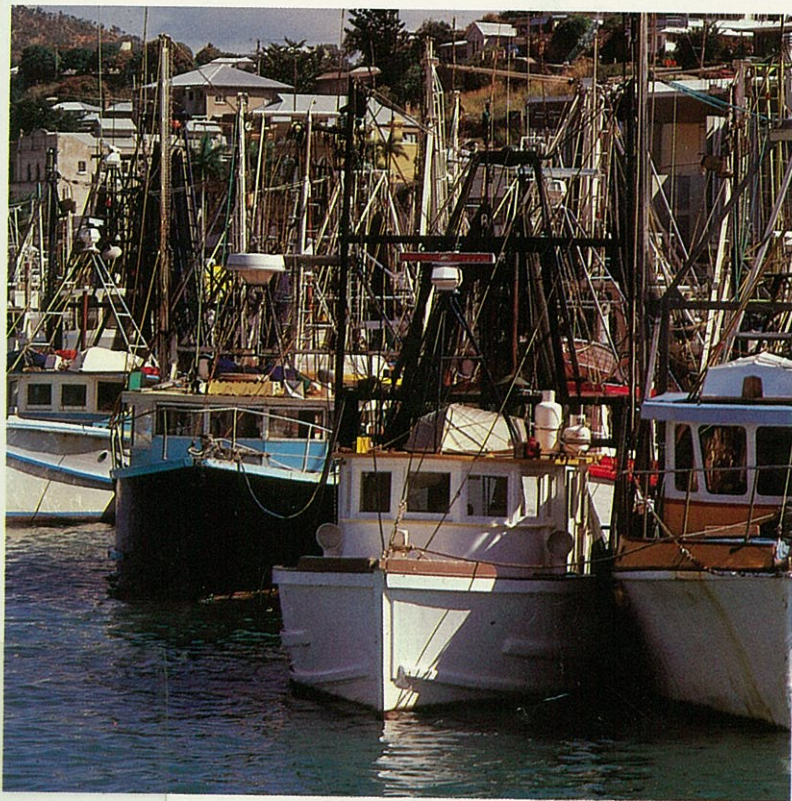


Fisheries of the Great Barrier Reef

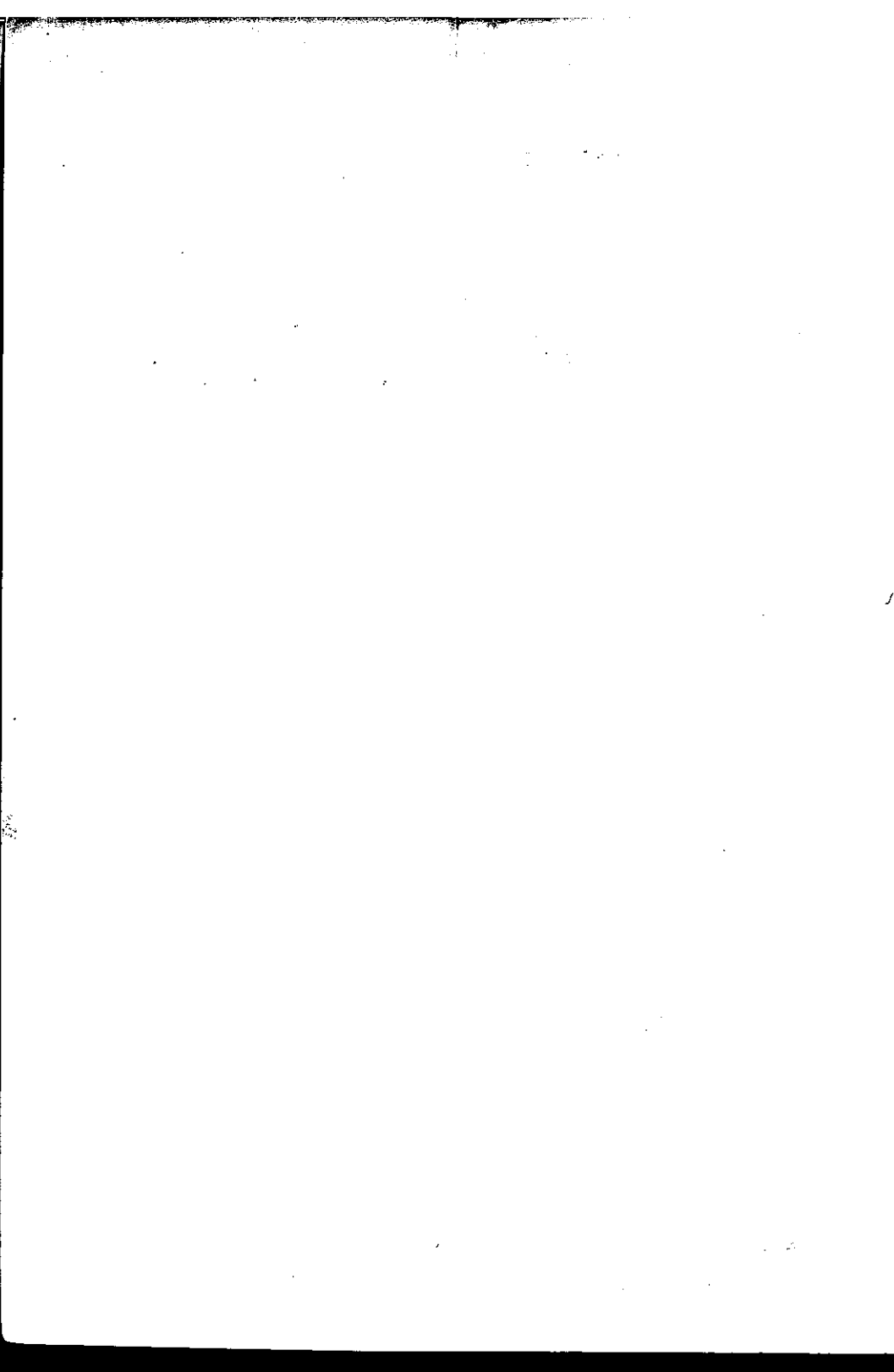
TOR HUNDLOE



Great Barrier Reef Marine Park Authority
Special Publication Series (2)

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Special Publication Series (2)

ISSN 0810—6983
ISBN 0—642—52417 3

Cover photograph:
Commercial trawling fleet, Townsville.

Photographic credits:
The Great Barrier Reef Marine Park Authority
thanks K. F. V. Fisheries (Qld) Pty Ltd,
David Wilson and Malcolm Florence for their
photographic contributions.



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Published by GBRMPA 1985

Printed by Prestige Litho Printing Pty. Ltd., Brisbane, Qld.

338.3727

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ACKNOWLEDGEMENTS

The author wishes to express thanks to many persons and organisations. The many people who have assisted in a variety of ways are too numerous to mention individually. They include all the fishermen and boat owners who provided the primary data on which much of the book is based. Staff of the Queensland Department of Primary Industries, the Commonwealth Department of Primary Industry and the Institute of Applied Social Research, Griffith University assisted in gathering data.

Of the organisations, first thanks must go to the Great Barrier Reef Marine Park Authority (GBRMPA) for its financial support to facilitate the gathering of the data and preparation of the manuscript. Without this support the book would not have been written, certainly not at this point in time. Second on the list are the Queensland and Commonwealth fisheries authorities for their generous co-operation during various phases of the research. Finally, the support of Griffith University must be recognised. In this regard a special mention goes to past and present colleagues associated with the Institute of Applied Social Research, in particular Sally Driml and also Steven Lack, Sandra Shaw, Jim Booth and Peter McGinnity. Their contributions in various forms (in the field, with the initial analyses, and by their good humour) made this book possible.

Certain individuals played very important roles during key phases in the preparation of this work. Much of the computer analysis of economic impact was undertaken by Rod Jensen, Guy West, and Julian Morison, of the Department of Economics, University of Queensland. Burke Hill (CSIRO) and Geoff McDonald (Griffith University) kindly read and commented on the draft manuscript. Any errors or omissions remain, of course, the responsibility of the author. Finally, a special thanks must go to Madelene Wischer and Lori Wright who painstakingly typed the manuscript.

