through March period. An evaluation follows of methods available for the collection of such records and of the method used at Gambell.

The collection of complete harvest records for one season for all species killed and recovered by all hunters in a village the size of Gambell may not at first appear difficult for a resident observer. Anyone generally acquainted with the conditions of native seal hunting knows, however, that it is. On any one day it is rare that all seals taken are killed and recovered in the same geographic area. Hunters often return from several different places during the day and seldom return at the same time. If an observer is hunting in company with other hunters his count of the day's kill must be limited to the group near and around him. During an extended research period he cannot visit every household every day for the purposes of a count, as an observer resident for a short time may do. The time required and the inconvenience to the household is excessive. As well, all seals taken may not be returned to the village. Occasionally a seal may be cached or left for fox bait. More importantly hunting may originate from camps anywhere from 4 to 20 miles from the community.

It is clear that the first and best method for collection of seal harvest records, the observation of animals killed and recovered, is not possible if the objective is a complete count for all hunters. It is essential to the success of any hunt, where more than a very few animals are sought and a very few hunters are pursuing them, that hunters spread out. When the animal is large, such as the walrus, and more than one man is required to handle them, accurate counts at a central point of return are possible. But as fall and winter seal hunting (and on occasion, walrus hunting) is done predominately by individuals from separate blinds, the observer may best confine himself to one small geographic area or to a very few hunters. The use of native hunters to assist in a total count may be little help unless a large number are employed.

An alternative initiated by Ak. DF&G is the bounty method. For each seal scalp (cap) returned to the regional office $3 is paid to the hunter (1972). This method has the obvious advantage of a potentially complete coverage of the harvest for all areas, with concrete evidence for each animal taken. The seal harvest counts derived from bounties have declined since about 1966 even though it is suspected that the harvest has not (Burns, 1970 p 5). In 1970 Gambell hunters turned in 541 caps, but the Department's estimate of actual annual harvest was 750 seals (ibid p 8). The reasons for this decline in participation in the initially successful program are obscure. Some of the younger men, even though they are successful, do not consider themselves seal hunters. They may not know about the bounty or how to obtain the return. Also, they may take a certain pride in not recording their seal takes with a white-dominated organization too often identified with game law enforcement. Some of the hunters of middle age and heads of large families do not consider the trouble required for collecting the caps worth the return. Other sources of income are much greater. The occasional hunters often consider their takes too small. The attitude of the women is also extremely important as it is their job to skin, flense and dry the skin and to prepare and set aside the cap. Some take the trouble, some do not.

A shift from seal caps to seal lower jaws for bounty return was discussed (March 24, 1972) among some of the hunters of Gambell and the Ak. DF&G biologist from Nome. It was agreed that saving a jaw was no more trouble than saving the cap, and perhaps less. Also, seals killed with direct head shots would be useable for bounty and age data would be available for the biologist. Now that subsistence hunters may not sell seal hides to commercial interests (U.S. House of Representatives, 92nd Congress. 1972. Marine Mammal Protection Act) renewed interest may be taken in the bounty. There is much to recommend at this time the change from scalps to lower jaws for bounty and the distribution to seal hunting villages of the necessary information and reminders.

The third alternative and the method used at Gambell 1971-72 (suggested by Burns, 1970 pers. comm.) is that of a personal agreement with each hunter to maintain and share his own harvest record. The results of this attempt are shown in Table 10. Such a request may not be as foreign to the hunter as it first sounds. Many hunters, especially those who are successful and who try to support their families by hunting, keep their own written records. Sure knowledge of each year's harvest lends security to those whose sustenance depends on it. Records allow an assessment of the hunter's contribution to the support of the family and of the development of his own skills. Records kept by these men are meticulously accurate. Some hunters (eg. Table 10: 8i, 13a) recorded the species, sex, general size, location, loss (if any) of all animals and birds on the day of the kill.

Given the possibility, obtaining good records by this method depends upon another factor: the relationship between the observer and the hunter. Only during an extended field period is it possible to flesh out personal relationships. But it is not possible to maintain a positive or neutral relationship with everyone. In the social climate of Gambell (Hughes, 1960 p 227) the visitor inevitably becomes identified with one segment or another of the community. Some records were not obtained or were not complete for these reasons. In situations where the hunter seemed reluctant to share or keep records, counts which appeared too low were most often given. This kind of information is by its nature privileged and hunters suspicious of the uses to be made of their records protected themselves by under-reporting. Only one apparently inflated estimate (hunter #8i, October) was received from a hunter absent part of that month.

The technique used in gathering this information was as follows:

mimeographed calendars for the month of October, November and December 1971 were prepared and distributed to 47 hunters; the purpose of the calendar was discussed with each hunter; the calendars were collected during the month of January 1972 and a purchased calendar given for that year; fall 1971 totals were posted on the village store bulletin board; 1972 calendar records were collected during the last week in May, most of the hunters keeping their calendars.

Seldom were hunters reminded about the calendars during the year. The number of seals a hunter gets is not a matter of public knowledge and is the hunter's personal affair. By general signs of activity and by reputation the level of success of most hunters is well known by his colleagues. The knowledge is unspoken, however, and not subject to direct questioning.

If successful this method has the advantage of establishing a basis for the often-stated proposition that it is relatively few hunters who take the majority of food animals, who are thereby providers for many and are wealthy in the products of the land. A very wide range of success was encountered and a record or two is available throughout that range. Yet, two limitations apply to the entire table: the counts are generally too low, the accuracy of seal species subdivisions is variable (records marked (') excepted). Setting all qualifications aside for the moment the table indicates phenomena of considerable interest in the study of factors affecting seal hunting practices.

Of the first group of hunters the record of the first hunter (1a) is the most disturbing. A very successful bachelor hunter of middle age who often hunts at camp in the fall, he is impossible to keep a supporting record on as he is in and out of the village regularly. He is very cooperative but not really interested in keeping detailed records. He is both a superb and sought after carver and story teller, and shares seals with many families or leaves them in camp. The second hunter (1b), his brother, is the head of a large family and one of the most consistent seal hunters in the village even though he is regularly employed part-time. When severe winter weather holds all but a handfull of men indoors, he is usually the first out of the day. He kept a detailed record of his seal take and loss. His hunting advice, although given in the most cryptic terms, is always sound. Hunters c and d hunted entirely from their fall camp and were absent during the winter. Hunter e, the oldest hunter and therefore boat captain, spends most of his time carving. He has become famous for the quality of his work to those familiar with the village. When he hunts, he does so entirely on foot. Except during the boat hunts, he confines most of his hunting to the fall. Not listed in this group of men is a much older man who, it was said, would be head of the clan in earlier days. He spends much of his time carving and trading stories at the store but he also helps launch the boat when the crew goes out, keeps track of the boat gear and makes occasional repairs, always watches from his house or from the beach for signs of animals, and most importantly, stays on the beach the entire time the boat is out, keeping watch.

These five hunters, all brothers or sons of brothers, directly cared for the 17 other members of their families and shared (mostly through marriage connections) with at least three other extended families of the village. Their ways of doing so just described are repeated in pattern in every other large family in the village. Among them they share a very wide range of skills, from diesel mechanics to ivory carving, not the least of which is the knowledge of the behavior of seals.

In addition to these what may be called 'style' or 'strategy' patterns, a fall-winter pattern emerges from the table. Ringed seals, with only occasional bearded seal boat takes and a very few harbor seals in January, completely dominate the record. Hunting effort appears to drop off for those hunters with low fall success, but does not drop off for the more successful. Of particular interest is that among these more successful hunters are several men under age 25 (hunters #3a, 8i, 13a), unmarried or just starting families. It also happens that several unmarried young men in Gambell have no interest at all in individual seal hunting, although they may serve a boat crew.

From 10 to 14 records accurately kept on a daily basis are summarized on Table 11. These records are of value in any effort to establish the physical determinants of a successful hunt.

Of 47 hunters originally contacted in the fall of 1971, 10 complete records were kept for the entire season on a daily basis. Eight more records were complete on a daily basis for three or more months of the period. Nineteen records comprising mostly estimates made by the hunter during interview were obtained, some very accurate by month, some not. Zero or near-zero takes for the entire year were obtained for about 10 of the original 47 hunters contacted. About a dozen records were incomplete because these hunters clearly resisted the idea. It must be remembered that two types of records are presented in Table 10: kills made by hunters covering individually the entire geographic area of this study and kills made by cooperative group hunting from boats. Records are presented by family groups usually consisting of allied brothers, fathers and son-in-law relatives and boat crewmen. Individual records are designated a, b, c, etc., the boat record following those hunters who are most often fellow crewmen. Records designated by (') were complete and well-kept on a daily basis for all or part of the October through March period. Records designated by (*) indicate takes estimated by the hunter and not kept on a daily basis. Other records not indicated with (') were carefully kept but the takes were too small to be of interest for the purposes of the count. Where zero appears it represents a known zero, records having been kept. Where the column is less than five numbers deep, no seals were reported for the excluded species. An (-) indicates no data available.

These records of seal takes stand as the hunters of Gambell were willing under the circumstances to present them. They are literally their records. These records reflect well the individual hunting activity observed in the village area. Six of the best kept records obtained (#s 1a, 2a, 5c, 8a, 8i, and 13a) are in themselves of considerable value.

3. The Economy

As one indication of the value of the marine mammal harvest to the

NW Cape population, the protein provided each member of the resident community each day has been estimated. These values may be summarized as follows:

Species		Weight (kg) recovered	Total protein (kg)	gm protein/ person-day
walrus		54,600	9,000	80
whales		11,000	1,800	16
seals		29,000	8,200	73
	Total:	95,000	19,000	169

If the harvest weights derived in the third section of Chapter II are accepted, about 5,200 kg of additional edible products are supplied from the harvest of other food species, or about 1,200 kg protein (11 gm protein/person-day). The total contribution of protein to the diet of the Cape population by local resources is estimated (Table 12) at 180 grams of protein per person per day. Throughout these calculations it has been assumed that no wastage of recovered edible quantities estimated for local foods harvested occurs in storage or preparation. If the minimum daily requirements of the National Research Council (Heinz, 1959 p 70-71: for 70 kg man, 70 g protein) are accepted, the local food resources harvested by the resident population during 1971-72 could supply the protein dietary component at these standards for a population at least twice its size. It is possible therefore that the Cape may once have supported a population of 600 on local resources alone. The importance of changes in storage practices once again emerges. An immediately obvious characteristic of the Cape resource system as it presently functions is that food and capital goods produced outside the Island are used by the community. It has already been mentioned that the flow of money through the community limits the harvest of local food species. It is relevant therefore to describe a few facets of the participation of the Cape population in the off-Island economy, particularly as they influence the local resource system.

It is in fact the concurrent operation of the Island economy and the economy of the mainland which produces the resource system as it now functions. This proposition is supported by a capital goods inventory (after Foote, 1968) conducted at the end of July, 1970. The results of this survey are summarized in Appendix 2. Their main lines are as follows. To support himself and three to four other members of the family, a hunter must first of all have a gun. Actually, two rifles and one shotgun are required, a large caliber rifle for walrus, a smaller and faster caliber for seals and a shotgun for birds. A second requirement, nearly equal in importance to the first, is access to personal transportation. One of the marks of an established hunter is the possession of his own snowmobile. Not all hunters do but nearly all have access to one. Those who do not are seriously restricted in their ability to maintain their families on local resources (compare Usher, 1972). A third piece of equipment essential to effective hunting is an outboard motor for use in boat hunting. The purchase and maintenance of these is the responsibility of the boat captains or is shared between brothers. Household equipment necessary for the support of hunting is also listed in Appendix 2.

A result of the survey of interest to this discussion is that three types of equipment essential to the maintenance of a household on local resources (a gun, snowmobile and an outboard motor) can be obtained only by purchase. In working condition, the value of this equipment is around $2,000. The increase in capital goods seen during the 1971-72 period probably brought the Gambell complement up to that of Savoonga in 1970, included in Appendix 2 for comparative purposes. The amounts of fuel necessary to operate this equipment was also surveyed on a household basis. The results are summarized in Table 13. Results of a fuel use survey in Savoonga were closely comparable. Comparing these estimates with the annual store order for fuels 1970-71 summarized in Table 14, the estimate for heating oil nearly matches the annual order, that for cooking fuel is probably combined in the survey with kerosene use and that for gasoline is very much too low. The impression gained in the course of the survey is that family heads are very aware of the use rates of heating fuel whereas little track is kept of the use rates of gasoline, usually purchased in small quantities as needed.

Another impression gained from the capital goods inventory and substantiated during the winter field period is that this critical participation in the economy of the mainland results in the removal of important components of the resource system from the control of the Cape population. A good hunter may expend a gallon of gasoline, a few cartridges, several hours at the blind and more hours maintaining equipment to get his seal. His wife may spend perhaps two hours (if the seal is small) flensing, cleaning, drying and stretching the hide. A few weeks or a month later the buyer arrives and the range of prices offered, perhaps $5 to $20 or perhaps $25 to $40, bears no relation to the abundance of seals, the effort required in its capture and processing or to the costs to the hunter. The price is much more directly influenced by the season's fashions in Europe, profit margins in the tanning and garment industries and product promotion programs (Samuel, Applebaum and Seligman, 1971). The cost of the commodities the hunter can buy with returns from the sale are also adjusted to production levels and a dollar system completely removed from the Island. This system does not directly reward the more energetic, efficient and skilled man over the less in that he cannot advance within the dollar system. The power the accumulation of money bestows (more control, more capital goods, more production, more consumption), accrues not in proportion to the intelligence and tenacity of the hunter but to the man willing to divorce himself from the local system for a steady job. The skill required of many heads of families is to play the two, for two quite separate systems are operating. Full-time jobs allow hunting only on the weekends and the few men who hold them hunt very little. Probably the most preferred situation is working in the summer months or part-time during the winter to earn the dollars necessary for maintaining the basic supply of outside goods, without which the life of the community would stop in its present form. These two systems meet most often at the community ANICA store.

Tables 14 through 18 summarize information on commodities sold, the magnitude of monthly sales, fresh foods air freighted into the community and the magnitude of monthly sales of hand crafted goods. This store's role as principle supplier of the commodities used by the community is obvious from its role in dollar outflow shown in Table 19. Private stores both at the Cape and on the mainland comprise another source of supplies. Transactions with off-Island suppliers most often takes place through the post office. Private transactions and the transactions with private stores at the Cape are at least common enough to balance the dollar estimated in Table 19 (compare Puchter, 1972 np). From this information, two very different patterns are discernible in the participation of the community in the economy of the mainland: the sale of hand crafted goods and the purchase of fresh frozen foods. The carving of ivory is the general part-time occupation in the community. It adds a last link to the events of the hunt which establishes a cycle and the paradigm of economic activity most profitable for the Cape. From the spring hunt stores of ivory, a walrus is carved. If it is large and well made the store will allow $10 credit for it. The hunter obtains ammunition, gas, an extra spark plug and expendables and hunts for the day. If successful his family eats well and a hide is available to be prepared for sewing or for future sale. A day or two later the hunter returns with another carving to exchange for goods and finds that the first has been sold, usually at a price 35% above the credit allowance. The store credits all but a 10% service charge on the total sale to the hunter (the "rebate") and supplies are once again assurred for the day's hunt. The sale price of the carving is determined by the store manager. It is also up to him to encourage quality in the carvings and efficiency in the use of ivory by, for example, the mark-up on the resale of uncarved ivory. No raw ivory is sold to anyone outside the community. The store serves as a repository for the ivory the hunter chooses to sell in raw form, usually just after a large supply is obtained, and sells it back to the carver needing ivory ($3 and $4/lb. raw ivory, $4 and $5/lb. fossil ivory in 1972). The carving is processed and sold locally, at the discretion of those who do the work. The magnitude of these exchanges is indicated in the store's monthly records by two categories (Table 18): "goods sold locally" and "goods exchanged locally". The first represents the dollars obtained by the store for hand crafted goods. The second represents the value of the commodities the carver receives in exchange. There is a $3000 annual difference between these two categories. Monthly difference demonstrates the rapid adjustment of raw materials available and sales of the finished product. During the month of January when several walrus were taken, goods exchanged well exceeded goods sold ($2,708 and $1,013 respectively). During the month of March, the situation was reversed with several visitors and traders passing through ($1,434 and $3,652 respectively). Since private transactions for ivory are excluded, rates in Table 8 represents a minimum. Rates are probably not less during the summer months, when walrus ivory and fox are not available, since the trade of fossil ivory increases. A similar pattern applies to the sewn goods produced by the women of the Cape, except that the store does not as often serve as a repository and distributor. Consequently the prices vary, and the highest price seen paid for any article ($80 for a rain parka) indicates that these items are under-priced.