Tor Hundloe
July 1985

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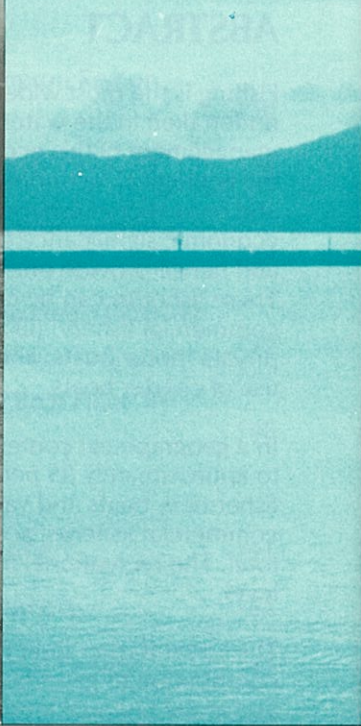
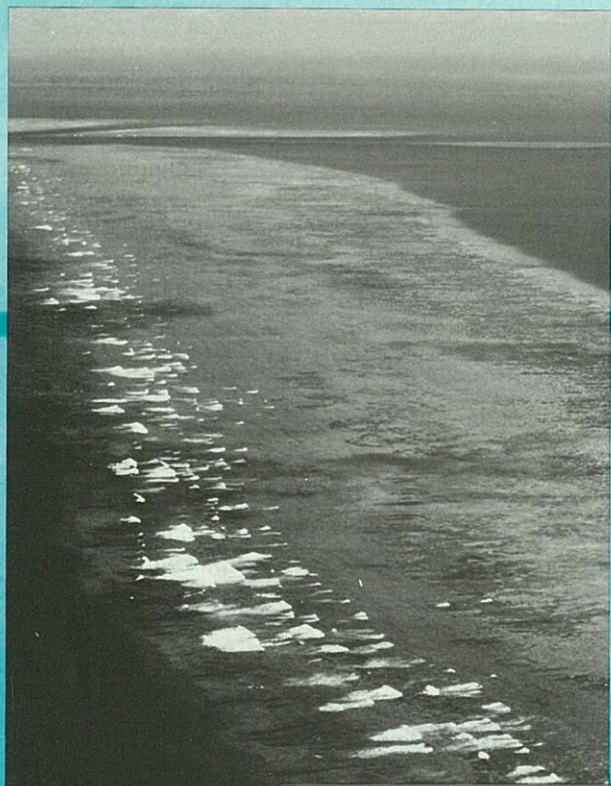
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ABSTRACT

Fishing is the most wide-spread and commercially important activity undertaken in the waters of the Great Barrier Reef. Rational management of this ecosystem is possible only with adequate data on the ecological, economic and social aspects of both the commercial and recreational fisheries. The purpose of this book is to describe the economic significance of the major fisheries in the Great Barrier Reef, and hence provide one element of the data required for management. These fisheries can be categorised into three major groups: (i) a commercial fishery; (ii) a recreational fishery based on individuals using private motor boats; and (iii) a recreational/game fishery based on the use of charter boats.

In a geographical context, the Great Barrier Reef fisheries are adjacent to approximately 85 percent of the Queensland east coast. In terms of fishermen, boats and value of product landed, the Great Barrier Reef commercial fisheries account for about one half of the Queensland total. The recreational fisheries are also significant at a state and national level.

The Great Barrier Reef fisheries are described in terms of their direct contribution to gross output, income and employment in Queensland, and at the regional level. Input-output multipliers are calculated to show the extent of flow-on effects. Flow-on effects result from the contribution which fishing expenditure and sales have on other sectors of the regional and state economies. The multipliers presented herein allow the estimation of the total impact of the fisheries at a point in time, and they can be used to predict what will happen to regional and Queensland-wide output, income and employment if the fisheries contract or expand. It is this predictive capacity which makes the multipliers useful for those concerned with the management of the fisheries.



Chapter One INTRODUCTION

This book describes the economic characteristics and significance of the major fisheries in the Great Barrier Reef Region.¹ Economic characteristics of the fisheries mean their economic structure, in terms of numbers of boats and fishermen, the value of investment, their fishing costs and earnings, and the significance of these fisheries related to their regional and state-wide importance.



What the book does not attempt is bio-economic modelling of the fisheries; that is, it is not concerned with maximum economic yields and estimations of the economic efficiency of the fisheries, in anything but a cursory way. In the context of the genesis of the book these omissions are as much deliberate as the result of data deficiencies.

Something needs to be said about the reason for writing the book and the data on which it is based. The book has its background in the research and planning requirements of the Great Barrier Reef Marine Park Authority (GBRMPA). This statutory body ultimately has responsibility for planning and managing the human use of areas of the Great Barrier Reef Region which are declared as Sections of the Great Barrier Reef Marine Park. It is required to plan and manage these areas by the means of "zoning plans" and regulations and these have to meet multiple objectives, ranging from strict preservation to "reasonable use". The ultimate resolution of conflicts between competing or incompatible demands on the resources of the Reef rests with GBRMPA. The latter task can only be sensibly undertaken with an adequate understanding of the existing and potential uses of the Reef. This understanding needs to be in terms of ecological, economic and social impacts.

Planning and management of the Reef involves a number of steps for the planner. He has to obtain an inventory of the biological and physical resources which comprise the area to be managed. He has to be able to comprehend these elements, for example fishes, corals, algae, as parts of an ecosystem. He next needs to obtain an inventory of the uses of the area in question; for example, how many fishing boats use the area, how many tourist facilities are in the area? He also needs to know what are the opportunities for increasing the levels of present use or for introducing new ones. He has to find out how important these uses are in economic terms and their role in meeting other social and cultural objectives. So far the planner's job has been defined as one of understanding the Reef ecosystem and what people are doing there. The next steps are crucial. He has to estimate the impact of human activities on the ecology and, if adverse effects are occurring, he will need to consider using his zoning plan and/or regulations to ameliorate the problems. At the extreme he could prohibit a particular activity. Obviously any action by the planner which effects the level of use (say the number of fishing boats or tourist operations) is going to have economic and social consequences. The planner has to know what the effects of his actions will be. These steps in formulating a management plan involve a process of interacting research and decision-making.

-
1. The Great Barrier Reef Region is the area, described in the Schedule to the **Great Barrier Reef Marine Park Act 1975** — in which sections of the Great Barrier Reef Marine Park can be declared and managed.

Fishing and tourism are the two commercially most important uses of the Reef. Management decisions can, or will, have impacts on the fisheries. Before the first lines were drawn on preliminary zoning plans and thought was given to drafting regulations, GBRMPA needed to know the extent and economic importance of fishing activities on the Reef.

The author and colleagues at the Institute of Applied Social Research, Griffith University, were commissioned to gather the data and undertake the analyses on which this book is based. That exercise commenced in 1979, prior to the declaration of the first Section of the Great Barrier Reef Marine Park (the Capricornia Section) and continued through to mid 1982, by which time the preparations for declaration of the next major area, the Cairns Section, were well advanced.

The book is based on both primary and secondary data. The secondary data were those held by Queensland State Government and Commonwealth Government departments. In 1979 the available information was virtually limited to that which was collected under the licensing requirements of the relevant departments. Two government agencies were responsible for licensing of vessels and/or fishermen for commercial fishing within the Reef Region. They were the Queensland Fisheries Service (QFS) and the Commonwealth Department of Primary Industry (CDPI). These agencies could supply data on number of boats and ownership. Additional information was available from the licences. Since 1979 changes have been made to the Queensland Government fisheries administration. The QFS has become an integral part of the state's Department of Primary Industries (QDPI) and a new statutory authority, the Queensland Fish Management Authority (QFMA), has been established as the major body for fisheries administration. The reason the two levels of government are involved in licencing is a function of the constitutional separation of powers. In practice, though not always in theory, the states have had jurisdiction seawards from low water mark for 5 kilometres (3 miles), from there to the outer limit of the 320 kilometre (200 mile) zone the Commonwealth has had jurisdiction.

Unlike commercial fishermen, recreational (or amateur) fishermen do not have to be licensed in Queensland and hence there is no easy means of establishing how many there are, how often they fish and a host of other pertinent facts. In off-shore areas of the Reef Region, recreational fishing is entirely undertaken from boats. Fishing from the shore is not dealt with in this book. Recreational fishing can be divided into two broad classes, according to the means of access: that undertaken from privately-owned pleasure craft and that undertaken from chartered vessels. As both types of vessels have to be registered

it was possible to obtain owners' names and addresses, as well as some boat characteristics such as length. The registration of motorised pleasure craft is undertaken by the Queensland Department of Harbours and Marine, and Harbour Masters at the various Queensland ports hold information on the names of charter boats operating out of their ports. It was possible to establish from such records the total number of boats which could be used for fishing trips into the Reef Region, but that was the limit of available information.

Studies of the type undertaken by the author had not been done previously for fisheries in the Reef Region. During the period in which the data were being gathered for GBRMPA other investigations, some as collaborative research with the author and others as independent studies, were undertaken by other agencies and researchers. Where appropriate this book draws on these other studies.

Given the paucity of information, of the type needed for management decisions by GBRMPA, the major task for the author was to collect sufficient primary data. This was done by personal interviews of fishermen in the case of commercial fisheries, and mainly by the use of mail interviews for recreational fishermen. The types of information sought generally pertained to the financial and economic characteristics of fishing activities. The important analyses were of costs and earnings, where appropriate, and of the regional economic significance of fishing. Details of data collection methods are reported in Appendix A.