About 1000 kg of sugar, 500 kg of flour go together with 29,000 kg of seal meat to make preferred meals for this community. Yet even with the other local meat products, 320 kg per person per year is not enough. The apparent deficiency is made up by the purchase of frozen meats (see Table 16). There is no question that a commercially prepared fresh food supply was much sought during the winter months of 1972. Table 17 indicates the rate of increase in air freight shipments which include these fresh foods. An average value of $4,400 and 890 kg of meat per month, as in Table 16, is probably conservative. The 10,600 kg of frozen prepared meats contributes 22.6 gm/person-day annually to the supply of the community. Fresh foods are also shipped from Nome to some families. The use of these foods is precisely the opposite of the paradigm of ivory carving: the community is in no way involved with the production and distribution of the product, only its consumption.

Increases in prices for all local products since the research year demonstrates the advantages that the existence of two disparate systems can produce for the Cape. For reasons foreign to the producer, an increase in the demand for and the price of local products may produce a period of affluence (see also Usher, 1970 II p 104). The 1920's was just such a period for the community and perhaps another is approaching. Even so, the fickle nature of the fluctuations in price paid for goods locally produced and for goods freighted into the community leads to a nonchalance towards the system which produces them. It cannot be depended upon. Every year the store traditionally runs out of certain essential commodities. The collecting of dollar capital has never appeared interesting, let alone sensible. Therefore the money flow through the community estimated in Table 19 is very much a maintenance quantity, even though it is true that a portion of the postal money orders are intended for children in school or relatives in hospitals. The 24 jobs represented, 20 at about $6,000 per year (BIA 4, ANICA 3, Post Office .5, Wien Airlines .5, Alaska Village Electrical Cooperation 2, Head Start 2.5, PHS 2, Police 1, National Guard 3, guiding walrus hunters 1.5) and 4 at about $10,000 per year (BIA 2, Post Office 1, FAA 1) do provide more than maintenance income but the accrual is in capital goods, not dollars. The store operations indicate about $8,000 in cash circulating in the community during any one month. If a flow of about $400,000 per year is a reasonable estimate, about $33,000 flows through the community each month (see Table 15, Monthly Store Sales). Locally there is apparently little use for cash. The existence of several small private stores and recent development of snowmobile dealerships indicates an appreciation of the magnitude of this out-flow and concrete measures taken to reduce it.

Further studies of dollar flow might dispel the notion that the small Alaskan community makes a good living from unearned income. The sample of commodities shown in Tables 14 and 16 indicates that food prices are too high. Unearned income constitutes an advantage to the supplier of the commodities (not to deny the advantage to the consumer) in that without it, consumption of these commodities would be much reduced. These high costs result in low 'real' income which daily curtails the freedom of action of the community. Some of the men jokingly refer to themselves as slaves to stove oil.

The flow through the community of about $400,000 and about 110 metric tons of meat each year supports a population of about 310 people ($1,300 and 350 kg of meat per person per year, $3.60 and 203 gm protein per person per day). There is still ample time for leisure and travel, the production and rearing of children and a long old age. Because of the disparate nature of the local and mainland resource systems the search for causal relations between the two, as they operate in one place, becomes a collection of independent variables (McConnell, 1971 p 25). The dependent variables, once found, vary with factors so foreign to the place that causal relations are lost. Chapter IV considers this problem.

TABLE 6

Summary of Walrus (Male, Female and Calf) & Hair Seal (Ringed & Harbor) Harvests

Alaska Department of Fish & Game for Gambell, Alaska

1959 - 1971

Year	Total Walrus Harvest[1] in Alaska	Gambell Harvest[2] Total	M	F	C	Winter (Jan-Mar) M	Winter F	Winter C	Spring (May-Jun) M	Spring F	Spring C	Summer (Jul-Apr) M	Summer F	Summer C	Fall (Sep-Dec) M	Fall F	Fall C	Hair Seal Harvest[2] Seals bountied	Hair Seal Harvest[2] Est. Harvest	Hunters (Bounty)
1959	1400																			
1960	2300	376-386								est. 200										
1961	1860	250-275																		
1962	1690	380							72	153	155							115	450	
1963	1725	314							54	117	77									
1964	975	108-118	43	29	36				42	15	19									
1965	1767	447	125	167	155				125	167	155				10	3	0	893		
1966	2788	488	104	196	188	17	4	0	80	192	188				7	0	0	820		35
1967	1317	84	58	22	4	14	9	0	22	4	4				22	9	0	1306		39
1968	1436	466	160	172	134	9	0	0	105	161	134				46	11	0	458		
1969	882	226	122	58	46				82	49	45				40	9	1	335	450	21
1970	1422	243	114	67	62	15	0	0	44	57	62				55	10	0	541	750	
1971	1915	175	130	28	17	16	0	0	69	13	13				35	15	4			
X̄	1652	300	107	92	80	14	3	0	70	93	85		0		35	8	<1	368	--	
X̄ Total							17			248			0			44		368		--

X̄ Composition

M = 1065
F = 362
C = 136

[1] Burns, J. J. 1971. Report of Survey & Inventory Activities, Walrus Studies. Vol. I, Fed. Aid in Wildl. Restoration, Proj. W-17-3, Job 8.0 & Proj. W-17-4, Job 8.0 (1st half). Table 4, p 11.

[2] Extracted from Progress Reports 1960-1971.

TABLE 7

Chronology of the May 1972 Walrus Harvest

Male+Female/Calves

Crews	DATE 5	6	8	11	12	14	21	Crew Totals
1	0	0	0	0	3/3	0	0	3/3
2	0	0	0	4/2	1/1	0	0	5/3
3	1/0	3/1	0	3/0	0	0	0	7/1
4	0	3/1	0	2/1	2/2	4/0	0	11/4
5	0	4/1	0	1/0	2/2	7/4	0	14/7
6	0	3/1	0	0	3/2	4/6	0	10/9
7	0	3/2	0	0	3/3	1/1	0	7/6
8	0	5/0	0	0	1/1	2/1	0	8/2
9	0	0	0	0	1/1	0	0	1/1
10	0	0	0	2/2	2/2	0	0	4/4
11	0	2/1	0	0	1/1	3/1	0	6/3
12	0	6/3	0	0	2/1	9/5	0	17/9
13	0	1/0	1/0	4/4	0	4/4	0	10/8
14	0	0	0	0	0	0	0	0/0
15	0	0	0	2/2	1/1	2/0	0	5/3
16	0	3/1	0	1/1	3/2	3/0	0	10/4
Daily Totals	1/0	33/11	1/0	19/12	25/22	39/22	0	118/67
								185

(Add: 1F May 25, 1F June 12)

TABLE 8

Costs and Returns of the May 1972 Walrus Hunt for

Boat Crew #4

Date	Time	Area	Take	Loss	Wounded	Butcher Area	Gas for outboard motor	Oil for outboard motor
May 6	11-2300	N, NE, NW ice floe, 5 miles out	2M, 1F, 1C, 1 fetus, 1 bearded seal pup	1F, 4 immatures	4 total	ice	11 gal	2 pt
May 12	08-2000	W to ice floe, 12 miles	0M, 2F, 1C	1 immature	1M, 1F	1 Gam. beach 1 water	13 gal	2.5 pt
May 13	10-2000	E, N to ice floe, 10 miles	2M, 0F, 0C	-	-	water	15 gal	3 pt
May 14	13-2400	NW, W open water	1M	1F	2M	water	10 gal	2 pt
Totals:	45 hrs 5 men		5M, 3F, 3C 1 bearded seal	7 total	8		49 gal	9.5 pts

TABLE 9

Estimate of Annual Walrus Harvest Returns, 1971-1972

Total Kill				Weight Recovered	
Oct-Dec	Jan-Apr	May-Jun	Total	Average Weight[2]	Weight recovered[4]
15M	26M[1]	19M	60M	1200 kg	33,800 kg[3]
1F	7F	99F	109F	900 kg	46,100 kg
0C	0C	67C	67C	64 kg	4,290 kg[4]
				Total:	84,200 kg

	Weight	$ Value	
Edible parts sold to Nome:	500 kg	310	(@ $.62/kg)
Raw tusk value:	680 kg	918[6]	(2kg/tusk[5] x 340 tusks x $1.35/kg)
Bacula:	--	480	(60 @ $8.00 ea.)
Boat covers: 3F, 2C hides/boat			
16 boats: 48F, 32C:	5430[7] kg		
	6790 kg		

[1]No sex data, ratio of 20% females for winter harvest from Table 6

[2]Fay, in prep.

[3]Method: 60M x 10% x 100% x 1200 kg = 7200 kg
60M x 70% x 50% x 1200 kg = 25200 kg
60M x 20% x 10% x 1200 kg = 1400 kg
33800 kg

(or 47% of 72,000 kg total)
The same method is used for females.

[4]Recovery of calves is 100%

[5]Walker, 1964 p 1297. 5 kg/100 cm
Gambell Average 15" (38 cm)

[6]See Chapter IV for carved ivory value

[7]Foote, 1965 p 352. Hides comprise 12% body weight

TABLE 10

Seal & Walrus

Harvests by Species by Month

RS - Ringed Seal
HS - Harbor Seal
BS - Bearded Seal
W - Walrus (M+F/C)
BR - Boat record

\- = no data
0 = known zero
' = records kept on daily basis

Family	Hunter	O	N	D	Sub Total	J	F	M	A	M	Sub Total	Grand Total	All Seals	Group Seals	Total Walrus
1														143	4/3
a	RS	-	-	-	2	-	-	-			20	22	62		
	HS				20						0	20			
	BS				20						0	20			
b'	RS	0	0	2	2	8	4	6			18	20	35		
	HS	6	4	5	15	0	0	0			0	15			
	BS	0	0	0	0	0	0	0			0	0			
	W	1	0	0	1	0	0	0			0	1			
c	RS	-	-	-	-	0	0	0			-	-	25		
	HS				-						-	-			
	BS				-						-	-			
	W				-						-	0			
d	RS	-	-	-	0	0	0	0			0	0	18		
	HS				8						0	8			
	BS				10						0	10			

Family	Hunter	O	N	D	Sub Total	J	F	M	A	M	Sub Total	Grand Total	All Seals	Group Seals	Total Walrus
e'	RS	0	0	0	0	0	0	0			0	0	3		
	HS	2	0	0	2						0	2			
	BS	0	1	0	1						0	1			
	W	0	0	0	0	0	0	0			0	0			
BR	RS				0	-	-	-			-	-	-		
	HS				0						-	-			
	BS				0						-	-			
	W				0					3/3	3/3	3/3			
2														80	13/3
a'	RS	1	0	7	8	5	9	7			21	29	45		
	HS	4	8	1	13	0	0	0			0	13			
	BS	0	0	1	1	0	1	0			1	2			
	W	0	1	1	2	0	0	0			0	2			
b'	RS	2	2	2	6	5	9	1			15	21	27		
	HS	1	3	2	6	0	0	0			0	6			
	BS	0	0	0	0										
c	RS				0						0	0	1		
	HS				1						0	1			
BR	RS			0	0	7	0	0			7	7	7		
	HS			0	0	0					0	0			
	BS			0	0	0					0	0			
	W			1	1	5				5/3	10/3	11/3			

Family	Hunter	O	N	D	Sub Total	J	F	M	A	M	Sub Total	Grand Total	All Seals	Group Seals	Total Walrus
3														107	11/1
a'	RS	0	14	12	26	-	-	-			30	56	92		
	HS	25	9	0	34						0	34			
	BS	0	0	0	0						2	2			
b	RS	-	-	-	0	-	-	-			3	3	4		
	HS				0						0	0			
	BS				1							1			
c	RS	0	0	2	2	-	-	-			0	2	2		
	HS											0			
	BS											0			
d'	RS	0	0		0	0	0	0			0	0	2		
	HS	1	1		2							2			
e	RS	0	0		0	0	0	0				0	0		
BR	RS	0	0	3	3	0	0	0			0	3	7		
	HS	2	2	0	4						0	4			
	BS		0	0	0						0	0			
	W		1	3	4					7/1	7/1	11/1			

Family	Hunter	O	N	D	Sub Total	J	F	M	A	M	Sub Total	Grand Total	All Seals	Group Seals	Total Walrus
4														26	11/4
a'	RS	0	0	3	3	-	-	-			9	12	13		
	HS		1	0	1							1			
b'	RS	0	1	1	2	-	-	-			0	2	6		
	HS	4	0	0	4							4			
c'	RS	0	0	2	2	-	-	-			1	3	3		
	HS				0										
d'	RS	0	0	0	0	0	0	0			0	0	3		
	HS	2	0		2							2			
	BS	0	1		1							1			
BR	RS	0	0	0	0	0	0	0	0	0	0	0	1		
	HS									0	0	0			
	BS									1	1	1			
	W									11/4	11/4	11/4			

Family	Hunter	O	N	D	Sub Total	J	F	M	A	M	Sub Total	Grand Total	All Seals	Group Total Seals	Group Total Walrus
5														48	15/7
a'	RS	0	4	0	4	0	0	0			0	4	9		
	HS	2	3		5							5			
b	RS	0	1	0	1	0	0	0			0	1	3		
	HS	2	0		2							2			
c	RS				0						0		0		
d'	RS	0	4	5	9	3	1	0			4	13	26		
	HS	9	3	0	12	0	0	0			0	12			
	BS		1	0	1	0	0	0			0	1			
	W			1	1							1			
e	RS	0	0	0	0	-	-	-			-	0	7		
	HS	3	3	1	7							7			
BR	RS	0	0	0	0	0	0	0		0	0	0	3		
	HS									0	0	0			
	BS									3	3	3			
	W									14/7	14/7	14/7			

Family	Hunter	O	N	D	Sub Total	J	F	M	A	M	Sub Total	Grand Total	All Seals	Group Seals	Total Walrus
6														12	10/9
a	RS	-	-	-	3	-	-	-			-	3	6		
	HS				3							3			
b	RS	0	0	0	0	0	0	0			0	0	1		
	HS	1			1							1			
c	RS	0	0	0	0	0	0	0		0	0	0	0		
d	RS				-						-	-	-		
e	RS	-	-	-	1	0	0	0			0	1	3		
	HS				2						0	2			
f	RS	0	0	0	0	0	0	0			0	0	0		
BR	RS	0	0	0	0	0	0	0		1	1	1	2		
	HS									0	0	0			
	BS									1	1	1			
	W									10/9	10/9	10/9			

Family	Hunter	O	N	D	Sub Total	J	F	M	A	M	Sub Total	Grand Total	All Seals	Group Seals	Total Walrus
7														11	7/6
a'	RS	0	0	5	5	-	-	-			-	5	11		
	HS	3	2	1	6							6			
b	RS	0	0	0	0	0	0	0				0	0		
BR	RS	0	0	0	0	0	0	0		0	0	0			
	HS										0	0			
	BS										0	0			
	W										7/6	7/6			
8														156	26/2
a'	RS	0	6	5	11	0	0	0		0	0	11	17		
	HS	4	2	0	6							6			
b	RS				-					-					
c	RS				-					-					
d	RS				-					-					
e	RS				-					-					
f	RS														
g'	RS	-	-	-	0	12	6	8			26	26	36		
	HS				9	0	0	0			0	9			
	BS				0	1	0	0			1	1			
	W				0	0	0	0			0				

Family	Hunter	O	N	D	Sub Total	J	F	M	A	M	Sub Total	Grand Total	All Seals	Group Seals	Total Walrus
h'	RS	0	0	5	5	17	2	5			24	29	59		
	HS	20	5	3	28	0	0	0			0	28			
	BS	0	1	0	1	0	0	0			0	1			
	W	0	0	0	0	0	0	0			0	0			
BR	RS	0	0	1	1	5	4	21	1	1	32	33	44		
	HS			0	0	3	0	0	0	0	3	3			
	BS			3	3	0	1	3	0	1	5	8			
	W			0	0	5	4	7	2	8/2	26/2	26/2			
9														17	1/1
a	RS	0	0	0	0	0	0	0	0		0	0	0		
b	HS	0	1	3	4	-	-	-			0	4	14		
	HS	3	3	1	7							7			
	BS	3			3							3			
c	RS	-	-		2						0	2	2		
	HS				-						-				
BR	RS			0	0	0	0	0	0	0	0	0	1		
	HS			0	0					0	0	0			
	BS			1	1					0	0	1			
	W				0					1/1	1/1	1/1			

Family	Hunter	O	N	D	Sub Total	J	F	M	A	M	Sub Total	Grand Total	All Seals	Group Seals	Total Walrus
10														36	4/4
a'	RS	0	2	5	7	1	3	0			4	11	19		
	HS	4	1	2	7	0	0				0	7			
	BS	0	0	0	1	0	0				0	1			
b	RS	-	0	0	0	0	0	-			0	0	13		
	HS				12						0	12			
	BS				1						0	1			
c	RS	0	-	-	0	-	-	-			-	0	1		
	HS	1			1							1			
d	RS	0	1	0	1	0	0	0			0	1	3		
	HS		2		2							2			
BR	RS				0	0	0	0		0	0	0			
	HS									0		0			
	BS									0	0	0			
	W									4/4	4/4	4/4			
11														11	6/3
a	RS	0	0	2	2	-	-	-	-		-	2	8		
	HS	3	3	0	6							6			
b	RS				0	0	1	0	0		1	1	1		
c	RS	0			0		-	-	-		-	0			
	HS	1			1							1	1		

Family	Hunter	O	N	D	Sub Total	J	F	M	A	M	Sub Total	Grand Total	All Seals	Group Seals	Total Walrus
BR	RS	0	0	0	0	-	-	-		0	0	0	1		
	HS									0	0	0			
	BS									1	1	1			
	W									6/3	6/3	6/3			
12														28	23/9
a	RS	-	-	-	1	-	-	-			-	1	8		
	HS				6	1					1	7			
b	RS			3	3	-	-	-			-	3	3		
c	RS				2	0	0	0			0	2	2		
d	RS				0	0	0	0			0	0	0		
e	RS	0	3	0	3	-	-	-			-	6	6		
	HS		3		3										
BR	RS			1	1	2	3	0		0	5	6	9		
	HS			0	0	0	0			0	0	0			
	BS			0	0	0	1			2	3	3			
	W			0	0	2	4			17/9	23/9	23/9			

Family	Hunter	O	N	D	Sub Total	J	F	M	A	M	Sub Total	Grand Total	All Seals	Group Seals	Total Walrus
13														80	15/8
a'	RS	3	1	11	15	10	15	3			28	43			
	HS	12	12	5	29	0	0	0			0	29	74		
	BS	1	1	0	2	0	0	0			0	2			
	W	0	0	2	2	0	0	0			0	2			
b	RS	0	0	0	0	0	0	0			0	0	0		
c	RS	0	0	0	0	-	2	-			2	2	2		
	HS						0								
d	RS	0	0	0	0	0	0	0			0	0	0		
BR	RS	0	0	0	0	0	0	0		2	2	2	4		
	HS					0				0	0	0			
	BS					0				2	2	2			
	W					1				12/8	13/8	13/8			
14														35	0/0
a'	RS	0	0	3	3	5	9	1			15	18			
	HS	0	4	0	4	0	0	0			0	4	24		
	BS	0	0	2	2	0	0	0			0	2			
b	RS	0	0	0	0	0	0	0			0	0	7		
	HS	1	6		7						0	7			

Family	Hunter	O	N	D	Sub Total	J	F	M	A	M	Sub Total	Grand Total	All Seals	Group Seals	Total Walrus
c	RS				0						4	4	4		
BR	RS	0	0	0	0	0	0	0			0	0			
	HS										0				
	BS										0				
15														41	9/3
a	RS	0	1	1	2	-	-	-			-	2	5		
	HS		1	1	2						-	2			
	BS		1		1						-	1			
b	RS	0	0	0	0	0	0	0			0	0	0		
c	RS	2	0	-	2	-	-	-			-	2	3		
	HS	1			1						-	1			
d	RS	0	0	0	0	-	-	-			0	0	0		
e'	RS	4	1	7	12	-	-	-			10	22	31		
	HS	3	2	2	7						0	7			
	BS	1		1	2						0	2			
	W			4	4						0	4			
BR	RS	0	0	0	0	-	-	-		0	0	0	2		
	HS									0	0	0			
	BS									2	2	2			
	W									5/3	5/3	5/3			

Family	Hunter	O	N	D	Sub Total	J	F
16							
a	RS	0	0	0	0	0	0
	HS	1			1		
b	RS	-	-	-	0	0	0
	HS				2		
c	RS	-	-	-	0	-	-
	HS				2		
d	RS	-	-	-	0	-	-
	HS				1		
e	RS	0	0	0	0	0	0
BR	RS	0	0	0	0	0	0
	HS			0	0	1	
	BS			0	0	0	
	W			1	1	3	

M	A	M	Sub Total	Grand Total	All Seals	Group Total Seals	Group Total Walrus
						10	14/4
0			0	0	1		
				1			
0			0	0	2		
				2			
-				0	2		
				2			
-				0	1		
				1			
0				0	0		
2		0	2	2	4		
0		0	1	1			
1		0	1	1			
0		10/4	10/4	14/4			

Family Hunter	O	N	D	Sub Total	J	F	M	A	M	Sub Total	Grand Total	All Seals	Group Seals	Total Walrus
Totals														
RS	12	42	91	156	80	68	54	1	4	281	443		841	169/67
HS	121	83	24	294	5	0	0	0	0	5	299			
BS	5	6	8	52	1	3	4	0	13	21	73			
Seals	138	131	126	505	86	71	58	1	17	307	818	+ 24		
		395					233					841		
W	1	2	13	16	16	8	7(31)	2	122/67		171/67			
											+ 2			
											240			

TABLE 11

Individual Daily Harvest Records

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total
October																																
Ringed Seal	0							0							1			1	0					2	0	0	2	0		0	0	6
Harbor Seal	2	3	2	0	2	0	0	2	1	2	1	0	1	1	2	0	5	1	2	0	0	3	0	0	2	1	5	2	2	5	1	48
Bearded Seal	0				1	0		0									1														0	2
Walrus	0							1																							0	1
Ribbon Seal	0							0																							0	0
																																57
																																12 Hunters
November																																
Ringed Seal	2	1	0	0	1	0	3	3	0	2	2	2	0	0	1	2	4	2	3	0	2	1	2	0	1	0	1	0	0	0	-	35
Harbor Seal	7	6	2	5	1	3	3	1	5	1	4	2	1	0	1	4	1	0	1	3	1	0	1	1	2	0	0		0	2		58
Bearded Seal	0							0			1	0			1	1	0					0	1	0	1	1	0		1			7
Walrus	0							0			0											1	0									1
Ribbon Seal	0							0			0											0										0
																																101
																																14 Hunters
December																																
Ringed Seal	0	0	1	0	1	0	2	1	0	0	0	0	0	3	1	4	2	4	8	1	1	3	4	5	2	7	3	7	5	2	0	67
Harbor Seal	5	0	0	3	2	0	0	0	3	0	0		0	2	0	0	2	0				1	0	0	0	1	0			0	0	19
Bearded Seal	0								1	0	0		0	0								0	0	1	0	0				0	0	2
Walrus	0									0	4		1	0								0	1	0	2	0				0	0	8
Ribbon Seal	0									1	0			0								0	0							1	0	2
																																98
																																14 Hunters
January																																
Ringed Seal	2	1	0	0	3	0	1	1	1	1	1	4	5	6	1	6	3	5	2	2	9	2	6	3	0	0	1	0	0	0	0	66
Harbor Seal	0									0	0																					0
Bearded Seal	0									1	0																					1
Walrus	0									0																						0
Ribbon Seal	0									0																						0
																																67
																																10 Hunters
February																																
Ringed Seal	3	7	3	0	1	4	4	1	0	0	0	1	4	0	0	1	0	0	3	0	1	0	1	2	9	5	2	5	1	-	-	58
Harbor Seal	0																						0	0								0
Bearded Seal	0																						1	0								1
Walrus	0																						0									0
Ribbon Seal	0																						0									0
																																59
																																10 Hunters
March																																
Ringed Seal	1	0	0	1	3	4	3	2	0	2	5	0	3	1	1	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	31
Harbor Seal	0																															0
Bearded Seal	0																															0
Walrus	0																															0
Ribbon Seal	0																															0
																																31
																																10 Hunters

TABLE 12

Annual Protein Contribution of All Foods

species	weight (kg) recovered	% protein	total protein (kg)	gm protein/ person-day
Local harvest:				
walrus	54,600	17[1]	9,000	80
whales	11,000	19[2]	1,800	16
seals	29,000	28.4	8,200	73
subtotal:	95,000		19,000	169
Pac. eiders	750	21.4[3]	161	
Eider eggs	100	12.8[4]	13	
Emperor geese	225	21.4[3]	48	
Long-tailed duck	450	21.4[3]	96	
Murres	1,400	21.4[3]	300	
Cormorants	150	21.4[3]	32	
Glaucous gulls	380	21.4[3]	81	
subtotal:	3,460		730	6.5
reindeer	500	23.9[5]	120	
all fish (dried)	400	51.4[6]	206	
beach throw	100	11.7[7]	12	
upa	10	11.7[8]	1	4.6
(arctic fox	750	23.9[9]	179)	
subtotal:	1,760		518	11.1
Total:	100,200		20,200	180
Purchased meats:				
(beef, pork, chicken)				
Total:	10,700	24[10]	2,500	22.6
Grand Total:	110,900		22,700	203

[1]Average of values for manguna, meat viscera

[2]Average of values for mangtuk and meat

[3]Method: 500 (annual harvest) x 3 kg (body weight) x 1/2 (edible portion meat) x 21.4 g/100 gm (Heller and Scott, 1967 p 182)

[4]Heinz, 1959 p 120 for fowl eggs

[5]Heller and Scott, 1967 p 182; skeletal muscle at 1/2, dressed weight 40% of live weight (Luick _et al_., 1970 p 24)

[6]_Ibid_ p 184

[7]At value for upa, weight is a rough estimate

[8]Heller and Scott, 1967 p 184

[9]Taken at reindeer value; fox carcasses supply dog food only, excluded from total

[10]Heinz, 1959 p 116 average value for beef taken for entire weight

TABLE 13

Annual Fuel Use by Household[1] 1970

	heating fuel (gal)	cooking fuel (gal)	gasoline (gal)
ave/mo/house	127	11	24
most common use rates/mo	50, 110, 150	∿5, 10, ∿25	10, 25, 40
range/mo	0-330	0-50	0-70
total/yr	65,400	4,400	9,500

[1]Households surveyed: 45, 42, 33 respectively

TABLE 14

Amounts and Values of Selected ANICA[1] Store

Commodities Sold 1970-1971

	Amount	Seattle Cost ($)	Unit Costs ($) Seattle	Gambell
Fuels (gallons)				
heating oil	74,000		.30	.45
		22,200		
gasoline	22,000		.34	.95
motor oil	555		.51	.88
kerosene	3,300		.38	.99
white gas	2,200		.53	1.23
		11,117		
motor oil	600		.59	1.04
"Heet"			.29	.54
		1,474		
total:	102,650 (391,400 liters)	34,800		
Ammunition (boxes)				
30-30 Winchester	150		2.77	4.26
222 Remington	150		3.19	4.83
22 high power	1,200		.62	.96
16 guage shells	240		3.47	5.37
20 guage shells	400		2.31	3.63
	total:	8,285		
whale bombs (not ordered 1971)				25.00
percussion caps	100	.80	.80	1.24
Foods (pounds)				
sugar	24,100	3,374	1.38/10	2.69
pilot bread	4,240	1,251	.30/box	.46
coffee	960	920	.96	1.52
lard	1,920	520	1.09/4	1.92
flour	12,500	1,240	.99/10	2.10
butter	960	936	.98	1.56
"Tang"	500	408	.85	1.40
soap powder (boxes)	720	223	.31	.56

[1]Alaska Native Industries Cooperative Association, Invoice Numbers 2406, 2408, 2969, Annual Order 1970

TABLE 15

Monthly Store Sales 1971-72[1]

	Total Sales (Dollars)	
October	21,300	
November	20,400	
December	18,300	
January	21,500	$\bar{x}$ = 20,100/mo
February	13,000	241,000/yr
March	26,000	

[1]ANICA 1971-72, pers. comm.

	Total Landed Costs[1] of Annual Store Purchases[2]
1967	77,270
1968	113,430
1969	134,650

[1]Including freight insurance, lighterage, service expense and loans
[2]ANICA, 1970 pers. comm.

TABLE 16

Fresh Foods Sold During Two Weeks in March, 1972[1]

	Amount	Seattle Cost ($)	Unit Price ($) Seattle	Gambell
Meats (pounds)				
ground beef	240		.72	1.55
pot roast	90		.75	1.61
bacon	96		.80	1.66
weiners	192		.68	1.48
Total:	990 (446 kg)	682		
Annual Total:	10,700 kg[2]			
Prepared foods		671		
Bakery foods		526		
Eggs	180 doz		.42	.97
Fresh fruits	837 ea		.04-.07	.15-.22
Potatoes	270 lbs	341		
total:		2,220		
Annual cost:		52,800[3]		

[1]From weekly invoices of two Anchorage and two Seattle wholesale firms

[2]12 x 890 kg

[3]12 x $4,400

TABLE 17

Total Store Air Freight[1] Shipments

	Seattle Cost ($)
1967	15,240
1968	34,580
1969	41,350

[1]ANICA, 1970 pers. comm.

TABLE 18

Handcraft Products Monthly Sales and Exchanges[1]

	Dollars
Products sold by store to buyer:	
Range:	1,015 - 3,560
Average:	2,032
Annual Total:	24,400[2]
Goods exchanged by store for product:	
Range:	1,220 - 2,710
Average:	1,780
Annual Total:	21,404[2]

[1]From ANICA Store monthly statements, October - March 1971-72

[2]2 x October - March

TABLE 19

Annual Community Dollar Flows 1971-72

	Income		Outflow
OAA AB AD AFDC[1]	81,600	Postal M.O. FY 1970[2]	98,092
Food Stamp Value[4]	31,080		
BIA Assistance[5]	53,000		
Pensions[6]	6,000	Annual Store Sales[3]	241,000
Social Security[8]	-		
Unemployment Benefits[8]	-	AVEC[7]	18,600
Job Income[9]	160,000		
Handcraft Income[10]	24,400		
Occasional Jobs[11]	-		
Private transactions	-	Private transactions	-
	356,080		357,692

[1]Ak. Dept. Health and Soc. Serv. 1973 pers. comm. Location and total amounts of active cases in Old Age Assistance, Aid to the Blind, Aid to Disabled, Aid to Dependent Children Programs, October 1972 (12 x $6800/mo)

[2]Postmaster, Gambell, Survey authorized by Seattle Central Office, fiscal year 1969-70.

[3]See Table 15

[4]Ak. Dept. Health and Soc. Serv. 1970. Food Stamp Information, February 1970. (12 x $2,590)

[5]Bureau of Indian Affairs. 1972 pers. comm.

[6]Est. 5 men @ 100/mo

[7]Alaska Village Electrical Corporation, meter survey, Gambell, 12 x $1550/mo

[8]Likely negligible

[9]Est. 20 jobs @ 6,000, 4 @ 10,000

[10]See Table 18

[11]Highly variable

APPENDIX 9

Monthly Summary of Climate and Hunting Observations

October through May 1971-72

To serve as a background for the discussion in Chapter III summaries of climate and hunting observations are given for each month from October through May 1971-72. Winds, temperatures, precipitation, condition of seas and ice, an example of a patterned sequence of climatic events; hunting activity observed for all species, and game takes reported are presented in tabular form for each month:

1	2	3	4	5
Winds:				
Ave. Beaufort speed for windy days	max. obsered wind	days wind > Beaufort 4	days wind calm	% wind direction northerly & southerly
Temperature:				
ave. daily temperature	no. of days <10°F, above >30°F	max. temp. range obsered		
Precipitation:				
days of zero or trace	days ≤ 2/10 cloud cover			
Seas and Ice:				
days of sea calm	open water at Gambell visible at sea level for days			
Game Takes Reported:				
ringed seal	harbor seal	bearded seal	walrus	no. of hunters reporting

October

	1	2	3	4	5
Winds	3.4/22	6	5	8	41% & 41%
Temperatures	31°	1 & 14	17° to 40°		
Precipitation	17	5			
Seas	5	-			
Game takes	6	48	2	1	12

Precipitation type:

Most storms accompanied by occasional wet snow fall, except drizzle rain October 10-11, 15, 25, 29.

Weather sequence:

9/22 - 9/30/1971 followed by a ten-day general lull:

Winds started ESE to SE midnight 9/22, moved to S after 48 hours, SW after another 24 hours, W after another 24 hours; speeds lulled and wind continued to shift NW to N during next day. N to NE winds blew for 3 days at about 35 mph, then shifted to NW diminishing. Storm ends with a northerly breeze. Temperature becomes progressively colder throughout storm in small increments. Light rains accompanied winds from ESE, S, SW, W; light snow NW, N, NE. Clouds are mostly below 100 feet.