The final introductory word by the author is to make a plea to those who might be able to improve the information in the book to not hesitate in providing additional material. In the final analysis, a book of this nature is only as good as the information provided by fishermen.



Chapter Two THE REEF FISHERIES IN CONTEXT

The Geographical Context

The fisheries of the Great Barrier Reef Region include the entire east coast of Queensland fisheries except those in the relatively small area south of the northern tip of Fraser Island and those in the Torres Strait. The Reef Region stretches along the Queensland coast from Lady Elliot Island to the tip of Cape York; from latitude 24° 30'S to latitude 10° 41'S.



The Reef itself continues farther northward to Papua New Guinea. The eastern boundary of the Reef Region is far enough seawards such that a "buffer zone" of open water exists east of the "outer" Reef. The eastern boundary does not correspond with the boundary of the Australian 320 kilometre limit (the Australian Fishing Zone), but except for all foreign fishing this does not exclude any existing fisheries from the Reef Region. The western boundary of the Reef Region is low water mark on the Queensland coast. Given these boundaries, the only Queensland fisheries not included in the Reef Region, except those already mentioned, are those in the Gulf of Carpentaria and the "inland" fisheries (river, estuarine and lake fisheries). The latter, other than those very near the coast, are insignificant.

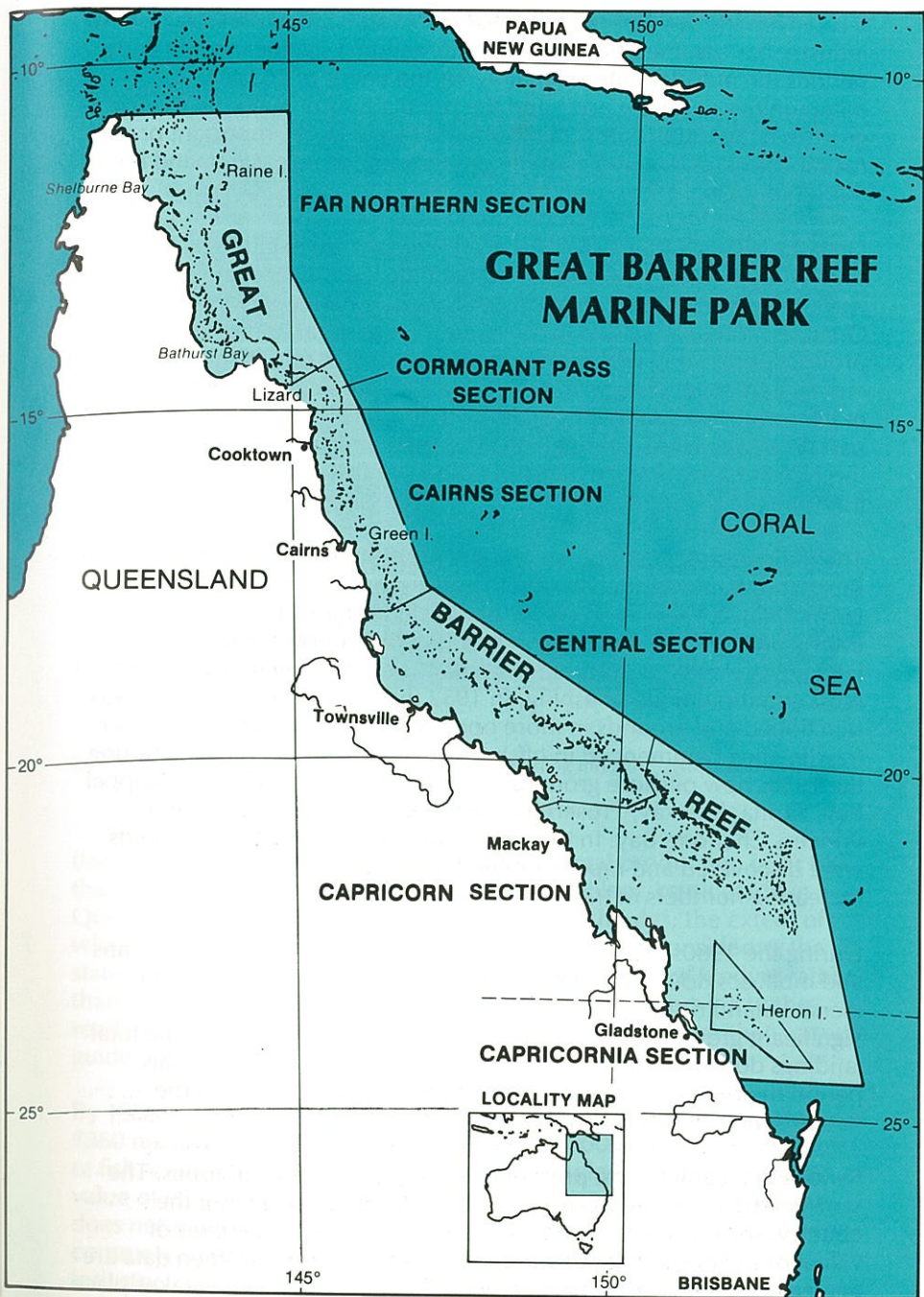
The east coast of Queensland adjacent to the Reef Region stretches for 4 300 kilometres and accounts for 85 percent of the total east Queensland coastline.

Except for the state capital, Brisbane, and the Gold Coast and Sunshine Coast, all the major coastal cities and towns act as ports for the Reef fisheries. The most important ones are Bundaberg, Rockhampton/Rosslyn Bay, Mackay, Townsville and Cairns. In terms of the number of boats that use it as their home port, Cairns is, after Brisbane, the major fishing base in the state. A sizeable proportion of what can be called the Cairns fleet does not primarily operate in the Reef Region but rather works in the Gulf of Carpentaria. All the major cities and towns have processing plants with Townsville and Cairns being the important centres. Nevertheless, the increasing use of the bulk-pack method of handling prawns, in which the product is packed and frozen on board, is decreasing the importance of shore-based processing. A more detailed description of the geography of the Reef fisheries is presented later when the specific fisheries are described.

Section One: Commercial Fisheries

The Economic Context

By 1981 Queensland had become, in terms of value of production, the top commercial fishing state in the nation. The prawn fishery, which covers the entire Queensland east coast and the Gulf of Carpentaria, is the most valuable Australian fishery. The prawn fishery also clearly dominates in the Reef Region. The Reef Region fisheries can be put into perspective by considering the Australian and Queensland production. A brief history of the development of Queensland and Australian fisheries is a useful place to commence.



It is only in the last two decades that the Australian commercial fishing industry has assumed national and international significance. In early periods the industry catered mainly for the needs of coastal communities at fishing ports and the populations of major cities. The growth in the industry resulted from the discovery of important prawn, rock lobster, scallop and abalone grounds and overseas demand for these products.

Until the 1950s, Queensland fisheries were almost exclusively localised, small, independent operations. At that time the Queensland economy was dominated by primary industries: wool production west of the Great Dividing Range and in the coastal areas sugar and meat production. Fishing was an avenue for alternative employment for cane cutters and meat workers in the off-seasons. As a consequence, many of the now important commercial fisheries developed from very small part-time operations although all fishermen or fisheries did not follow this historical route since many people were first and foremost fishermen.

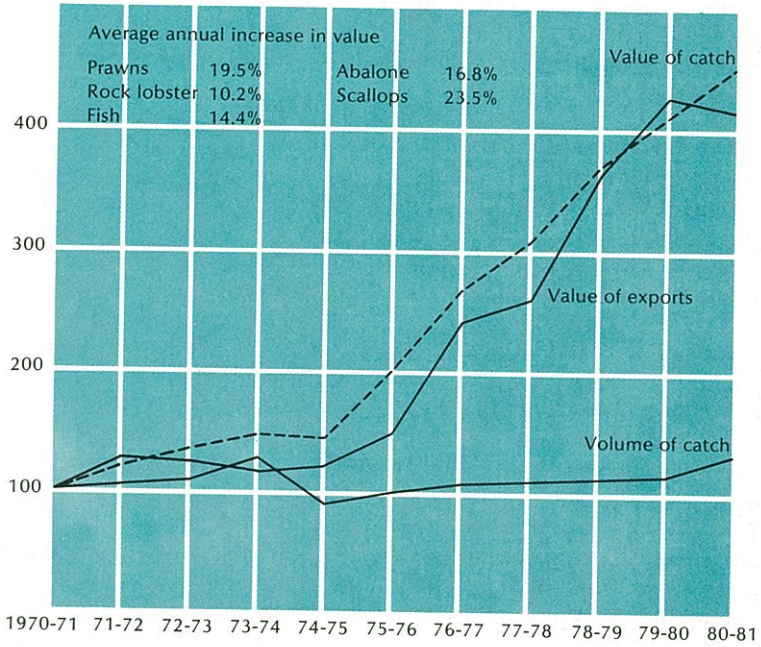
The prawn fishery commenced in the mid 19th century in the Brisbane River and then extended to other nearby rivers such as the Albert, Logan, Noosa Lakes, and yet further afield to the Mary River (Maryborough) and the Fitzroy River (Rockhampton). Prawns were taken by a variety of nets, but eventually beam trawling became the most common mode of fishing. In 1952 the use of otter trawl gear was sanctioned and grounds in more open waters were opened up. Otter trawling first commenced in offshore areas of Moreton Bay and during the 1950s new offshore grounds were developed at Gladstone, Keppel Bay, Sarina, Mackay, Proserpine, Bowen, Townsville, Cairns and Princess Charlotte Bay. In the 1960s the Gulf of Carpentaria grounds were discovered and rapidly opened up. Finally in the late 1970s increasing numbers of trawlers began fishing in the Torres Strait.

During the 1960s the value of the Australian catch of fish, crustaceans and molluscs doubled from \$30 million to \$60 million per annum. (Senate Standing Committee on Trade and Commerce, 1982). Significant growth in the industry occurred in the 1970s, with the total landings doubling and the value of the catch trebling. During this period the prawn fishery overtook the rock lobster fishery as the nation's most valuable fishery.

Serious inaccuracies are present in the official fisheries statistics. The statistics are collected from a number of sources throughout the country, some reliable, others much less so; further, the bases of valuations vary considerably from one state to another. When data are aggregated it is obvious that very significant under-reporting takes place

Figure 1: Trends in the Australian Commercial Fishing Industry

\$ and '000 tonnes (live weight)



Source: Bain, R., "An Overview of the Australian Fishing Industry", **Australian Fisheries**, Vol.41, No.10, October 1982.

(for some fisheries at least); that is, recorded total production is far less than actual production. Compounding the problem, particularly in Queensland, is the existence of unrecorded cash sales, the extent of which are unknown. A final point to be noted when considering the statistics is that catch is attributed to the state/territory of landing rather than the fishery in which it is caught. The above is a warning to the reader that the statistics presented below are nothing more than a rough guide, in the case of some fisheries.

By 1980-81, the value of the total Australian catch was in the order of \$360 million, representing approximately 150 000 tonnes (live weight) of fish, crustaceans and molluscs. In the following year the estimated value of the catch was over \$399 million (Lilburn, 1983). Though this does not make Australia a major fishing nation by world standards, the commercial fishing industry is nevertheless an important primary industry.

Figure 1 (page 13) shows the trends in production, in terms of volume and values, over the period 1970–71 to 1980–81. The quantity of the total catch has remained reasonably static, but the nominal value has increased significantly. Of course, the nominal increase in value is an illusionary statistic: what is relevant is the increase in real terms, that is, taking account of inflation. In real terms the value of most products has outstripped inflation.

The composition of the total catch and the relative value per major species is interesting. In 1980–81, the prawn fishery was the most valuable fishery, earning \$127 million for approximately 27 000 tonnes (live weight). Rock lobsters ranked next, earning \$83 million for 15 000 tonnes (live weight). Fish comprised approximately half the volume of the catch and generated \$67 million in income.

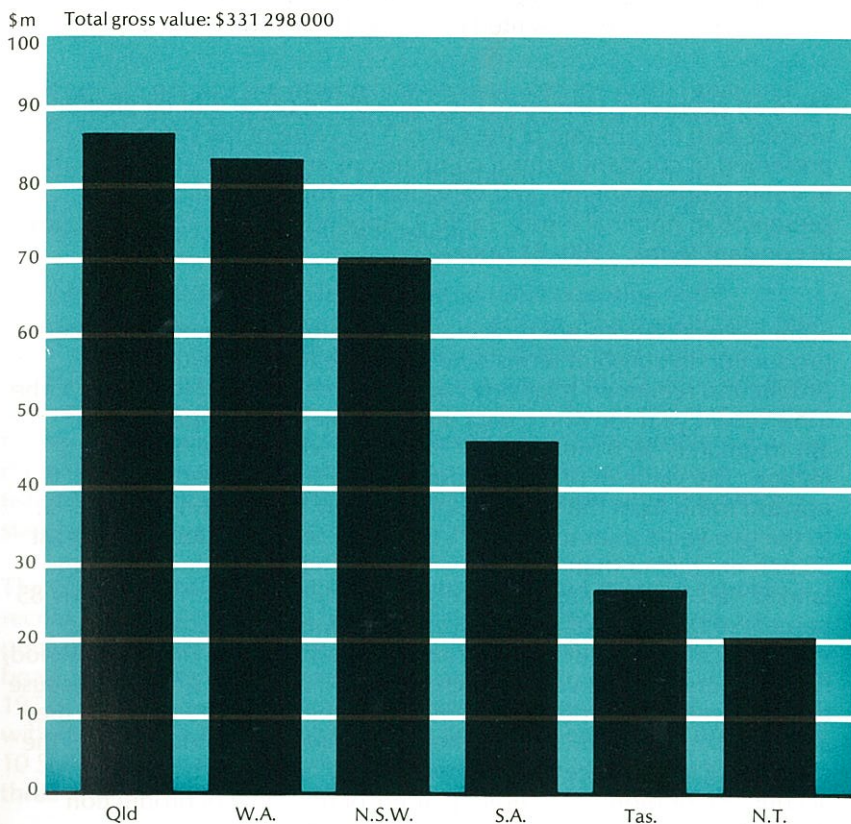
On a state/territory basis, the 1980–81 value of catch is shown in Figure 2 (page 15). (Victoria is excluded, but it is estimated that production in that state was worth approximately \$30 million: see Appendix B, Table 3.) Nearly 50 percent of the Queensland catch is estimated to have been caught in the Reef Region.

Statistics for one year do not necessarily tell the whole story, because catches and prices fluctuate. Further consideration has to be given to the trend lines in Figure 1, initially to the volume of catch. It is informative to consider some of the more important species individually.

In the period 1972–73 to 1981–82, the Australian prawn catch fluctuated from a low of approximately 16 000 tonnes (live weight) to a high of 27 000 tonnes (live weight). The average annual catch for the period was approximately 21 000 tonnes. The Queensland catch over the same period fluctuated from a low of approximately 4 500 tonnes (live weight) to 14 500 tonnes (live weight), with an average of approximately 9 500 tonnes (live weight). From 1976–77 to 1981–82, the prawn catch was relatively static, except for the record year 1980–81. (A detailed break-down of catch by state/territory is found in Appendix B, Table 4.)

Australian fish production over the same period fluctuated from a low of approximately 39 000 tonnes (live weight) to a high of 51 000 tonnes (live weight), with the average annual catch being approximately 45 600 tonnes (live weight). The lowest Queensland catch was approximately 4 500 tonnes (live weight) and at its highest nearly 6 000 tonnes (live weight), with an annual average of approximately 5 200 tonnes (live weight). (A detailed state/territory break-down of catch is presented in Appendix B, Table 5.)

Figure 2: Gross Value of Australian Fisheries Production (a), (b), 1980-81



(a) Excludes value of pearling (b) Excludes Victoria.

Source: **Fisheries Australia**, ABS, Cat. No. 7603.0.

Other than prawns and fish, the other major commercial fishery in Queensland is scallop trawling. The Australian and Queensland scallop catch has fluctuated widely in the past decade. (See Appendix B, Table 6, in which the state/territory catches are presented). In Queensland the catch was at its lowest at approximately 500 tonnes (live weight), and at its highest at approximately 4 000 tonnes (live weight), with an annual average of approximately 2 300 tonnes (live weight).

Summarising the Queensland situation, we obtain the following information: the average annual catch of prawns is approximately 9 500 tonnes; for fish it is approximately 5 200 tonnes, and for scallops it is

approximately 2 300 tonnes. These figures do not represent the total Queensland catch as crustaceans other than prawns and molluscs other than scallops are excluded. (A more detailed break-down of the Queensland catch is presented in Appendix B, Table 7.)

From an economic viewpoint the value of the catch is of far greater interest than the volume of the catch. The value of the catch has to be presented in constant terms if comparisons are to be made. Appendix B, Table 8 brings volume and value figures together, with values presented in nominal terms; Table 9, Appendix B, presents the values in constant terms, 1980-81 prices.

Some generalisations are possible on the value of Queensland fisheries production in constant terms over recent years. The value of fish production remained relatively constant from 1972-73 to 1980-81 (the most recent year for which data are available). The range is from approximately \$6.8 million to \$7.9 million, with an average of \$7.5 million. The value of prawn production has shown a very marked upward trend from the low of approximately \$12 million in 1974-75. In the two years prior to 1974-75 the value of production was at least 50 percent higher than in that year. By 1980-81 the value of prawns landed had reached approximately \$73.1 million, which was nearly 85 percent of the value of all fisheries production in Queensland. The value of scallop production fluctuated widely over the nine year period, though there has been some degree of stability since 1977-78. Because the other minor fisheries are relatively insignificant in value terms they are not discussed here. One of the most obvious facts to emerge is the over-riding importance of the prawn fishery. Since 1976-77 it has accounted for more than three-quarters of the value of production (each year).