A four to five hour snow storm on October 31 showed the following pattern:

0500	clear, calm, about 30°F
0700	wind 3 mph S
1200	cloudy, wind 5-8 mph S
1300	snow, wind 10-15 mph S
1700	snow, wind 25 mph SW
1930	cloudy, wind 25 mph, gusting 35 mph WSW about 18°F

Hunting observed:

Open water seal hunting from coastal blinds entire month

Some boat hunting from camps, especially around Niyrakpak Lagoon, many bay ducks present but inaccessible

Cormorant and Gull hunting on east side of Cape
Several groups camping for extended periods
Best times for cliff bird hunting and fishing are past

November

	1	2	3	4	5
Winds	4.3/27	7	12	2	36% & 15%
Temperature	24°	2 & 8	2° to 36°		
Precipitation	19	0			
Seas/ice	2	9/10 for 30			
Game take	35	58	7	1	14

Precipitation type:

Periodic snow storms followed by blowing snow
Less north wind and slower ice formation than expected

Weather sequence:

11/8/71 snow storm:

0800 low cloud banks (400'), periodic snowfall, winds 15-25 mph SW, 19°F
1100 low clouds, snowfall ended, winds 25 mph NW
1800 low clouds, little wind, 20°F

11/10/71 first strong blizzard: 0200 winds shift to NW

1200 low clouds, snowfall, winds 25-30 mph NW, 22°F
2100 clearing snowfall ended, winds 20-25 mph, NNW

Hunting observed:

Open water seal hunting from coastal blinds diminishing toward end of month as shore slush forms
Boat hunting at Akaftapak and Niyrakpak continued until mid-month
Families still camping
Some fishing through the ice at Koozaata Lagoon
Season is past for cormorant and gull hunting

December

	1	2	3	4	5
Winds	4.0/29	7	10	2+	77% & 23%
Temperatures	13°	16 & 4	-10° to 32°		
Precipitation	18	5			
Seas/ice	17	1-3/10 for 25 4-6/10 for 6			
Game takes	67	19	2	8	14

Precipitation type:

All blowing snow except drizzle during period of warmer temperatures December 22-24

Weather sequence:

11/2 - 11/3/71 of ice-in period at NW Cape:

11/2: 0600 snow blowing, winds 30-35 mph N, 10°F

1600 snow blowing, winds 30-35 mph NE, 10°F cloud types: dark low (800-1000 ft) pass with brief clearings between

0800 at Kyaillgit: no swells, ice shore-fast from Tatugnuq to perhaps Eevwak, slush ice cracks in ice near-shore with occasional shift cracks farther out but none observed toward Akeftapak

1300 at Aatinnuq: slush and brash ice packed closely ashore by winds, swells muted, vertical ice ledge forming, sheets of greese ice offshore

11/3: 1100 intermittant snow, winds 15 mph N, 10°F, cloud type same but approaching from NW while ground winds are NE

1200 arc of shuga approached from far off-shore from NW, by 1500 arc touched shore

1600 entire limit of vision covered with consolidated brash ice, extending from Kit Bay to Ooynik, swells muted, current very strong

Hunting observed:

Boat hunting for walrus occurred December 1-6, 11-21, 26

Many bay and eider ducks but mostly inaccessible
Ice-edge and ice-lead seal hunting
Bird hunting off Gambell point begins, morning and evening
Fox trapping begins December 1

January

	1	2	3	4	5
Winds	4.7/27	7	12	1	55% & 30
Temperatures	12°	8 & 5	-25° to 34°		
Precipitation	14	11			
Seas/ice	--	1-3/10 for 20 4-6/10 for 11			
Game take	66	0	1	0	10

Precipitation type:

All blowing snow except brief drizzle January 25
Fog December 22-26

Weather sequence:

Ice pack in NW Cape area very open January 1-5, open to close pack January 6-16 and very close pack January 6-7, 26-31
Pack mostly open and mobile January 2-3, 16-17
North winds gusting to 40 mph, predominated January 5-14, 21-25
Southerly winds gusting to 35 mph occurred January 15-18, 26-28

Hunting observed:

Boat hunting for walrus occurred January 13-18, 26-27
Bird hunting at Aatinnuq continued
Ice-lead seal hunting

February

	1	2	3	4	5
Winds	4.8/21	7	12	8	76% & 19%
Temperatures	7°	23 & 5	-19° to 32°		
Precipitation	4	20			
Seas/ice	-	1-3/10 for 13 4-6/10 for 14 7-9/10 for 1			
Game take	58	0	1	0	10

Precipitation type:

all blowing snow, except drizzle February 22 fog two days

Storm sequence:

see page

Weather sequence:

Close to very close pack during month; overnight young ice in new leads; heavy brash ice associated with moving pack; large lead regularly occurred about 5 miles north of north shore; first large piling of ice off-shore; north winds increase consolidation of pack February 1-13; Gambell point lead open February 16; huge ice hummocks at Gambell Point by February 21

North winds and calms occurred January 19 - February 17, February 22 - March 13, SE winds on February 19-21

Hunting observed:

Ice lead seal hunting entire month, except February 1, 8, 9, 19, 20-23 because of high winds or south winds, especially at Gambell, Uyugunut, Meruwtu and Akeftapak. Boat hunting Akeftapak Bay February 21-29; bird hunting off Gambell point entire month, morning and evening; Sculpin fishing began February 4; upa-hooking at Akeftapak began a few days later

March

	1	2	3	4	5
Winds	4.6/18	9	8	9	100% & 0%
Temperatures	3°	15 & 0	-16° to 20°		
Precipitation	12	17			
Seas/ice	-	4-6/10 for 15 7-9/10 for 16			
Game takes	31	0	0	0	10

Precipitation type:

Only very occasional snowfall the first part of the month, otherwise blowing snow

Weather sequence:

Very little open water appeared March 1-6, 8-9, 12-15, 17-20. Recurring open water areas off west and north coasts of Cape mostly open March 10, 11, 16, 21-23, 28-31, but often closed by young ice formation

The highest winds recorded during the winter occurred March 24 and 31 (gusting to 60 mph) 0500

Periods of calm weather March 16-23, 25-30 separated mostly northerly storms

Hunting observed:

Ice lead hunting entire month except during periods of highest winds

Boat hunting for walrus occurred March 10-11, 16, 21, 27, 29

Peak of bird hunting off Gambell point has passes

Ice fishing and upa-hooking off the NW Cape area continued

April

	1	2	3	4	5
Winds	4.1/21	8	9	5	62% & 29%
Temperatures	20°	12 & 6	-4° to 48°		
Precipitation	16	14			
Seas/ice	-	1-3/10 for 16 4-6/10 for 5 7-9/10 for 9			
Game takes	0	0	0	0	15 boats

Precipitation type:

snowfall increased from March, blowing snow entire month

Weather sequence:

April 1-25 lines of ice arrived periodically from N & NW, young ice formation common
Mostly navigable conditions entire month, flow small to medium
Ablation began first of April
Ice was mostly well off-shore April 1, 2, 7-9, 15, 16, 20-30 and most closely consolidated near-shore April 3-6, 10-14, 17-19
April 26-27 SW winds clear all ice from Cape except Kitt Bay E and SE winds April 8 loosened much shore ice

Hunting observed:

Whaling took place intermittantly from April 11-May 1, very little seal or walrus boat hunting occurred
Bird hunting improves along all coasts with the arrival of spring migrants
Fox trapping ended April 15

May

	1	2	3	4	5
Winds	4.5/22	8	11	6	68% & 18%
Temperatures	30°	0 & 19	18° to 58°		
Precipitation	11	9			
Seas/ice	10	1-3/10 for 25 4-6/10 for 6			
Game take	4	0	12	163	15 boats

Precipitation type:

Occasional snowfall and blowing snow for month, except drizzle May 5, rain and snow mixed May 26-29

Weather sequence:

Scattered brash and rotton ice under the influence of winds and currents mostly well off-shore (+5 miles)
Ice visible at sea level about half the month
Except for May 2-4, 23-25 open water dominates areas of navigation
Sea swells occur with all storms
Mostly northerly storms occur May 1-4, 11-29

Hunting observed:

Boat hunting for walrus May 1, 5-6, 13-14, 21, 25, 31
Most walrus taken May 6, 12, 13, 14
Occasional bird and seal hunting on walrus hunts
Occasional off-shore fishing from boats at end of month

APPENDIX 10

Summary of Captial Goods Investories of Gambell and Savoonga July 1970

	Gambell	Savoonga
Interviews	46	42
Total sample	269	265
Households without male head	5	4
Hunters in sample	73	59
Locally owned residence buildings		
in sample	47	39
unoccupied	16	6
families with camps	39	not surveyed
Hunting equipment		
outboard motors	43	53
snowmobiles	48	60
motor bikes	3	4
skin boats	35	23
plywood boats	6	29
dogs	144	147
sleds	25	32
firearms	188	192
rifles	138	-
shotguns	50	-
ammunition reloaders	19	17
traps (#1, 1 1/2)	566	485
fish nets	39	37
bird nets	20	0
Household equipment		
stoves		
heating	47	62
cooking	47	39
sewing machines	40	23
washing machines	24	25
radios	64	56
TV	0	3
phonographs	20	27
tape recorders	16	16
walkie-talkie sets	50	23

CHAPTER IV

PATTERNS OF RESOURCE UTILIZATION

1. Introduction

The central purpose of this chapter is to define and quantify patterns of resource utilization at the NW Cape of St. Lawrence Island. A pattern will be considered defined if repeated sequences of events with a typical range of flow or exchange values can be found. It is not the purpose of this discussion to address the question of the nature of systems, but to establish equivalents useful in understanding the function of the Cape community. That the various elements previously described are integrated (with variable degrees of control) in the community by the work of its members allows an estimate of their functional and quantitative relations. Two important and perhaps opposite patterns have been mentioned so far: consumption of imported fresh foods, and the carving of locally obtained walrus ivory. In the first instance dollars flow out of the community in exchange for fresh meats, vegetables, fruits, bakery goods and prepared foods. The exchange ensures returns to at least the producer, processor, wholesaler, buyer and carrier, all participants in the mainland economy. In the second, work is done by the community on a local raw material. The Cape economy is supported by the part-time employment provided its productive members, the accumulation of tool capital and by contributing to the maintenance of an active market for an important by-product of the hunt. Dollar values have been ascribed to these activities, but these quantities alone do not reflect their relation to other activities in the community. Information from the field year must be drawn upon to describe these interrelations. It is, for example, common for the carving and sale of ivory to support the small daily exchange purchases of gasoline and ammunition required for hunting, especially during the winter months. Even larger purchases such as snowmobiles, made on partial credit, are paid for by some active carvers. The purchase of fresh imported foods on the other hand is largely supported by unearned income and their purchase is common among older members of the community. It is the purpose of this chapter to specify these interrelations.

Those concerned with causes might initiate several basic questions: Why are dollars, so essential to present day hunting, not saved for these expenses rather than being spent on expensive items such as frozen hamburger patties of doubtful quality, fresh frozen strawberries or TV dinners? Why is ivory, formerly so useful when made into harpoon heads, ice testers, crampons, plugs, slings, boat keels, buttons and latches, needles, toys, charms, labrets and a myrid of other practical and pleasureable items, now made into carvings of animals, bilikins, Eskimos, or jewelry, penholders, pickle forks and sold; the former items exhumed from the dwellings of their forefathers and sold as well? To suggest answers for such questions, without resorting to cultural and social references requires the derivation of related patterns of production and consumption, first on an annual basis, but also in such a way that seasonal variations are revealed. To this end, three methods of interpretation will be attempted in this chapter, each with a different graphic display.

2. A Compartment Model of System Components and Annual Flow Rates

An assemblage of the several components of the Cape resource system described in the course of preceeding discussions of the population, habitat, biotic communities, production techniques and economy and their annual rates of flow or exchange is presented in Fig. 12 (compare Kemp, 1972 p 108-109; Foote and Greer-Wootten, 1966 p 32). The broad outlines of the function of the Cape resource system may be established from these quantities as a first step towards derivation of its larger patterns.

Two major and very complex effects which served to define the community system in previous discussions are expressed in Fig. 12: the annual flow through the community of about 100 metric tons of edible meats and the annual flow through the community of about $400,000. Except for the components of storage, the production of locally used tools and clothing, and the maintenance of imported equipment, this system is 'open', in that it is apparently dominated by boundary fluxes of materials and energy which flow through it. It is apparent from Fig. 12 (see also ibid) that in such an assemblage exchange flows between various forms of production and consumption cannot be consistently specified. Earned and unearned dollar incomes, many types of goods and foods, fuels, electricity and several forms of human work are all exchanged. The need for a common unit of measurement by which these exhanges may be compared is again obvious. But the figure does reveal one pattern of overriding importance to the operation of the Cape resource system: the system is almost totally dependent on the through-put of materials and energy from sources outside its boundaries. Compared to a rather more autonomous community as studied by Rappaport (1971), changes in these boundary fluxes undoubtedly result in major changes within the system. The work done by the community has little influence on the form, amount and rate in which its materials are provided. Nearly all the components represented in Fig. 12 have been discussed previously, some in more detail than others, but not all have been expressed in terms of annual rates of flow. These rates and a few additional components may be briefly described.

At the beginning of April, 1972, Kenyon accomplished a first comprehensive survey of the distribution of walrus in the Bering Sea. A high concentration of walrus was located in the region west and south of the Cape (6,000 square miles surrounding the area this paper has suggested comprises a perspective faunal unit) of about 60,000 animals (Kenyon, 1972 p 24). This is the pool from which an average of 300 walrus (see Table 6) are recovered each year by the Cape hunters. Burns (1966 p 15) estimates the annual reproductive rate of the entire walrus population at 14-15% and the annual mortality rate at about 13%. Applying these preliminary estimates to the segment of the population exploited by Cape hunters, about 4% of its annual production is recovered by the community (reproduction rate taken at 14%). If estimates of recovery and wounding loss are included, the Cape community might crop an average of 10% of the 8,400 animals annually produced by this segment of the walrus population.

Two basic types of storage components are sketched in Fig. 12.

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Essentially all fuels, foods and manufactured goods imported into the community must be stored for variable lengths of time, usually in facilities operated by the ANICA store. The cost to the community of maintaining this essential function is represented by rates of monthly overhead since additional charges for buying, transportation, lighterage, insurance and loss are absorbed by the Gambell unit cost increase. Total store operating costs ranged in 1971-72 from about \$4,000 to about \$10,000 per month depending on activities involving costs additional to overhead. If October is taken as a month of average store activity (see Table 15), overhead costs for that month (see Appendix 11) may be used to estimate the annual overhead. The \$27,000 estimated annual overhead may be compared to that calculated for the post office and community well. A second storage component is that of locally harvested foods and by-products. As part of the census and capital goods inventory conducted in July of 1970 an attempt was made to assess the kinds and amounts of local foods stored for human consumption by the 46 households interviewed. Walrus meat was stored on drying racks and balled bundles of meat and manguna in meat houses and cellars. Seal (mostly bearded seal), bird (mostly anatids) and fish (mostly salmonoids and cottids) products were also dried and stored on outdoor racks. Appendix 12 summarizes the amounts of these products found at the time of survey. Although the walrus harvest was not large the spring of 1970 (see Table 6) it appears from the relative amounts in storage that the bearded seal harvest was good. Overall impressions were that nearly every family had some local products in storage (about 10 of 60 families had none) but that for the majority of households, the amounts were small. All information indicated a maximum of four functional meat cellars, but perhaps only two of these had been cleaned and freshly stocked that spring. Since about 10 of the 46 households interviewed reported storage of walrus products in the form of meat and mangona balls (about 70 kg each), impressions gained later that the meat sheds used by every hunting household for initial butchering and storage were also being used for long-term storage was supported. The amounts of stored products in Appendix 12 are intended to no more than indicate relative amounts of fish, bird, seal and walrus products seen. A total of about 2,000 kg dried meats and about 12,000 kg balled or fresh meats is at best a general estimate. Since the walrus harvest was small and no whale was taken the spring of 1970, the only by-product found in storage by individual households was hides. By species, 24 walrus hides and 43 bearded, 38 ribbon and 125 harbor and ringed seal hides, or a total of 230, were claimed or counted. The large number of the usually rare ribbon seal hides in storage likely derives from the unusually large harvest of this species the year before (Burns and Fay, 1970 p 363). Although storage components for local products are indicated in Fig. 12, no values are entered since those surveyed were for the 1969-70 season.

Another important component not previously mentioned is water. Appendix 13 summarizes several aspects of water consumption in the community as monitored mid-winter of 1972. About 14,000 gallons (53,000 liters) were used by 56 household units (3 non-native) per month or about 60 gallons (230 liters) per unit per week. If food production and industrial uses are included, the per capita daily rate of consumption for the U.S. (1960) is 1500 gallons (56,000 liters) (Ehrlich and Ehrlich, 1972 p 76). An average man drinks 2.3 liters of water per day (Altman and Dittmer, 1968 p 547), or about 97 liters per family of six per week. These are broad differences in the use of this essential component which express broad differences between hunting and industrial economies.