How important is the commercial fishing industry in Queensland in terms of value of production? One useful comparison is with other primary industries. Even in terms of the official statistics the commercial fishing industry is a major primary industry. It was estimated in 1980 that fishing ranked behind "heavyweight" industries such as sugar, beef, grains, wool and dairying but ahead of other prominent industries such as tobacco, barley, eggs, peanuts, cotton, pigs and poultry². In certain regional centres the commercial fishing industry (that is, the catching and processing sectors and their associated industries) is an

2. This fact was reported by the Committee to Enquire into Matters Relating to Fish Marketing and the Future of Operations of the Fish Board, in its Final Report (23 January 1981), page 12.

important component of the economy, though no large Queensland towns or cities are primarily fishing ports, and hence reliant on the industry for economic survival. Today, only the small township of Karumba in the Gulf of Carpentaria is first and foremost a fishing town.

Fisheries are not just the product landed but also the boats, gear and fishermen involved. It is necessary to put the Reef Region boats and fishermen into an Australia-wide and Queensland context. But first a warning. There is probably no more frustrating task than that of attempting to discover the actual number of boats and fishermen operating in many of Australia's fisheries.

The official statistics are bedevilled with double counting and inconsistent classification of boats and fishermen. The statistician's task is not made any easier by the degree of mobility of boats and the multiple licensing system caused by Commonwealth/State jurisdictional separation of many fisheries. It seems inevitable that at this stage in the history of Australian fisheries we will be faced with the problem that we do not know the exact number of boats and fisherman in many fisheries. Nevertheless, there is some value in considering the official statistics as a rough guide to the actual situation.

The official statistics on boats and fishermen do not cover the more recent years, with 1978-79 being the latest year for which data are published. In that year there were nearly 13 000 commercial fishing boats in Australia and their estimated value was over \$400 million. From 1972-73 to 1978-79 the number of boats remained relatively constant, with the average number operating in any year being in the order of 10 500 boats. The value of the Australian fleet increased by between three and four fold in nominal terms over that period.

Queensland has contributed between 20 and 25 percent of the total Australian fleet and at the time of writing it is estimated that over one quarter of the Australian fleet can be considered Queensland boats. In terms of value, the Queensland component has been reasonably constant at approximately one quarter of the value of the total fleet. (Appendix B, Table 10, presents the information on the Australian and Queensland fleets and Table 11 presents more detailed data on the Queensland fleet.)

At the beginning of 1979 the Queensland commercial fleet comprised 3 829 boats, excluding any foreign vessels and pearl-shell, trochus-shell and oyster-farming boats. At the time of writing, the number is approximately 3 500 boats. Both of these figures are not accurate accounts of the number of boats fishing in the waters around Queensland. On one hand they are an over-estimate because "tender

boats" are included, on the other hand they are under-estimates as vessels registered in other states or the Northern Territory which fish in the waters around Queensland, particularly in the Gulf of Carpentaria, are not included (unless of course they also hold a Queensland licence). Because of the problems associated with using the above vessel numbers, the author has used other estimates of the fleet size, based on estimated numbers of Master Fishermen. These numbers are discussed later.

There are no statistics for recent years on the number of fishermen in Australia. The total number of fisherman (that is, skippers and crew) was reasonably stable over the years 1972-73 to 1976-77 (the most recent year for which Australia-wide statistics are available), averaging about 18 250 persons. The number in Queensland for the period 1972-73 to 1978-79 ranged from a low of 4 091 persons to a high of 5 417 persons, with the average for the period being approximately 4 500 persons. These figures indicate that approximately one quarter of Australian fishermen are Queenslanders. This percentage corresponds with the proportion of boats which are designated as Queensland based. It can be noted that in terms of employment in fishing, Queensland has ranked second to New South Wales which is the top state. (Appendix B, Table 12 presents data on Australian and Queensland fisheries

Table 1: Estimated Total Number of Primary Fishermen by Type of Fishery: Queensland 1979 to 1981

Type of Fishing	1979	1980	1981
Otter trawling: prawns	1345	1459	1446
Otter trawling: scallops	30	66	43
Beam trawling	102	103	157
Gill netting	337	429	411
Line fishing ^(a)	256	213	279
Beach seining	315	129	130
Mud crabbing	107	80	112
Sand crabbing	63	65	70
Tunnel netting	39	36	42
Spanner crabbing	0	3	22
Other types	41	57	66
TOTAL	2635	2640	2778

(a) Includes mackerel fishing and demersal reef fishing. In 1979 there were 100 mackerel fishermen; in 1980 there were 103 mackerel fishermen.

Source: Hill, B.J., Unpublished, 1983.

Table 2: Estimated Number of Master Fishermen 1979, by Primary Fishery and Home Port within the Reef Region

Home Port	MASTER FISHERMEN BY FISHERY										Total
	Prawn: Otter Trawling	Scallop: Otter Trawling	Prawn: Beam Trawling	Mackerel	Demersal Reef	Netting: All Types	Mud Crab	Sand Crab	Other	Total	
Burrum Heads	3			1		5	1			10	
Bundaberg	51	11	4	9	6	24	6			111	
Gladstone	20	4	1	1	10	4	38	1		79	
Rockhampton	54	10	8	5	8	23	10	2	8	128	
St. Lawrence				1		1	1			3	
Sarina						12				12	
Mackay	23		1	7	31	35	4		3	104	
Bowen, Proserpine	19		1	5	9	36	4		4	78	
Ayr, Home Hill	8		1			21				30	
Townsville	132			21	2	30				185	
Ingham to Cardwell	20		4	2	2	13				41	
Tully						25				25	
Innisfail	21					36				57	
Cairns	274		9	26	9	47			9	374	
Port Douglas to Mossman	40			3	7	10				60	
Cooktown	3			3	5	3	3			17	
Far North Queensland						9	1			10	
TOTAL	668	25	29	84	89	334	68	3	24	1324	

Source: Williams, M. Survey of Fishing Operations in Queensland 1980, Queensland Fisheries Service Technical Report No.2, November, 1980.

Table 3: Estimated Number of Master Fishermen 1980, by Primary Fishery and Home Port within the Reef Region

Home Port	MASTER FISHERMEN BY FISHERY										Total
	Prawn: Otter Trawling	Scallop: Otter Trawling	Prawn: Beam Trawling	Mackerel Reef	Demersal Reef	Netting: All Types	Mud Crab	Sand Crab	Other		
Hervey Bay											
Maryborough											
Burrum Heads	149	61	25	12	13	85	45	6	10		406
Bundaberg											
Gladstone											
Rockhampton											
St. Lawrence											
Sarina	25	0	2	4	22	41	9	0	1		104
Mackay											
Bowen											
Proserpine											
Ayr, Home Hill											
Townsville											
Ingham to Cardwell											
Tully	535	0	9	72	34	174	11	0	16		851
Innisfail											
Cairns											
Port Douglas to Mossman											
Cooktown											
Far North Queensland	0	0	0	0	0	4	0	0	0		4
TOTAL	709	61	36	88	69	304	65	6	27		1365

Source: Williams, M. "Queensland Fisheries Survey Reveals Interesting Trends", *Australian Fisheries*, Vol. 40, No. 12, December 1981.

employment.) Because of some double counting and the inclusion of part-time fisherman, the above figures are at the best only a rough guide to employment in Australian and Queensland fisheries.

The data deficiencies and inconsistencies in the recording of boat numbers suggest that another approach to estimating the Queensland populations of fishermen and boats is warranted. Fortunately there exist data on Master Fishermen (as mentioned previously) and a more accurate picture can be obtained by using those data.

Table 1 below presents the number of "primary" fisherman in each type of Queensland fishery. A "primary" fisherman is one whose first interest is the fishery he is assigned to in the table. A small proportion of fishermen are from interstate; in 1979, there were 93 representing 3.5 percent of the total.

While the number of Master Fishermen does not necessarily convert exactly into the number of boats, it is a reasonable approximation if tender boats are excluded. The figures in Table 1 are used in this book as the best estimate of the size of the Queensland fleet.

Estimating the proportion of these fishermen who work in the Reef Region is an extremely difficult task, because of the mobility of otter trawl fishermen and the difficulty of separating estuarine and river fishing from that undertaken from low water mark. (Mobility is discussed in the next chapter.) A first approximation to differentiating Reef Region fishermen from the other Queensland fishermen is to consider the number of fishermen operating from home ports adjacent to the Reef. This means that beam trawl operators, mud crabbers and net fishermen who fish in rivers and estuaries, which are areas not in the Reef Region, are included. Tables 2 and 3 present this information for the most recent years for which statistics are available.

In Tables 2 and 3 the category "netting: all types" includes gill netting, beach seining and tunnel netting.

Tables 2 and 3 are not directly comparable in some regards, due to the fact that a detailed break-down by home port is not available for 1980. In Table 3 two home ports south of the Reef Region (Hervey Bay and Maryborough) are included. Based on the 1979 figures it can be assumed that if Hervey Bay and Maryborough were excluded, the number of Master Fishermen in the area from Burrum Heads in the south to Rockhampton in the north would be in the order of 315.

If we take home ports adjacent to the Reef Region (Burrum Heads to far north Queensland) as a guide to the number of fishermen operating

in the Reef Region (which means neglecting, at this stage, mobility) some idea can be gained of the percentage of Queensland fishermen working in the Reef Region. The results are: approximately one half of the Queensland population of Master Fishermen can be considered Reef Region fishermen; one half of prawn otter trawl fishermen and net fishermen (all types) can be considered Reef Region fishermen; the majority of scallop otter trawl fishermen (80 percent to 90 percent), the majority of mackerel fishermen (about 85 percent), the majority of mud crab fishermen (in the order of 65 percent to 80 percent), and the majority of demersal reef fishermen (about 60 percent) can be considered Reef Region fishermen; only about one-third of prawn beam trawl fishermen and very few sand crab fishermen (5 percent to 10 percent) can be considered Reef Region fishermen; of the non-specified fishermen about one half can be considered Reef Region fishermen.

These figures help put the Reef Region fisheries into perspective. It is, nevertheless, important to qualify these estimates, as mobility of fishermen take some out of the Reef Region and fishermen with home ports not adjacent to the Reef Region enter it to fish. Mobility is discussed in the next chapter when the specific fisheries are described. The other qualification is that by including all beam trawlers, netting operations and crab fishermen the Reef Region fleet is overestimated.

At this point we will leave the discussion of the commercial fisheries and turn our attention to the non-commercial fisheries.

Section Two: Recreational Fisheries

While it has been possible to put the Reef Region commercial fisheries into a national context, this is not possible for the recreational fisheries. Statistics are not collected on recreational fishing in Australia, other than on an ad hoc basis. This also applies to Queensland.

Nevertheless, there are a few indications of the extent of recreational fishing in Australia which can be used as a rough guide to the importance of recreational fishing in Queensland. For example, it has been suggested that 36 percent of the Victorian population and 30 percent of the New South Wales population participate in recreational fishing. The Victorians are estimated to spend less man-days per annum than New South Welshmen: 17.3 man-days/year as opposed to 22.5 man-days/year (Russell and Saenger, 1981). Another partially helpful statistic is that of the home consumption of fresh seafood by residents in Australian capital cities 16 percent was caught or obtained as a gift. The percent of home consumption caught or supplied as a gift was 33

percent in Brisbane, over double the national average (P.A. Consulting Services and Fisheries Division, Commonwealth Department of Primary Industry, 1978). Bandaranaïke and Hampton (1979) and Bandaranaïke (in press) have reported that in Rockhampton, Townsville and Cairns, over a third of households were engaged in recreational fishing; in inland towns of Mt Isa, Charters Towers, Hughenden and Mareeba, the figure was approximately one-quarter of households; in Brisbane, the figure was 38 percent; and in the coastal city of Bowen, the figure was as high as 71 percent. On the basis of these figures, it could be postulated that participation in recreational fishing in Queensland is at least as important as in Victoria and New South Wales. Queensland's geography, climate and settlement patterns lead one to deduce that it would have the highest recreational fishing participation rate in the nation. This untested hypothesis will have to stand until accurate national and state statistics are collected.

It is somewhat easier to put at least one component of Reef Region recreational fishing into a Queensland context. As stated previously there are two important components of recreational fishing in the Reef Region: fishing undertaken by small groups of individuals, or sometimes just a single person, from privately-owned pleasure craft, and fishing undertaken by generally larger groups of persons from chartered vessels. The third, and minor, component of Reef fishing is that undertaken by guests at Reef tourist resorts. It is easier to put fishing from privately-owned boats into a state-wide context than it is for the other two categories, because in this case reasonably reliable statistics exist.

In 1983 there were approximately 84 000 motorised, privately-owned pleasure craft in Queensland. At the time the research for this book was done the number was about 73 000 and it is this number which will be used for the basis of further description and analysis. It should be noted in passing that the numbers refer to registered boats and it is believed that some number of boats are not registered. The number of registered boats has doubled in the 10 years since 1972 (see Appendix B, Table 13). About one third of these boats are registered in the towns and cities adjacent to the Reef Region. On a per capita basis boat ownership in this area is in a ratio of about 1:28, which is the same as for the Brisbane/Moreton Region. While obviously not all the boats in the Reef Region are used for fishing (pleasure boating and water-skiing are other major uses), it is estimated that close to 60 percent are used occasionally, if not regularly, for fishing trips.

Table 4 presents 1980 statistics on a regional basis on the number of boats used for fishing and non-fishing activities within and outside of the Reef Region. The regions are defined in Chapter Six and are identified

Table 4: Use of Pleasure Craft for Fishing in the Reef Region: 1980

Economic Region	No. of Pleasure Craft 1980	Number used for Fishing in Reef Region	Percentage of Total	Number used for Fishing Elsewhere ^(a)	Percentage of Total	Not used for Fishing ^(b)	Percentage of Total
Rockhampton	8 331	4 440	53.3	1 425	17.1	2 485	29.5
Mackay	4 774	2 597	54.4	955	20.0	1 221	25.6
Townsville	7 469	4 320	57.9	1 740	23.3	1 408	18.9
Cairns	4 700	3 530	75.0	494	10.5	677	14.4
Rest of Queensland	Approx. 48 000	—	N.A.	N.A.	N.A.	N.A.	N.A.
TOTAL	Approx. 73 000	14 887	N.A.	N.A.	N.A.	N.A.	N.A.

(a) For all the Reef Economic Regions this category of use pertains to fishing in inland waters such as rivers, estuaries, lakes and dams.

(b) This category of use pertains to all non-fishing activities, such as pleasure boating, water skiing, boat racing etc.

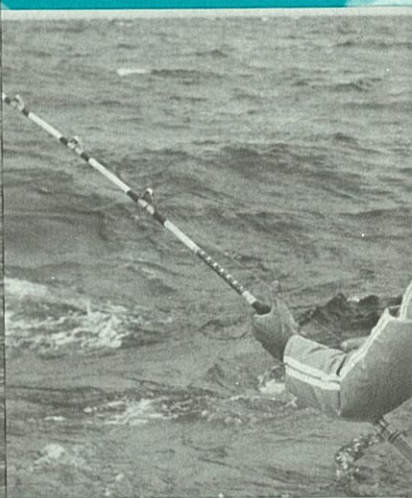
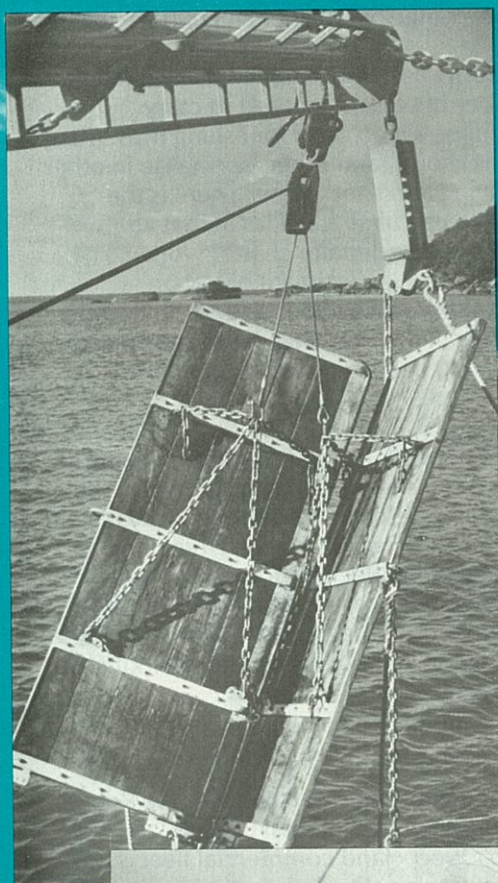
here by the name of the major city associated with the particular region. On average two or three persons per boat engage in fishing. This means that the fishing population is in the range of 30 000 to 45 000 persons.

An accurate estimate of fishing from chartered boats cannot be made. The official statistics on the number of vessels licensed to carry passengers do not reflect the number which cater for fishing trips. Many are ferries and tourist (sight-seeing) boats, and others specialise in other water-based activities, such as diving and snorkelling. There is the additional problem in attempting to calculate statistics in that an unknown number of unlicensed boats undertake charter work. Notwithstanding these data deficiencies, an estimate based on information provided by Harbour Masters can be made of the number of charter boats presently operating in the Reef Region. In recent years it is estimated that approximately 120 boats operated out of ports adjacent to the Reef Region.