A component very difficult to evaluate is that of the locally manufactured hunting equipment and clothing. Perhaps the single most important hunting implement at the Cape is the skin boat (angiyaq). All of these boats are locally made and maintained, their design a modification of a smaller flat-bottomed boat commonly used before the 1930's. An older member of the community mentioned the arrival of a King Islander and his skin boat on the steamer Northland at about that time as an important stimulus for this change. The frames are made of high-grade hickory purchased from the community store, keels are made of softer woods and the whole is covered with two split walrus hides and parts of a third, lashed to the frame with rope made from the hide of walrus calves. These boats are about 25 feet long, with the exception of two 17 foot boats and one boat reaching 35 feet kept at a summer campsite. The frames of these boats need not be replaced for as long at 30 to 40 years if well maintained, while the keeps must be replaced more often. The hide covers and lashings must be replaced every three to four years. Appendix 10 lists 35 boats for the community. This count represents the number of useable frames. In the range of 18 boats were in maintained condition during the research year. This maintenance is the responsibility of the boat captains, but the women of the community perform several key operations. The skin is split by an older woman, after being cured and mounted on a frame by the boat owner. After drying, the rewetted skin is laid over the inverted frame and the flat-fell seam is sewn amidships by the women with braided whale or reindeer sinew (dried strips of tendon). Principle crew members draw and lash the skin to the frame during the sewing process. It is curious that the King Islanders discard the inner surface of the split walrus hide. The Cape hunters note that not only does the use of this inner layer cut in half the number of hides required, but the inner layer is also the most durable. This portion of the hide is therefore placed toward the bow and stern of the boat. Appendix 14 summarizes the costs and processes of boat recovering. The cost estimate of $425 for a single boat appears conservative. The value of a boat frame is at least in excess of $500, as a Savoonga buyer offered this price most of the winter of 1972 and received no response. A total value of a maintained 25 foot skin boat is at least $1000, and most men of the community would not sell them at this price.

At least $100 are required to clothe a hunter of the arctic maritime climate of the Island ($50 parka, $25 insulated pants, $25 boots) with commercially manufactured items. Locally made skin clothing, still used by perhaps half the hunters of the Cape, if placed on the dollar market has a value of at least $150 per man ($35 boots and liners, $50 skin pants, $65 parka and ruff). Generally, commercially made clothing requires replacement every year, but other articles may last as long as six or eight years, properly maintained. The annual cost of replacement of these two types of clothing are comparable ($50 per person). The use of skin clothing emerges then as not only a rejection of commercially made items but also of the dollar advantage ($100 per man) of selling skin clothing which is in high demand.

The last additional component to be considered in Fig. 12 is electricity. This energy source accounted for 12% of total U.S. consumption in 1940 (Ehrilch and Ehrlich, 1972 p 265), while for the Cape community, electrical service began February 14, 1971. Appendix 15 presents a summary of a survey of use rates (in dollars) taken March, 1972. Three facts of interest emerge from this information: first, high rates of consumption are encouraged by the graduated costs of electricity; second, the Bureau of Indian Affairs schools supports a disproportionately large protion of the cost of the service; third, private use rates increased sharply in November, 1971. It did not appear that any large private user was added at that time and a best estimate of the effect is that not until this time did a new complement of electrical applicances and tools reach the community. That carving work increases as the fall seal hunting slacks off also contributes to increased use rates during this and succeeding months. Unfortunately, the electrical service does not represent a first example of the community garnering a new energy source, electrical service being dependent on diesel fuel imports. That this source is totally maintained by the men of the community especially trained to do so is another example of the capability of the community to maintain its supplies once the sources are established.

Before turning to a discussion of the several rates of exchange between components represented in Fig. 12, a few characteristics of the mainland economy, especially those of Nome, deserve mention. That at least 30% of the 1958 Cape population emigrated temporarily or permanently to the mainland (see Fig. 3) might justify a much fuller treatment of living conditions there than allowed by the brief survey taken in September, 1970. Four of the 16 resident emigrant families were visited and results of these interviews (Appendix 16) strongly indicate the mutually exclusive character of participation in the Nome dollar economy and hunting. Resettlement studies of the American North are scarce (see Katz, 1971 research proposal) even though the impact of resettlement on the larger Alaskan rural towns is evident.

Of the several representations of annual rates of exchange in Fig. 12, the costs of imported equipment maintenance and, most important of all, the cost of hunting, deserve special mention. By far the largest portion of human work involved in the first is devoted to the maintenance of snowmobiles. Usher (1972 p 174) estimates that a maintained machine must be replaced every two years. Experience at Gambell indicates that three years is a best estimate for this community since several four to five year old machines are still in operation and all used parts from older machines are kept for service needs of the newer ones. Unmaintained, snowmobiles last perhaps one season or less. The value of maintenance work is then the difference between a one year and a three year replacement rate, or $32,000 annually. For outboard motors and firearms, the same calculation applies except that their replacement rates are considerably slower, estimated at six and ten years respectively. An unmaintained outboard motor may last at most three seasons and the savings to the community of maintenance work these motors require is then $5,600. Table 20 summarizes the annual flow of materials from mainland sources listed in Table 14 at Gambell unit costs. The minimum annual dollar input required for hunting may be extracted from this table.

Item		Annual requirement in dollars
guns		4,000
snowmobiles		16,000
outboard motors		5,600
	subtotal:	25,600
ammunition		12,400
gasoline		22,000
motor oil		4,400
	subtotal:	38,800
	total:	64,400

The annual return for an investment of about $64,000 is about 100,000 kilograms of edible products (180 grams protein per person per day, Table 12) and perhaps $24,000 in saleable by-products (Table 18). One hundred metric tons of local foods cost the Cape community about $40,000 per year ($400/metric ton) and a great deal of risk and human work. The 20,000 kg protein from this harvest was gained at a cost of about $2 per kilo. The cost of a metric ton of imported fresh meats (Table 16) is about $3,260 ($14/kg protein)* with very little human work or risk required. Without the 2.12 mark-up factor on the Gambell price of fresh meat

*$682 x 2.12/446 kg beef x 24% protein (average value) = $13.60 kg protein

required by purchase, transportation, overhead and distribution costs, the cost of a kilogram of protein from this source should approach $6.50. These additional costs deriving from the geographic isolation of the Cape allow hunting to remain profitable. If the costs of imported meats ever more closely matches that of locally harvested meats (given the same dollar flow), the labor and risk factor would likely cause hunting activities to diminish. After F. Fraser Darling (1951, p 244) it might be said, "Show me the price of imported fresh meats in any Alaskan coastal community and I will tell you the health of that community."

3. Human Work and the Annual Flow of Local and Purchased Materials (Energy) in Caloric Terms

A principle this study has accepted from its beginning is that expenditure of human energy is critical to the operation of the Cape resource system. Work must be done by the human population to establish and maintain the flow of any resource material into the community. This obvious point is lost by many who consider life in small Alaskan communities essentially sedentary. Without the expenditure of work any material, regardless of its value, is lost to the community. The present loss of seal blubber is one such example. Were the Cape and mainland economies in closer communication, a market for this blubber would be expected to develop. The single exception to this principle is that of unearned income, contributed from State and Federal tax sources.

The description of the character of human work is the overriding concern of this study. Some estimate of its magnitude, measured in caloric terms, is required by its method. To do so three different sorts of information are required: first, the number of people in the community who work; second, the number of days or hours spent at particular kinds of work during the year; and third, the energetic cost of the types of work done. Estimating the energy expenditure of various kinds of work on an annual basis averages out variations in efficiency (see Table 10) and ignores the importance of activities not involved in handling resource materials. This one set of tasks is, however, of central interest to this study. The exclusion of other activities does not denote their devaluation.

The work force of the community may be arbitrarily established as those men and women over the age of 15 years. Fig. 4, the population profile for 1972, displays for this age group 92 men and 78 women resident in the community the year around. Harvest records for 70 hunters are presented in Table 10, a few of whom were absent part of the year. Table 22 (see below) indicates that during the spring walrus hunt, when more hunters were present in the community than at any other time during the year, the sum of the average sizes of 16 crews is 80 men. All 16 crews were hunting May 12, 1972, even though three did not report walrus killed (Table 7). Records of crew sizes for that day indicate that 86 men participated in the hunt. These groups, although slightly different in composition, establish maximum estimates of the size of the male work force. The female work force is comprised of those women of the total 78 who are married or regularly employed. Table 2 lists nine women over age 20 who are unmarried and Fig. 3 indicates seven resident women of the 15-19 year age class who are unmarried. The female work force is then about 55 women who do mostly housework and about seven who spend much of their time as salaried employment (see Table 19 and discussion). These records establish a maximum estimate of the size of the total male and female work force from which a rough classification of the work done may be made:

Sex	Age	Classification	Number
men	15 yrs +	active and efficient hunters	10
		less active, less efficient hunters	25
		regularly employed	17
		not employed, not regular hunters	46
women	15 yrs +	housewives	55
		regularly employed	7
		unmarried, unemployed	16

Since food is prepared daily it is undoubtedly fair to say that work is done on resource materials 365 days of the year. The few people involved in full-time employment work about 250 days of the year. Full-time hunters work at hunting or hand work about this many days since many men leave the community during the year for travel, National Guard activities or occasional work.

The magnitude of human energy expenditure has recently been assessed for a sample of the Eskimo community of Igloolik, N.W.T. by oxygen consumption studies of hunting, wage work and household activities (Godin and Shepard, 1972). The energy costs of these activities (ibid p 6-9, 22-23) may be assumed similar for similar activities at the Cape. Using this information, Table 21 summarizes estimates of the average human energy expenditure for single seal, walrus and whale hunts. In contrast to Laughlin's five series of patterned activities which comprise hunting (Laughlin, 1968 p 315 in Lee and Devore, 1968), the four series of activities considered basic to all hunting observed at the Cape are: equipment preparation, travel and equipment maintenance and search for prey, killing and retrieval of prey, and the butchering and processing of by-products. For the seal and walrus hunts assessed in Table 21, estimates are made of the hours of a 10 hour hunt spent at these activities. There appears to be a fair match between activities at Gambell and those at Igloolik, with the exception of a general lack of work expenditure data on boat hunting. As indicated in the table, appropriate substitutions have been made in these cases. Since only one whale was taken at NW Cape during the field year the nine days hunting expended in its capture may be considered one hunt. Total expenditure for this hunt is therefore estimated in Table 21. Of the 3,800 hours of work required for the capture of one whale (see Chapter III, section 2) all but about six hours (for 14 crews) were spent in equipment preparation, boat launching and docking, and in the search. The entire community was involved in the four days of butchering which followed, but about 50 men of the 10 principle boat crews (2,400 man-hours) did most of the work.

Man-hours spent walrus hunting are listed in Table 22 from records of the days men were hunting and the number of men making up the 16 crews listed (Ak.D.F.&G., Nome, 1973 pers. comm. for crew composition during May). Most hunts prior to those during May appeared to occupy about five hours, the limitation being the brief winter daylight. At 310 kCal/hr as derived in Table 21, an annual expenditure of 5.85×10^6 kCal is calculated for walrus hunting.

Collating by day all seal harvest records allows a minimum estimate of the number of days seals were hunted during the year. For the months of October through May for which records are available, seals were recovered on 137 days. Certainly not all 35 hunters were hunting on those days but there are also days on which several of the men of the community hunt without success. For the summer months of June through September, 15, 20, 23 and 23 days are estimated respectively, based on the October count of 23 days, for a total of 218 days of seal hunting. Table 23 summarizes the calculation of an annual energy expenditure for seal hunting of 16×10^6 kCal. From its treatment in Table 21 it is obvious that seal hunting is a composite of activities. Without detailed task-time measurements it is not possible to separate the time the hunter spends at each of these activities or additional activities such as bird hunting, fishing through the ice or collecting beach-throw. The total reached in Table 23 is then taken to represent hunting and collecting activities of seals, birds, fish, fox, invertebrates and vegetation.

The caloric expenditure of household, carving and wage work may be estimated in a slightly different fashion. The three equations below are perhaps self-explanatory:

household work: 19×10^6 kCal/yr

55 women x 365 days/yr x 7 hrs/day x 850 kCal/7 hr day (Godin and Shepard p 13)

carving work: 1.6×10^6 kCal/yr

$24,400/yr (Table 18) x 1 item/$6 x 2 hrs/item x 60 min/hr x 3.4 kCal/min (Godin and Shepard p 22)

wage work: 9.8×10^6 kCal/yr

24 jobs x 8 hr/day x 250 days/yr x 1,640 kCal/8 hr (Godin and Shepard p 13)

In a very approximate manner, a total caloric expenditure of 53×10^6 kCal per year has been calculated for most of the activities of the group of people in the community who most influence the annual rate and magnitude of its resource supply. About 23.1 kCal/yr is expended in the harvest of local food sources and about 30.4×10^6 kCal/yr to accomplish household, handcraft and wage work. These values, the values derived for the annual supply in calories of energy source materials and converter losses are charted in Fig. 13.

For the Cape community a resource is a material containing energy in a form accessible for its use which enters from outside its boundaries. A characteristic of the system is that, without the direct management typical of agriculturalists, these resources appear in quantity at certain times during the season. With few exceptions, all food species harvested by the Cape population are migratory. The North Star III supply vessel arrives once a year, usually during July, to deliver food and fuels in bulk.

The routes these materials follow through the system have been approximated in Fig. 12 and various operations performed on them have been discussed. The effect of these operations is to supply materials to consumers in a useable form, quantity and rate. In a general sense all resource materials assimilated may be considered as being, at some point or series of points, combusted. The measurement of the heat evolved at combustion provides one estimate of the energy contained in the material supplied the consumer. The amount of this estimate actually converted by the consumer into energy useable for self-maintenance or the accomplishment of other forms of work is a separate consideration usually expressed in terms of an efficiency (output/input x 100). For the Cape community there are several consumer components which receive fuels, assimilate and combust these fuels, and accomplish various forms of useful work thereby: the human population, the dog population, stoves, snowmobiles, outboard motors, firearms, electric motors and light bulbs. These converters are structural components of the system. Yet each has a lifespan and a replacement rate. Therefore these components, like materials, enter and leave the community. The complexities of the processes involved in the replacement of these converters cannot be considered at this level of energetic analysis, because of arbitrary limits of area and scale. To arrive at an energetic valuation of a snowmobile, a rifle or a human infant might be feasible but would require digressions far afield from the subject of this study. A comparison of the roles of energy sources may then be made on an annual basis in caloric terms, accepting these structural elements as given. Table 22 lists the caloric value, cost per unit volume, quantities used annually by the community, calories per dollar cost and generally accepted efficiencies of appropriate converters for the food and fuel sources of the community. Energetic analyses of non-human biological systems have at their base a single process: metabolism. Since the time man learned to use fire, he, unlike animals, has not been limited to his own body as a power source which is a comparatively poor one (Cottrell, 1955 p 18 maximum of about one horsepower/day or 640 kCal). Only man has found a way to use energy sources which are inappropriate for metabolic use. Even though heat values per unit volume for these sources are not greatly different from those of food sources, they remain qualitatively different. Caloric values for fuels, foods and human work may best be considered discrete. It is with a certain reluctance that these energy flows are added as an estimate of the total energy budget of the Cape community. The principle purpose for doing so is to derive a kCal-dollar equivalent by use of the quotient of total energy budget and total dollar budget (Odum, H. T., 1972 p 204 <u>in</u> Patton, 1972).

A comment is in order on some of the values derived in Table 24. The method used for fuels is obvious. Values for flashlight, radio and walkie-talkie batteries are derived to demonstrate the extreme range of kCal/dollar ratios possible and to stress the importance of manufacturing processes in establishing these values. The same methods are used for the derivation of values for a selection of foods purchased at the store. Only a few of the items sold are included and values for a wide variety of canned goods, dried fruits and condiments are not calculated. The same holds true for weekly fresh food shipments, represented only by the meat component. Since there is a wide range of variation in the basic data available on the protein, fat and carbohydrate composition of local foods (Mann et al., 1962 p 72 walrus: 59.9 % water, 26.5% protein, 11.6% fat; Heller and Scott, 1967 p 184 walrus flesh and subcutaneous fat: 58.9% water, 16.3% protein, 24.1% fat; Rodahl, 1954 p 34 meat boiled: 59.6% water, 20.8% protein, 18.9% fat) deriving caloric values from this data results in a wide range of possible values. Therefore, summaries of the caloric values of whole animals (Foote, 1965) are used. Only edible portions of dietary nutrients are included in his calculations and under circumstances where consumed portions seem well below body composition values, as in the case of seal blubber, per cent values are lowered.

Fig. 13 attempts to organize the information on the human work and resources of the NW Cape population just presented. The translation of this information into caloric units allows their comparison: about

53×10^6 kCal of human work are expended by the population to maintain the flow through the community of about $3,400 \times 10^6$ kCal of fuel, about $1,200 \times 10^6$ kCal of food and about $400,000. The flow of manufactured goods and a variety of purchased foods has not been considered in this calculation. For this system at this time, there is a gross calorie-dollar equivalent of 11,500 kCal/$ ($4,600 \times 10^6$/$400,000), or about 20% above that for the general economy (Odum, H.T., 1971 p 182 10,000 kCal/$). This surplus may be taken as a measure of the independence from the general economy gained by the harvest of local resources, not completely off-set by unearned income.