The Reef Region is particularly attractive for keen fishermen seeking an extended trip of some days or weeks duration, for tourists visiting the major coastal cities or staying at island resorts and desiring a days fishing experience, and for the sports and game fishermen seeking record catches. One of the features of the Reef Region which has helped put it on the world map is the black marlin sports fishery off Cairns. There is no comparable attraction elsewhere in Australia. These attractions of the Reef play their part in stimulating the tourist industry and hence are of economic importance.

Conclusion

In summary, from geographical and economic perspectives the Reef fisheries are a very significant component of the total Queensland fisheries. About 50 percent of the Queensland commercial fleet is based in home ports adjacent to the Reef Region. On a per capita basis ownership of pleasure craft along the coastal strip adjacent to the Reef Region is the same as for the Gold Coast/Brisbane/Sunshine Coast area.



Chapter Three THE FISHERIES: SPECIES, AREAS, MODES

Introduction

A fishery is usually described as a stock or stocks of fish and the enterprises which exploit them. That is, a fishery is defined by the species sought and fishing methods.



In circumstances where for management reasons a single fishery is divided geographically, the area in which fishing takes place defines the fishery. Another method of definition is by the mode of fishing: a particular stock can be fished by different methods. For multi-species fisheries, such as the demersal reef fisheries, a species-specific definition of the fishery is too narrow. This is also the case with most recreational fisheries, certainly if the fisherman's objective is "to catch whatever is biting". All these methods of description are relevant in describing the Reef Region fisheries, and will be used here. For example, on the basis of species separation the discussion can be in terms of prawn, scallop, mackerel, etc., fisheries. In terms of management regimes the discussion can be in terms of the northern prawn fishery and the east coast prawn fishery. According to methods used, prawn fishing can be separated into otter trawl and beam trawl fisheries. In some cases, multi-species and recreational fisheries can be defined according to the main species sought. In later chapters in this book the Reef Region fisheries will be analysed in a regional context, with the regions defined according to groupings of home ports.

Section One: Commercial Fisheries

The Prawn Fishery

In terms of value of product caught and value of the fleet, the prawn fishery is the most important fishery in Queensland and in the Reef Region.

The prawn fisheries in northern Australia are usually divided into the Queensland east coast prawn fishery and the northern prawn fishery. This can be confusing as the boundaries overlap. The northern prawn fishery is defined as an area from Bowen on the Queensland coast to Broome on the Western Australian coast, and the Queensland east coast prawn fishery covers the entire east coast except for the separately managed area in and around Moreton Bay. The northern prawn fishery as defined is not a management entity, and the species caught in it are not necessarily different from those caught south of its boundaries. It exists purely as a convenient unit for data gathering on landings. Within the northern prawn fishery there is a managed, limited-entry, fishery the so-called Declared Management Zone (DMZ) and the Queensland component of it is entirely within the Gulf of Carpentaria. The Queensland east coast prawn fishery (which includes that part of the northern prawn fishery north of Bowen to the extremity of Cape York, and into the Torres Strait) is a management entity. Since 1979 there has been a freeze on entry of additional vessels. The prawn fishery in the

Reef Region is therefore the same thing as the Queensland east coast prawn fishery, except that the Torres Strait and the area south of Lady Elliot Island are excluded from the Reef Region.

Species Caught

The major species caught in the east coast fishery are: eastern king prawns, blue leg king prawns, tiger prawns, endeavour prawns, banana prawns and coral prawns. The by-product catch includes Moreton Bay bugs, scallops, crabs, tropical rock lobsters and squid. In the Gulf of Carpentaria most emphasis is placed on tiger, endeavour and banana prawns.

Fishing Methods

The predominant method of catching prawns on the east coast is by otter trawling. The other method of prawn trawling is beam trawling. This is mainly confined to south Queensland and under four percent of Master Fishermen in Queensland are beam trawl operators. Only about one-third of the total of beam trawlermen operate out of ports adjacent to the Reef Region.

In recent years there has been an increasing trend for otter trawl fishermen to tow more nets than the traditional one or two, with three or four nets now being more popular. At the time of the surveys for this study most east coast fishermen were using two nets, with about one-quarter towing three nets and only a small number towing four nets. Recent data are not available to show to what extent the trend to use more nets has continued.

Seasonality and Area

Seasonal mobility is an important factor in the otter trawl prawn fishery. In south Queensland (from the top of Fraser Island in the north to the Queensland/New South Wales border in the south), otter trawling is carried out mainly in the summer months. Approximately half the number of trawlermen work this area in June as compared to the peak month of December. In north Queensland the seasonal pattern is reversed. From Bowen to Thursday Island the peak season is the winter months. For the Gulf of Carpentaria, two major peaks occur, one in March/April and the other in September/November where the early peak corresponds with the annual banana prawn season and the latter with the tiger prawn season (mainly around Weipa). For the Torres Strait, July and August are the principal months for trawling. The areas south of Bowen and north of Fraser Island (taking in the major ports of

Mackay, Rosslyn Bay, Gladstone and Bundaberg) show a seasonal pattern intermediate between the areas that bound them on the north and south. The average period worked by otter trawl prawn fishermen is approximately 9 months.

Mobility

Otter trawl prawn fishermen are far more mobile than any other fishermen. While some limit their operations to areas in close proximity to their home port, others will trawl, according to season, along most of the east coast, the Torres Strait and in the Gulf of Carpentaria (if they have entitlements to fish in this area).

Some idea of the degree of mobility can be estimated by reference to the regional analysis of fishing, undertaken in recent years by the Queensland fishery authorities and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). The analyses divide Queensland waters into seven regions: (i) from the New South Wales border to Sandy Cape; (ii) from Sandy Cape to St Lawrence; (iii) from St Lawrence to Abbot Point; (iv) from Abbot Point to Cooktown; (v) from Cooktown to the top of Cape York; (vi) Torres Strait; and (vii) the Queensland portion of the Gulf of Carpentaria (See Map 1, page 31). These are large areas. In 1978 the average number of regions worked per fisherman was 1.9; by 1979 and since the number has been 2.3 regions (Hill, unpublished). Data do not exist for the years prior to 1978.

Since 1979 there have been some significant shifts in the intensity of otter trawling in some areas. Using a crude measure of effort, months worked, it has been estimated that fishing time doubled in Torres Strait between 1979 and 1981, leading to the claim that this area has become a trawl ground in its own right (Hill, unpublished). Originally the Torres Strait area was used primarily by trawlers moving between the east coast and the Gulf of Carpentaria. There were also significant increases in months worked in the Gladstone area and in the area north of Cooktown. On the other hand there was a significant decrease in trawling in the area south of Sandy Cape. These measures must be treated with extreme caution for two reasons. Firstly, they are unweighted measures of effort, paying no attention to the fishing power of the boats or the economic costs of fishing. Secondly, the shifts need not be permanent.

The mobility of otter trawlers makes it extremely difficult to separate fishing in the Reef Region from that in other areas. The problem is most obvious with regard to those boats entitled to fish both on the east coast and in the DMZ.

QUEENSLAND

Areas Used in the Mobility Surveys

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At the time of writing, 203 Queensland trawlers have entitlements allowing them to operate in both the DMZ and on the Queensland east coast. In 1981 it has been estimated that 163 trawlermen worked both areas during that year, and there was nearly equal allocation of time between the two areas, with 47 percent of fishing time spent in the Gulf and 53 percent spent on the east coast, including Torres Strait. (Hill, unpublished) This fact has to be taken into account in the analysis of the economic significance of Reef Region fishing.

It is common for prawn fishermen to engage in secondary fishing operations. Estimations of the extent of secondary fishing have been made by Williams (1979, 1980, 1981). Nearly one half of otter trawl fishermen were operating in other fisheries in 1980. This was an increase on the previous year, in which apparently one third worked other fisheries. It is not clear whether this is a permanent change. Data for previous years are not available. Otter trawling for scallops, particularly in the area east of Bundaberg/Gladstone, is the most common secondary fishing, although line fishing and beach seine netting are also practiced.

Beam Trawling

Beam trawl fishermen usually operate close to their home port. Only about one-third of them are solely engaged in prawn fishing. Net fishing is the main secondary activity for those who work other fisheries. Nearly all beam trawl fishermen are involved in some type of fishing on a full-time basis.

The Scallop Fishery

A trawl fishery for saucer scallops commenced in Queensland waters in the mid-1950s. The major scallop grounds are in the area east of Bundaberg/Gladstone/Roslyn Bay (between latitudes 22°S and 26°S). This means that the fishery extends from the southern-most part of the Reef Region and down to Fraser Island. In other areas scallops are incidental catches. Scallops are caught by typical east coast trawlers. These vessels also trawl for prawns (mainly king and banana prawns) with non-target catches of sand crabs and Moreton Bay bugs. Eighty percent of scallop fishermen are involved in prawn trawling as their secondary fishery (Williams, 1980). Only between one and two percent of Queensland fishermen are primary scallop fishermen, and these all have home ports in the area adjacent to the main grounds.