4. Component Interactions and Control

The resource system of the NW Cape has been described in preceeding sections of this chapter in terms of the several components which fulfill the energy requirement of the community. Their interactions have been translated into caloric terms. That a large share of the human work expended at the Cape is devoted to the harvest of local foods, the caloric content of which is relatively small, gives the impression that the transition of this system from one organized around the use of local resources to one organized around the use of petroleum fuels and the dollar flow of the U.S. economy is incomplete. The fact that local foods provide a large part of the protein dietary component and that this component is highly valued by the community also contributes to this impression. Fig. 12 graphically stressed the importance of imports into the community and the lack of influence on the form, amount and rate in which these materials are made available. This is not to say, however, that there is little control of the amount and rate in which these materials enter the community. That each input of potential energy into the community requires an input of human work to maintain its flow is displayed in Fig. 13. It remains to indicate the level of control allowed the community by the organization of these components.

Control refers to the influences change in an energy flow of one interaction exert upon the rates of another. These changes often arise from responses in output of a component with a change of input. When the flow rate of an input is influenced by an output which responds to that input, then control is established: when there is no locally harvested food available. men carve. search for occasional work or hunt more frequently and spend more dollars on purchased foods; when dollars are in short supply, local foods stored for such occasions are recovered and by-products are processed for sale rather than for local use; when fresh imported meats and dollars are abundant, men hunt less frequently; when local foods and by-products are abundant, dollars usually spent on local food purchases are released for purchases of manufactured goods; when the supply of dollars is below a certain limit, hunting stops. As charted in Fig. 14 the use of the switch module (see legend: curved box) for control interactions indicates that, even though various rate interactions show multiplicative effects while others show direct linear or sigmoid relationships, not enough is known in enough detail of the nature of these interactions to describe them as any other but on-off effects.

In addition to work expenditures already described, three institutions emerge as fair exemplars of three important and quite different methods of securing inputs sufficient for the maintenance of the community: the storage of local foods, the ANICA store and the post office. The storage of local foods provides the only source of influence by the people of the Cape on the form in which local foods are made available. A storage medium used consistently across the arctic is rendered blubber. Its general effect is an increase in the caloric content of foods already rich in protein. The storage of local meats in dried form provides a handy source very high in protein (Heller and Scott, 1967 p 183 dried bearded seal meat: 82.4 gm protein/100 gm). The storage of by-products involves processes, some of which require considerable work expenditure, which allow them to be held until they are sufficiently dried for processing or until time is available for the manufacture of goods. These goods are then stored or sold at the ANICA store. The geographic isolation of the community requires that the ANICA store expend much of its overhead in the storage and distribution (through dollar transactions) of purchased foods and goods. The post office, on the other hand, stores nothing whatever and its role in the flow of resource materials into the community is that of carrying out dollar transactions.

These three components focus the work done on resource materials (or in exchange for dollars) required to maintain their flows through the community. Fig. 12 indicates their general relations with other components in the system and summarizes the size and character of their interactions. Fig. 14 considers these relations in a slightly different fashion. The figure may be read from left to right. From a variety of sources within the U.S. economy, purchases of goods foods and fuels are made by agents of the community store. Private purchases of mostly manufactured goods are made through the post office. All dollars which actually leave the community do so via the post office. These fuels and goods (in exchange for dollars) are required for the hunting of local food species. Without these supplies, there can be no hunting. Remaining portions of foods, fuels and goods serve the households of the community. After recovery loss, portions of the foods locally harvested enter the community and smaller amounts are placed in storage. These materials support the work expenditure of the community. Caloric values entered in the chart are summarized in Table 25. Parentheses indicate those values calculated by use of the calorie-dollar equivalent (12,000 kCal/$).

As expressed in Fig. 14, the supplies of food and goods from local harvests and those purchased are additive, and if the supply of one diminishes, the other would be expected to increase. Either the use of dollars for purchased food must increase or the use of stored local products and the frequency of hunting must increase. The proposition emerges that the functions of the ANICA store and those of wage work replace the functions of storage of the local harvest. That the functions of these components overlap indicates the degree to which adoption of the goods and dollars of the U.S. economy is inimical to the economy of hunting. The minimum annual caloric value of all goods entering the NW Cape population is 1,200 x 10^6 kCal. The recommended dietary caloric allowance for this population is somewhere near 240 x

10^6 kCal (Table 26), or about 20% of total food inputs. There is no shortage in either protein or caloric value in the diet provided the population by the Cape resource system as it now operates.

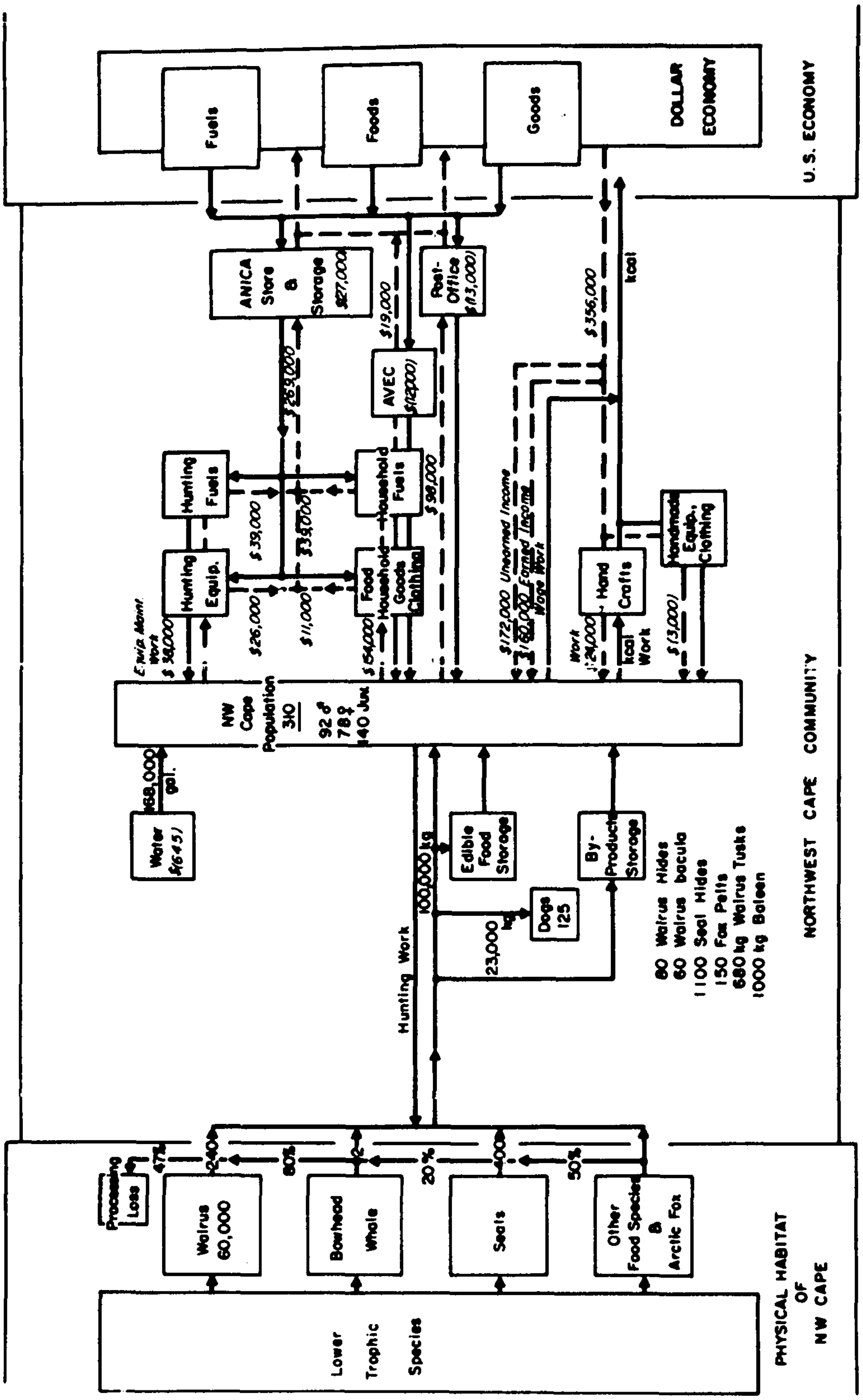
Withall, a basic pattern of all Cape operations emerges: a series of three components separated by two work inputs. A hunter uses equipment to obtain meat which allows the performance of further operations. A hunter uses equipment to obtain ivory, skins or baleen, which sale allows further operations. A man or woman uses equipment to produce a handcraft or good which is then sold or used, the sale or use allowing further operations. A woman prepares food which is consumed by her family, which consumption allows further operations. The store distributes food, fuel or goods which are used by the population to obtain other food, fuel and goods. The larger patterns charted in this chapter are comprised of these basic units. Each series ends with an open-ended operation in that a choice may be made of the objects which may next receive work.

FIGURE 12

A Compartment Model of System Components and Annual Flow Rates of Materials and Dollars at the NW Cape Community

This figure assembles components and flow rates of the NW Cape resource system as described in Chapters I-IV. The system is largely defined by two principle fluxes: an exchange of work for edible meat and animal by-products between the physical habitat and biotic communities of the Cape area and the community, and an exchange of work for foods, fuels and capital goods (with a dollar flow in reverse directions) between the community and the mainland economy. Flow rates are represented by a variety of units: numbers and weights of local resources, dollars for imports and human work. No functional definition is implied by the shapes, sizes or positions of components and flow rates.

The graphic methods of Kemp (1971, p 108-109) and Foote and Greer-Wootten (1966, p 32) have been used with modifications in this figure. Input and output are differentiated by arrow types. Dollar in parentheses represent estimated values of human work or the costs of operation of complex components.



Fuels
Foods
Goods
DOLLAR ECONOMY
U.S. ECONOMY
ANICA Store & Storage $127,000
Post-Office $(13,000)
AVEC $(112,000)
$19,000
$356,000
kcal
Hunting Fuels
Hunting Equip.
Household Fuels
Food
Household Goods Clothing
$39,000
$26,000
$11,000
$54,000
$98,000
$172,000 Unearned Income
Earned Income
Wage Work
Hand Crafts
Handmade Equip. Clothing
kcal Work
$(3,000)
NW Cape Population 310
92 ♂
78 ♀
140 Juv.
Water $(645)
168,000 gal.
Edible Food Storage
By-Product Storage
Dogs 125
23,000 kg
100,000 kg
Hunting Work
80 Walrus Hides
60 Walrus bacula
1100 Seal Hides
150 Fox Pelts
680 kg Walrus Tusks
1000 kg Baleen
NORTHWEST CAPE COMMUNITY
Processing Loss
47%
240
80%
12
20%
400
50%
Walrus 60,000
Bowhead Whale
Seals
Other Food Species & Arctic Fox
Lower Trophic Species
PHYSICAL HABITAT OF NW CAPE

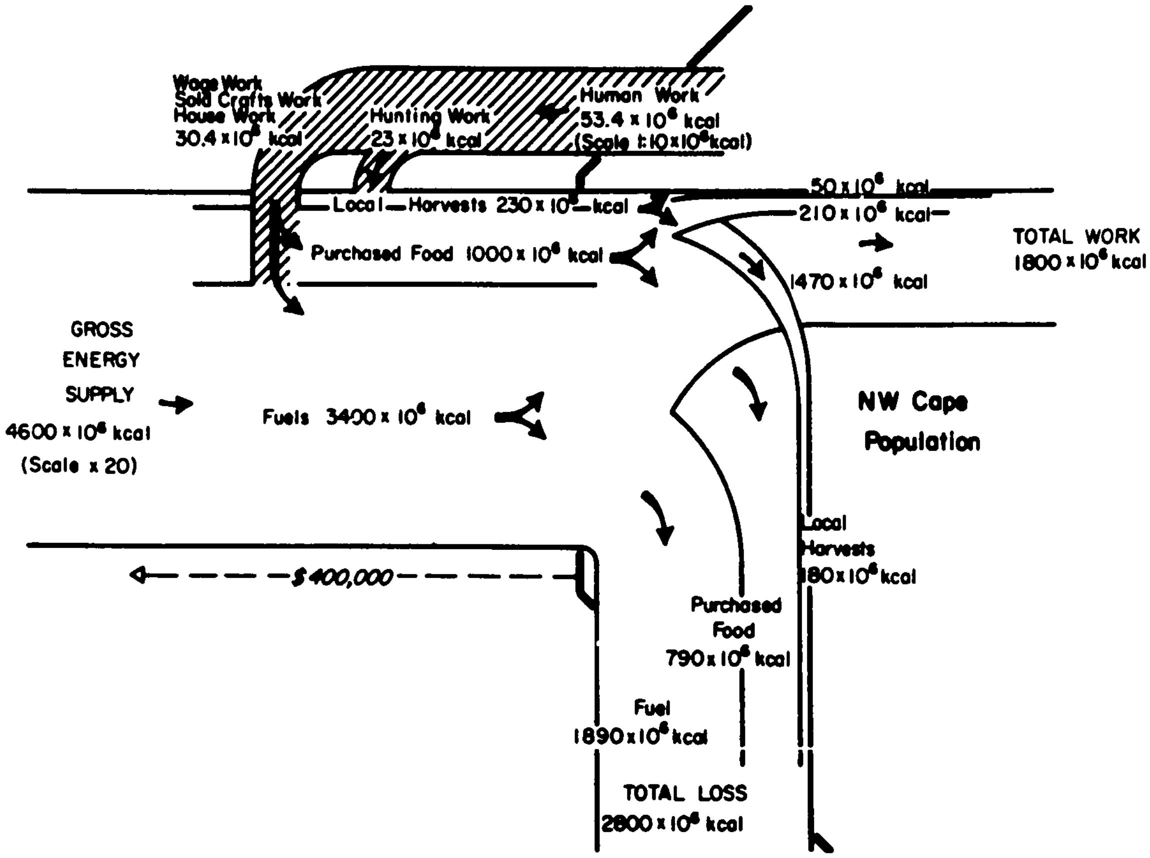
FIGURE 13

Human Work and the Annual Flow of Energy

in Caloric Terms

This figure displays the relationship between the annual caloric contents of foods and fuels, and the human work required to maintain these resources. Values appearing in this figure are derived from Tables 21 through 24. Graphic methods are adapted from Cook (1971) and Odum (1971).

	x 10^6 kCal		
Inputs	gross	loss	work
Human work			
hunting	-	-	23
household	-	-	19
saleable hand work	-	-	1.6
wage work	-	-	9.8
subtotal			53.4
Foods			
local harvests	230	180	50
purchased foods (selected)	1000	790	210
subtotal	1230	970	260
Fuels			
all fuels	3360	1890	1470
Total:	4600	2800	1800



Wage Work
Sold Crafts Work
House Work
30.4 x 10⁶ kcal
Hunting Work
23 x 10⁶ kcal
Human Work
53.4 x 10⁶ kcal
(Scale 1:10 x 10⁶ kcal)
Local — Harvests 230 x 10⁶ — kcal
50 x 10⁶ kcal
210 x 10⁶ kcal
Purchased Food 1000 x 10⁶ kcal
1470 x 10⁶ kcal
TOTAL WORK
1800 x 10⁶ kcal
GROSS
ENERGY
SUPPLY
4600 x 10⁶ kcal
(Scale x 20)
Fuels 3400 x 10⁶ kcal
NW Cape
Population
$400,000
Local
Harvests
180 x 10⁶ kcal
Purchased
Food
790 x 10⁶ kcal
Fuel
1890 x 10⁶ kcal
TOTAL LOSS
2800 x 10⁶ kcal

FIGURE 14

Annual Rate Relations of Storage, Transaction and Work Components of the NW Cape Resource System

The symbols used in this chart (Odum, H. T. in Patton, 1972 p 140-210) are:

circle: Energy sources from outside the defined boundaries of a system . . . are indicated by a circle (ibid p 143).

solid lines: . . . solid lines represent flow of potential energy from a source (ibid p 145).

broken lines: dollar flow

heat sink: The second energy principle requires that all spontaneous processes include dispersal of potential energy as heat . . . (ibid p 162).

tank: . . . potential energy stored within the system (is defined by the) quantity of potenital energy in calories and its storage form . . . (ibid p 163).

junctions of solid lines: If two flows are of similar materials and energy types, then may add (or subtract) forces and flows . . . (ibid p 177).

curved box: (. . . work done by one or more energy circuits (which) controls another with only an on and off position (ibid p 193).

Rate values are expressed in kCal x 10^6. Rates in parentheses are calculated using the kCal-dollar equivalent of 12,000 kCal/$ (see Table 25).

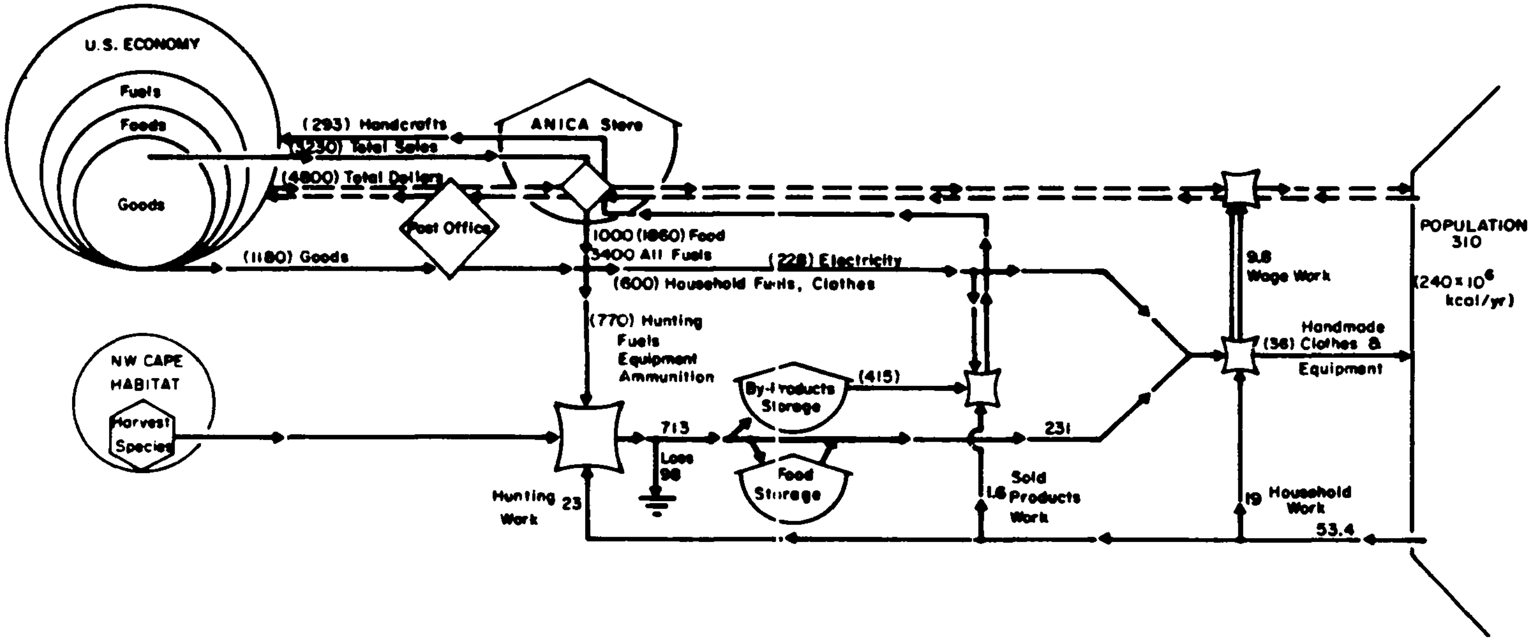

U.S. ECONOMY
Fuels
Foods
Goods
(293) Handcrafts
(1230) Total Sales
(4800) Total Dollars
ANICA Store
Post Office
(1180) Goods
1000 (1860) Food
3400 All Fuels
(228) Electricity
(600) Household Fuels, Clothes
(770) Hunting
Fuels
Equipment
Ammunition
NW CAPE
HABITAT
Harvest
Species
By-Products
Storage
(415)
713
Loss
98
Food
Storage
231
Hunting
Work
23
1.6
Sold
Products
Work
9.8
Wage Work
Handmade
(36) Clothes &
Equipment
19
Household
Work
53.4
POPULATION
310
(240 × 10^6
kcal/yr)

TABLE 20

Annual Cost to the Community of Imported Store Materials

(Gambell Unit Costs)

					Dollars
Foods					
weekly fresh food shipments[1]	$41,350[2]	x	1.2[3] x 2.2[4]		109,164
annual food shipment	$25,932[5]	x	1.75[6]		46,380
				subtotal:	154,544
Goods					
guns	$200[7]	x	20[8]		4,000
snowmobiles	$1,000[7]	x	16[9]		16,000
outboard motors	$800[7]	x	7[10]		5,600
stoves	$188[11]	x	2 x 1.5[12]		564
				subtotal:	26,164
Fuels					
ammunition	$8,285	x	1.5[6]		12,428
gasoline	$1	x	22,000 gal		22,000
motor oil	$.88 $1	x x	2,200 qt 2,400 qt		4,350
				subtotal:	38,778
white gas	$1.23	x	2,200 gal		2,700
kerosene	$1	x	3,330 gal		3,300
heating oil	$.45	x	74,000 gal		33,300
				subtotal:	39,300
				total:	258,786

[1]Table 16 plus cigarettes, candy, soft drinks

[2]Table 10: 1969 Seattle cost

[3]Increase 1969 over 1968

[4]Table 16: average Gambell unit cost increase

[5]Seattle cost of total 1970-71 food shipment; compare Table 14

[6]Table 14: average Gambell unit cost increase

[7]Estimated average Gambell cost

[8]Replacement rate of 10 years x 1970 complement Appendix 10 (1/10 x 188)

[9] " " " 3 " " " " " " (1/3 x 48)

[10] " " " 6 " " " " " " (1/6 x 43)

[11]Special invoice 1971

[12]Gambell cost increase

TABLE 21

Average Energy Expenditure by Hunter for Single Seal and Walrus Hunts and by Community for the Whale Hunt of 1972

Gambell Activities

	equipment preparation	travel, equipment repair & search	killing & retrieval	butchering & preparation
Seal Hunt (10 hrs)				
hours	1	6	1	2
kCal/min	4.2	3.4 ave	6.9	6.5 ave
comparable activities at Igloolik	hunt preparation	Skidoo driving-no load snowmobile repair standing at floe edge seal hunt	loading sled	loading meat skinning seal

average: 4.5 kCal/min; 270 kCal/hr; 2700 kCal/hunter (10 hrs)

	equipment preparation	travel, equipment repair & search	killing & retrieval	butchering & preparation
Walrus Hunt (10 hrs)				
hours	1	5	2	2
kCal/min	5.1 ave	3.4 ave	6.9 ave	7.3 ave
comparable activities at Igloolik	hunt preparation snowmobile delivery	see seal hunt	walrus skinning walrus hunting loading meat	walrus skinning walrus hunting loading meat snowmobile delivery

average: 5.1 kCal/min; 306 kCal/hr; 3060 kCal/hunter (10 hrs)

	equipment preparation	travel, equipment repair & search	killing & retrieval	butchering & preparation
Whale Hunt (6,200 hrs)				
hours	400	3,000	400	2,400
kCal/min	5.1 ave	3.4 ave	4.5 ave	3.2 ave
comparable activities at Igloolik	see walrus hunt	see seal hunt	checking net by canoe 10% walrus hunting 90%	standing at floe edge 50% garage work 20% walrus skinning 10% snowmobile driving-heavy load 20%

Total expenditure: 1.3×10^6 kCal/~ 80 hunters (6,200 man-hours)

TABLE 22

Man-Hours spent Walrus Hunting by 16 Crews 1971-1972

		December 23-31		January 11-20		February 11-26		March 10-29		April[1]	May 5-21[2]		
	Average	3 days		11 days		12 days		6 days	-		8 days		Total
Crew	size	Days	Man-hours	Days	Man-hours	Days	Man-hours	Days	Man-hours	-	Days	Man-hours	Man-hours
1	4	1	20[3]	3	60[4]	4	80	2	40	-	1	32	232
2	4	2	40	5	100	6	120	3	60	-	2	160	480
3	5	2	50	3	75	2	50	2	50	-	6	1000	1225
4	4	0	0	0	0	0	0	0	0	-	5	1000	1000
5	4	0	0	0	0	0	0	0	0	-	5	1100	1100
6	7	0	0	6	210	5	175	2	70	-	5	1100	1555
7	6	0	0	0	0	0	0	0	0	-	4	680	680
8	6	3	90	10	300	11	330	6	180	-	7	2000	2900
9	4	0	0	0	0	0	0	0	0	-	1	32	32
10	5	0	0	0	0	0	0	0	0	-	2	150	150
11	3	0	0	0	0	0	0	0	0	-	4	470	470
12	6	2	60	5	150	4	120	3	90	-	4	700	1120
13	7	1	35	1	35	0	0	0	0	-	7	5200	5270
14	5	0	0	0	0	0	0	0	0	-	5	620	620
15	5	0	0	0	0	0	0	0	0	-	4	650	650
16	5	3	75	4	100	2	50	2	50	-	5	1000	1275
Totals:	80	14	370	37	1030	34	925	20	540	-	67	15,894	18,759

Totals
men: 80
beat days: 172
man-hours: 18,759
total energy expenditure: 5.75×10^6 kCal (306 kCal/hr x 18,800 hrs)

[1] Whale hunting activities for all crews occurred entire month. See Table 21.

[2] Alaska Department of Fish & Game, Nome. 1973. pers. comm.

[3] Average hours for hunts December-March taken at 5 hours.

[4] For all calculations: days x hours x crew size.

TABLE 23

Man-Hours Spent Seal Hunting by 35 Men 1971-1972

	days of hunting	hours/hunt	cKal/hr hunt	kCal x 10^6
June	15	10	2700	1.4
July	20	10	2700	1.9
August	23	10	2700	2.2
September	23	10	2700	2.2
October	23	10	2700	2.2
November	28	5	1400	1.3
December	27	5	1400	1.3
January	22	5	1400	1.1
February	23	5	1400	1.1
March	14	10	2700	1.3
April	-	-	-	-
May	-	-	-	-
			Total:	16.3

TABLE 24

A Comparison of the Annual Supply of Energy Source Materials 1971-1972

item	annual supply	kCal gram	gross $kCal x 10^6$ supplied	unit volume dollar	kCal dollar	total dollars spent	converter %[2] efficiency	net $kCal x 10^6$ obtained
Fuels								
heating oil	74,000	9.7[1]	2000	2.2	59,000	33,000	55 stoves	1100
kerosene	3,300	10.4[1]	92	1	29,000	3,300	55 heaters	51
cooking fuel	2,200	7.8[1]	47	.81	18,000	1,800	60 stoves	28
diesel fuel	19,000	10.3[1]	545	nd	29,000	18,600	38 engine 99 generator 63 elect. motor	120
gasoline	22,000	10.4[1]	640	1	29,000	22,000	25 auto engine	160
motor oil	1,155	11.5[1]	37	.26	8,300	4,800	25 auto engine	9.3
storage batteries	8,640 ea	6 Watt-Hr ea	.04	33 ea	15	2,200	73 battery 4 bulb	.013
			3361					1468
Selected Store Foods	kg							
lard	870	9.0[3]	7.8	.96	8,600	835	20 man	1.6
sugar	11,000	3.9[3]	430	1.7	6,500	6.500	20 man	86
flour	5,700	3.6[3]	210	2.2	7,800	2,600	20 man	42
fresh meat	10,700	3.6[4]	385	.26	720	41,000	20 man	77
			1033					207
Local Foods	kg							
walrus	55,000		120[5]				20 man	24
whales	11,000		41				20 man	8.2
seals	29,000		37				20 man	7.4
others	5,200		5.7				20 man	1.1
			204					41

1 Spiers, 1962, p 269-271; Odum, 1971, p 47, value for all fuels: 10, all foods: 4.5.
2 Summers, 1971, p 151.
3 Heinz, 1959, p 106 ff.
4 ibid, p 116, value for hamburger.
5 Foote, 1965, p 350, 352, 356, 362.

TABLE 25

Annual Rate Relations of Storage, Transaction and Work

Components of the NW Cape Resource System

Component and Materials	Work Input	Annual Rate ($\times 10^6$ kCal)
Harvest species	hunting work	23
gross harvest		713
recovery loss[1]		98
By-products storage	sold products work	1.6
raw by-products[2]		415
handcrafts sold[3]		293
Food storage[4]		31
edible foods		200
Post office[3]		1,180
Dollar flow	wage work	9.8
total[3]		4,800
ANICA store	household work	19
total sales[3]		3,230
food[5]		1,000 (1860)
hunting fuels, ammunition and equipment[3]		770
household fuels and clothing[3]		630
electricity[3]		228
handmade clothing and equipment[3]		36
Total annual caloric requirement of resident population		240

[1] Average recovery loss: 49% (see Fig. 12)

[2] Dollar value of raw by-products:

baleen:	1,750 kg	at	$ 5.50/kg:	$ 9,600
ivory:	860 kg	at	7.00/kg:	4,760
hides:	1,100	at	15.00 ea:	16,800
bacula:	60	at	8.00 ea:	480
fox pelts:	150	at	20.00 ea:	3,000
				$34,640 x 1,200 kCal/$

[3]Dollar rate x 12,000 kCal/$

[4]Heller and Scott, 1967 p 184-185:

dried walrus meat:	260 kCal/100 gm;	wet 216 kCal/100 gm
dried seal meat:	365 " " " "	140 " " "

[5]Both direct caloric and conversion calculations

TABLE 26

Recommended Dietary Caloric Allowance for

the NW Cape Population

Resident population[1] males	age	females	recommended percapita daily[2] caloric allowance (kCal) males (65 kg)	females (55 kg)	total daily requirement
2	80-84	1	2,000	1,400	5,400
3	75-79	2	2,000	1,400	8,800
2	70-74	3	2,200	1,600	9,200
4	65-69	4	2,200	1,600	15,200
4	60-64	8	2,400	1,700	23,100
3	55-59	1	2,400	1,700	8,900
6	50-54	3	2,600	1,800	21,000
8	45-49	6	2,600	1,800	31,600
7	40-44	6	2,700	1,900	29,800
11	35-39	6	2,700	1,900	41,100
8	30-34	6	2,800	2,000	34,400
8	25-29	17	2,800	2,000	56,400
16	20-24	7	2,800	2,000	58,800
10	15-19	7	3,000	2,200	45,400
23	10-14	23	2,600	2,100	108,100
30	5-9	20	2,000		100,000
26	0-4	18	1,500		66,000
171		138			663,200

Total daily caloric requirement: $.66 \times 10^6$ kCal

Total Annual caloric requirement: 240×10^6 kCal

[1]See Fig. 4

[2]National Research Council, 1964 p 3-7. Weights given are for "reference" man and woman from which allowances at ages 20-35 are derived, with reductions of 5%, ages 35-55; 18%, ages 55-75; and 10%, ages 75+

APPENDIX 11

Operating Expenses of the ANICA Store for October 1971[1]

	Dollars
Salaries	1,393
Extra labor	49
City sales tax	429
Operating supplies	13
Heating	154
Light	180
Postage	36
October total:	2,254
Estimated annual total:	27,000

[1]From monthly store statement

APPENDIX 12

A Survey in July 1970 of Local Foods Stored

Total households surveyed: 48

Total families represented: 60

Families with no stored local foods: 10

Products Stored

	Walrus	Seal	Bird	Fish
number of shared storage units:	25 (4 cellars)	25	10	7
amounts (kg)				
wet:	10,000	2,000	current catch	-
dried:	1,000	1,000	75	50

APPENDIX 13

Community Water Consumption January-February 1971

The community well is maintained by a resident employed by the City Corporation of Gambell. A calendar was marked on the days the storage tank was filled by an engine driven pump. The days on which the Bureau of Indian Affairs elementary school hauled water to its own storage tanks were also marked. Since the well storage tank was not completely emptied before each refilling the used volume of the 450 gallon capacity tank was estimated at 400 gallons.

Period: January 14 - February 17, 1972 (31 days)

Gallons used during period:	34,000	
Gallons used by BIA:	20,000	(80, 55 gallon drums were hauled 5 times)
Gallons used by 57 households:	14,000	(60 gal/household/week)
annual total:	168,000	

Monthly cost of maintenance:

labor:	$125	
gasoline:	10	
heating oil:	150	(for 6 months)
annual total:	$645	

APPENDIX 14

Processes and Investments in Recovering Skin Boats

Process	Labor investment Dollar cost or value
A female walrus hide is taken in the spring and stored until June or July. Adult size females are required as male hides are excessively scarred.	2 men 1/2 hour to skin animal 2 men 1/2 hour to scrape hide
The full hide is prepared for mounting once it has decomposed enough for the outer hair to be easily removed. Three inch slits spaced about a foot apart are made around the outer edge of the hide and the hide is then loosely stretched on a large frame.	1 man 3 hours and 2 men 2 hours
The hide is then split from top to bottom by an experienced woman. The best complete the job in 1 1/2 hours.	$10 payment
The frame is then lowered, the hide restretched and once again raised for drying.	2 men 2 hours or $10 payment $140 Anchorage hide value at this stage.
After 2-3 weeks drying time the hide is soaked in water for 1-2 days in preparation for recovering the boat frame.	1 man 1 hour
The hides are then sewn, trimmed, patched and roped to the boat frame.	1 man 2 hours collecting and transporting 4 women 12 hours sewing 2 men 12 hours lashing
man-hour investment:	60 hours or $135 at $2.25/hour
dollar investment:	$280 for 2 hides 10 for splitting
total:	$425
Processes and time investments unaccounted for:	transportation; removal of old boat covers; painting of new cover; maintenance of stretching frames; preparation and cost of walrus calf hide rope.

APPENDIX 15

A Survey of Annual Use Rates of Electricity in Dollars

Survey completed: March 22, 1972

Period covered: March 1971 through January 1972 (11 months)

Service equipment:
4 8,600 gallon diesel fuel tanks
2 75 KW generators (one standby)
underground wiring and house meters

Fuel use during period: 18,500 gallons

Cost rates per KWH:
$ .20 first 75 (min. charge per month: $15.00)
.15 75-225
.12 225-700
.09 700+

Dollar cost to customers over 11 month period:

	all users	private	commercial	public buildings
Total	17,049	11,963	2,136	2,951
Average/mo	1,550	1,087	191	268

An additional monthly rate of $2,500 is paid by the Bureau of Indian Affairs elementary school.

Monthly dollar cost for private users (57 households):

March 1971	1,147
April	1,117
May	1,442
June	1,029
July	1,248
August	1,330
September	1,403
October	1,413
November	2,590
December	2,283
January, 1972	2,048

APPENDIX 16

A Survey of Living Conditions in Nome 1970

Date of Survey: September 6, 1970

Sample: 4 resident households, 28 people

Summary of results:

Three of the four heads of families surveyed have full-time cash employment. One retired head of household moved to Nome for medical reasons.

One family owns the house occupied, the other three rent. Rental rates of $200-$300 per month are most common. All families use heating oil stoves and electric or propane stoves for cooking. All homes are supplied with a full array of appliances. One family owns two motor vehicles.

Three of the four families have males of hunting age. One of the three has a small complement of hunting equipment used only on occasion.

The only game food in storage among these households is local fish caught the preceeding winter.

CONCLUSION

The purpose of this study is to assess the role of local food resources in the function of the community at the Northwest Cape of St. Lawrence Island. In the course of descriptions of its components several consistencies have been noted in the overall function of the community which establish its patterns of resource utilization. These may be reviewed as part of a final comment on the characteristics of the community, the likely effects of current changes and the utility of the analysis.

It has been established that the basic production unit common to the entire Island is and has long been the composite band. Groups larger than extended families reside together and cooperatively exploit the migratory food species of their habitat. Accepting the importance of the tribe or rumka, the family remains the institution most highly valued. The best that a hunter can do is provide an ample supply of fresh and varied food to his family and to as many of his next-of-kin as will accept it. The division of labor within families requires that each member espouse this value. The conclusion that a devaluation of the family leads to a devaluation of the society as a whole is required by the fact that the entire social and economic fabric of the community is structured around the family. The emigration of whole family units in number during the 1958-1972 period substantiates its importance in social and economic processes. Another demographic pattern of importance to the strength of the families of the community is the large and persistent excess of unmarried males over unmarried females. These patterns appear to be mainly responsible for the observed leveling of the size of the Cape population.

These and another very different set of events reveal the importance of evaluating the economy and demography of the Island-mainland complex rather than the Island alone: the recently initiated use of the SW Cape area of the Island as a spring bowhead whaling station. One of the adjustments required of the population during the European contact period was, in addition to a reduction in size, the abandonment of the south side of the Island. The institutions of school, church, store and post office undoubtedly contributed to its lack of resettlement, as did the very important fact that the people who owned and used the area were dead and unburied. The prevalence of emigration indicates a certain dissatisfaction on the part of the Cape population which is difficult to typify. The opening of the SW Cape area of the Island for collective use represents the selection of another alternative for increased status and income. It is also an expression of a trend toward autonomy. The private ownership of land, the current interest in a local two year high school and the responsibility held by the councils of the community for the activities of persons and corporations who visit the western Island areas are also expressions of this trend. The observation that disruptive effects of overpopulation or depopulation are buffered by the larger mainland population pool is supported by similar effects in the economic realm. The larger economy is the source of foods, fuels, capital goods and the dollar flow around which the economy of the Cape has partially reorganized. The magnitude of the harvest of local foods is a fair measure of the independence from the U.S. economy the Cape population maintains. It is a matter of choice. The degree of integration into the larger economic and social system is a matter of choice deriving from one priciple characteristic which protects the Island: its geographic isolation.

A conclusion which is perhaps obvious from the history of the occupation of the Cape is that this area has, of any other Island area, best fulfilled the needs and desires of the population. Several elements of the physical habitat have been described which contribute to this relative prosperity: a beach, a point, a headland, a nearby lagoon and rich pelagic and sublittoral waters. Cape hunters are an edge species since no important food species is resident year around and since the interfaces of different physical habitats produce the greatest abundance in the biotic assemblages which support the population. The division by use and ownership of the 600 square miles area of the western Island provides a means of spatially distributing hunting pressures on these assemblages. The land has two additional functions: reference points for ocean navigation, and perhaps most important of all, providing a place for shelter and drying out. The 50 meter channel lying between the Cape and the coast of Siberia, and the very proximity of this coast, allowed Sevuokuk to survive the Great Starvation, when other settlements did not. This channel was a common navigation route for the American and European sailers who brought about the crash. The security given thereby and immigration from the nearby Siberian coast prevented the population from perishing. That the habitat of the Cape is rich and the community is longstanding encourages a more traditional way of life than in the neighboring community of Savoonga. Savoonga people consider the people of Gambell "old fashioned". The very wealth and proximity of its ectones encourages autonomy and reliability. But these communities are spectacularly wealthy in food species only during the very short spring migration period. Persistent effort is required during other seasons, as indicated by the several harvest records presented of individual hunters. The prevalence of tide currents, sea swells large enough to prevent navigation by skin boat and unstable sea ice require a high degree of skill and accumulated knowledge still actively sought and gained by younger hunters of the community. This fact alone speaks for the enduring quality of the relationship between Cape hunters and their habitat, a relationship which is likely to continue. Cape hunters deal daily with their habitat with an intimacy unfamiliar to the urban dweller.

In doing so the hunters provide a higher protein supply for their community than perhaps any other in the world. If it is true that securing sufficient caloric intake (Scott, 1956 p 1) was the principle nutritional problem faced by Alaskan communities, the present disposal of dietary fat (blubber) indicates that this is no longer so. That the annual caloric requirement of the community (see Table 6) is about one fifth of the annual food calorie input allows considerable leeway. The population apparently has the choice of making up any caloric deficiency which might occur with either an increased consumption of locally obtained fats and carbohydrates or an increased consumption of purchased foods. Only a small fraction of the edible protein provided the community originates from off-Island sources of fresh imported foods, whereas the relative dollar amounts required for hunting and the purchase of fresh foods are similar. Thus the geographic isolation of the community allows hunting to remain a profitable means of securing dietary protein.

It is obvious from the large amounts of petroleum fuels used by the community that heating fuels have replaced the use of seal oil as a fuel and gasoline used in snowmobiles has replaced the use of dogs. These effects are recent. Hughes notes (1960 p 113 facing) that seal oil lamps were still in limited use in 1955 and Fay (1970, pers. comm.) counted in the neighborhood of 600 dogs in the community in 1960. In cases such as these where one material which is a source of potential energy replaces another (or when such replacement does not occur) it is assumed that this replacement occurs for reasons detectable by an energetic analysis. Snowmobiles travel faster, further and longer than dogs and in many situations approaching emergencies, are more dependable. The advantages of freeing a woman from more or less constant care of the seal oil lamp for other duties are obvious. In both instances a savings of work results, which means a gain in energy. It would be foolish and wasteful not to take advantage of such savings as well as any reduction in risk. When considering the caloric contributions of store foods and local foods, the role of purchased foods is very important. Scott (1956, p 1-2) observes that there are very good reasons for the consumptions of imported foods. The local food supply may be inadequate, it may lack variety, it is subject to spoilage and its consumption is not encouraged by neighboring Americans. With the exception of the last, all of these qualifications are aspects of food storage operations. That the principle trading seasons during the last century were in the spring and fall and that trade began to increase as the population numbers of food species began to decrease effectively destroyed food storage practices is of considerable importance among the several changes required by the post-contact resource system. To encourage a dependence upon trade, food storage as practiced by native Americans had to be abolished.

An important aspect of the current technology of hunting is that dollars are required to hunt. A set of basic hunting equipment which cannot be locally manufactured costs a family about $2,000. Without dollars, hunting cannot take place. Therefore, a reduction of dollar flow would likely bring a reduction in hunting. Part of this dollar flow comes from the manufacture of handcraft goods, part from full- and part-time employment and part from unearned income. Any dollar source which does not require that a man give up hunting is preferred, since the central purpose of the dollar flow is to facilitate hunting. That men from the Cape cannot advance within the dollar system in the usual ways give rise to this pattern. Dollars from different sources are used for different purposes. Handcraft dollars generally support the daily cost of the hunt. Unearned dollars generally pay for imported fresh foods. Any surplus dollars are used for the purchase of tools and other goods useful to the Cape resource system.

It is a generally accepted proposition that the rate of energy use per person is a fair measure of the power controlled, or the 'standard of living'. But the reverse may also be true: the rate of energy use per person is a measure of the energy that person is constrained to supply. The magnitude of fossil-fuel energy supplies of the community necessarily reflects the magnitude of the dollar flow. There has been little change in annual per capita energy use and annual per capita real income for the U.S. as a whole since about 1943 (Odum, H.T. p 183 about 60 million kCal and $2,300 respectively). Annual per capita energy use (food and fuel) and annual total per capita income are 15 million kCal and $1,300 respectively. These lower values may be taken either as a measure of poverty or as a measure of independence. The choice is the reader's.

Fig. 14 dispells, at least qualitatively, the notion that the Cape system, or any other isolated system dominated by boundary fluxes, comprises a cluster of independent variable. At the very least there are dependent relations among throughputs. These relations derive from the "open" end-point of the pattern basic to all human operations seen at the Cape: by the use of harnessed potential energy, work is done which products allow further operations, some of which involve harnessing further energy sources.

The utility of an analysis of the sort attempted in this study may be judged by the conclusions just mentioned and by the several questions suggesting further investigation. Certainly past and present storage practices deserve study, both in historical and in quantitive terms. The roles of several important components in the system have not been considered here at all: tools, water, energy inputs from climatic sources and the enigmatic role of information exchanged between hunters. It is also possible that the information available here might allow a detailed consideration of the Cape system from the point of view of units smaller than the community, such as the rumka or the family. As well, a variety of interesting questions remain which concern the wealth of skills mastered anew by each generation of its hunters in accommodating to the Cape habitat. One of the older and most experienced hunters puts it simply: "The sea is our garden" (U.S. Senate Hearings, 1972 p 847). Although certainly not cultivated, the means for gathering from the sea are, and a man and his family is easily as attached to it as the farmer to his fields.

Considerable variation year by year may be expected in the rates of interaction of the components ascribed to this system. Recent legislation granting lands to aboriginal inhabitants of Alaska may require the larger dollar incomes usual to the ownership of private property, while that prohibiting the sale of seal hides or the provision of guiding services for visiting hunters will certainly reduce earned dollar flow. Increased dependence on unearned dollars is a likely result of these two current changes. Another likely result of a reduction in the flow of goods and services relative to the flow of dollars is an increase in the quantities of food stored and in the quantities of by-products sold. Given the need, the capacity for a economic independence of this community from the Alaskan mainland clearly exists.

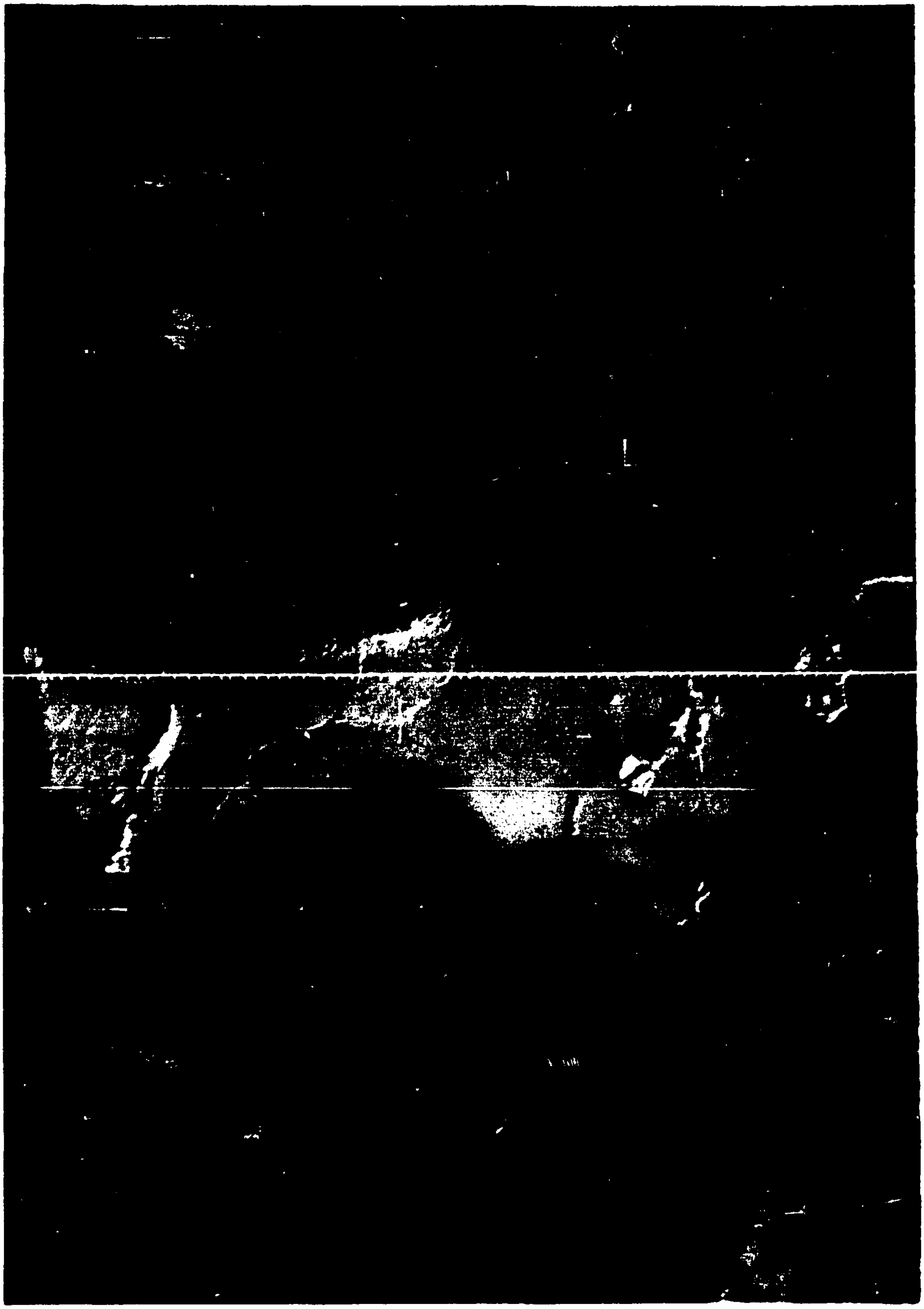
Perfectly orchestrated, the human population keeps itself well fed, and its supporting populations young and highly productive without subjecting them to excess stress. The extreme control required by domestication most clearly expresses these effects. There is no question that the principle food species of the human population of NW Cape are domesticated in an important sense. Centuries of accumulated experience with their distribution and habits, and with techniques for their capture make success in gathering themjust as predictable as the major weather patterns, which is the same limitation faced by the agriculturalist. The long-traditional exercises of a certain restraint with regard to these species make this sort of domestication possible. It is not domestication in reverse although it may be reciprocal. The information and experience necessary for efficient hunting is actively sought and taught. These hunters consider themselves professionals. The relaxed atmosphere of the community, the lack of fence-building or tilling the soil are misleading. If the ways of the NW Cape hunter contribute an ethic, and a set of skills necessary for its implementation, it is this: he lives within his habitat by letting it preserve itself. He crops the biological communities sharing his habitat without violating his functional role in a biological sense. He integrates these biological communities by the effects of his activities, turning them to serve his welfare. He has skills, and the restraint, to use the processes of the habitat for his benefit without its destruction.

FIGURE 15

A Photograph of St. Lawrence Island March 3, 1973

Scale 1:1,000,000

Two Earth Resources Technology Satellite photographs taken on the same day at an altitude of about 570 miles are joined in this figure which conveys a general impression of the relation of ice, sea and the land of St. Lawrence Island.



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Three different bibliographies follow, each with a different purpose. The first, Literature Cited, contains all sources referred to this study with the exception of those in the Introduction and Methods. The second, A Bibliography of the Works of Don C. Foote, presents full citations of all writings known by this author. References to the late Dr. Foote's papers cited in the Introduction and Methods are listed here. The third, A Regional Bibliography of St. Lawrence Island, is presented as a contribution toward a comprehensive regional bibliography for this area and is not referred to in the text.

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