Scallop catches are made throughout the year with a peak in the latter part of the year. The amount of effort input into the scallop fishery

(measured in boat hours per annum, which is a crude measure) is variable from year to year. One reason for the variable effort is that a number of trawlers move to other areas to fish prawns, particularly in the winter months (Dredge, in press). As discussed in the previous chapter, the annual catch has fluctuated widely over recent years.

The Mackerel Fishery

The mackerel fishery is predominantly centred on barred Spanish mackerel, but other pelagic/schooling species are caught. This fishery has been established for a very long time. Fishing is undertaken by trolling with very small quantities being taken by gill nets. Most fish are caught between the outer edge of the Reef and the coast.

The fish occur from the Gulf of Carpentaria, through Torres Strait, south to the New South Wales border. The largest number of mackerel fishermen are found between Cape Flattery in the north and Cape Conway in the south, though the entire east coast of Queensland south of that area is also important for mackerel fishing.

Adult Spanish mackerel migrate seasonally up and down the east coast. This is an important feature of the fishery with obvious implications for commercial fishing. A significant percentage of fish embark on a southward migration in the late part of their second year or the early part of their third year. This migration commences about December. A return (northward) migration of larger fish occurs during September each year, particularly of fish in their fourth year (McPherson, 1981). These apparent migration patterns have a major bearing on the seasonality of fishing. Most fishing is undertaken in the northward migration and spring spawning season. Significant catches during the southward migration do not occur until the fish reach southern Queensland and northern New South Wales waters.

The majority of mackerel fishermen also engage in demersal reef fishing as a secondary activity. On the other hand, mackerel fishing is a common secondary activity for many other fishermen in most areas of the Reef Region. Mackerel fishermen can range long distances in their search for fish; but most (about two-thirds) limit their fishing to an area associated with their home port and other ports relatively close by. Not all mackerel fishermen are full-time operators, with about 14 percent being part-time fishermen (Williams, 1980).

The Demersal Reef Fishery

Fishing for demersal fishes commonly associated with coral reefs, such as coral trout, sweetlip, cod, red emperor, tusk fish and wrasse is

commonly called "reef fishing" or the "reef line fishery". To save confusion, the term "demersal reef fishing" is used here. This is an old established fishery, frequently undertaken as a secondary fishing activity by mackerel fishermen, and it is a secondary or tertiary fishery for many other fishermen. Fishing is undertaken by handlines, with various breaking strains and a range of hooks used.

Demersal reef fishes are found along the entire east coast, but very few fishermen operate north of Cape Flattery. The majority of primary demersal reef fishermen operate in an area reasonably close to their home port, though some do range far afield. Approximately 12 percent are part-time fishermen (Williams, 1980).

The Net Fisheries

The net fisheries can be divided into (i) beach seine and mesh netting fisheries and (ii) set and drift net fisheries. In terms of number of fishermen involved, the first category is second only to otter trawling for prawns, and the other category ranks next. All net fisheries can be defined as "in shore" fisheries, that is, catches are generally made in coastal rivers and creeks, estuaries, and foreshores extending less than one half a kilometre from low water mark. The major net fisheries involve gill netting for barramundi, salmon, mullet and other estuary fish. (Barramundi is discussed separately below.)

Beach seine and mesh netting are important activities in all areas on the east coast except north of Cape Flattery and in the Torres Strait. Set and drift netting is important along the east coast south of Cape Flattery and in the Gulf of Carpentaria: the major concentrations of fishermen being in the area between Cape Flattery in the north and Abbot Point in the south, and in the Gulf of Carpentaria. About three-quarters of beach seine/mesh net fishermen also work other fisheries, mainly set or drift net fishing and mud crabbing and approximately 80 percent of set and drift net fishermen have mud crabbing and beach seining as secondary and tertiary activities. Most net fishermen work in reasonably close proximity to their home ports. Approximately 10 percent to 11 percent are part-time fishermen (Williams, 1980).

Barramundi

Barramundi deserves a brief, special mention in its own right. It is one of the most popular table fish in Australia, relatively scarce and commanding a higher price than most other fish. Barramundi is distributed widely in rivers and estuaries in tropical and sub-tropical Australia. Its southern most occurrence is the Mary River.

The species occupies both fresh and salt water streams, lakes, billabongs, estuaries and adjacent coastal waters. The seaward limit of distribution coincides with high levels of suspended solids. Barramundi is a catadromous fish, spending part of its life in freshwater and part in saltwater. It breeds in saltwater (estuarine) areas.

The Crab Fisheries

There are three crab fisheries, based on mud crabs, sand crabs and spanner crabs. For fishermen operating from home ports adjacent to the Reef Region mud crabbing is the most important. Most mud crab fishermen operate in the locality from Rockhampton to Sandy Straits (the latter is between Fraser Island and the mainland). Maryborough and Gladstone are the most important mud crabbing centres, though this species is caught along the entire coast and in the Gulf of Carpentaria. There is recent evidence to suggest that mud crabbing is gaining in importance in areas north of central Queensland (Hill, unpublished). Mud crabs are mainly caught in baited pots, though some hooking from burrows occurs. The crabs live in shallow estuarine areas and tidal flats adjacent to large river outfalls. Catches show a marked seasonal trend, with high landings from November to May.

Sand crabbing with pots and dillies is important as a primary fishing activity only from Yeppoon south. Sand crabs are caught in large numbers in otter trawl nets at certain times of the year, but such catches are generally restricted to the south of the state. Spanner crabbing is generally limited to the area south of the Reef Region, mainly out from Mooloolaba.

Mud crabbing is a secondary fishing activity for many other types of fishermen, including sand crab fishermen. Net fishing is an important subsidiary activity for many crab fishermen. Most fishermen operate in close proximity to their home base. Over 90 percent are full-time fishermen (Williams, 1980).

Other Commercial Fisheries

Numerous other fisheries exist in Queensland and virtually all of these are found in the Reef Region as well as outside of it. Some, such as Moreton Bay bug fishing, occur as a by-product of otter trawling for prawns or scallops; while others require specific methods, such as traps, long-lines etc. A short-list of these fisheries is fish trapping (and arrow-head trapping), bait fishing, shark meshing (and long-lining), stripe netting for prawns (in the Maryborough/Hervey Bay area), crayfishing (tropical rock lobster fishing) and oyster farming and gathering. The Japanese exploited tuna fishery and illegal clam fishing also warrant

mention. In addition to the catching or harvesting of seafoods, the list would include the taking of shells and corals for commercial purposes and aquarium fishing.

Leaving aside the Japanese tuna fishing and pearling in the Torres Strait, these fisheries are insignificant in terms of Master Fishermen who primarily are engaged in them. The fisheries are also not significant in terms of value of product landed. For this reason, as well as the lack of sufficient data, they are either omitted from the economic analyses in later chapters, or in the situation where they are secondary or lower order elements of a primary fishery they are included with the primary fishery. Brief descriptions of some of the more relevant of these fisheries follow.

The Tuna Fishery

The existing tuna fishery is a relatively far-offshore fishery operating along the outer edge of the Reef. The species caught are yellow fin tuna, big-eye tuna and other large pelagic species. At present the fishery is mainly exploited by Japanese long-line and pole and line vessels. Investigations are underway to determine the economic feasibility of developing the tuna fishery for Australian fishermen. As the Japanese fleet is excluded from the Reef Region and all Australian fishing so far has been outside of the Reef Region, this fishery is not included in this study.

The Aquarium Fishery

Various small, colourful fishes are found throughout Queensland waters. Many of the species are closely associated with coral reefs. Such include surgeon fishes, anemone fishes, butterfly fishes and wrasses. All Master Fishermen are entitled to collect aquarium fish and as well there are licenced collectors servicing the aquarium trade. At present the level of participation is low, due to competition from low-priced Philippine imports.

Handnets are the preferred method of collection with divers using either snorkels in shallow water or "hookah" in deeper water. Because of the relative economic insignificance of this fishery it is not included in the economic evaluation in future chapters.

The Bait Fishery

Fishing for bait is either undertaken as a necessary prerequisite for trolling and hand-lining by those in these fisheries or as a separate fishery. Mackerel fishermen use seine nets and cast nets in estuaries, off

beaches and in island lagoons, with garfish as the target species. The marlin game fishery (discussed later) uses mackerel and tuna for bait, and fishing for marlin bait coincides with the marlin season between September and December.

The Tropical Rock Lobster Fishery

Tropical rock lobsters (or crayfish) are found throughout the Reef Region. They are located around the base of reefs. There are two methods of fishing: one based on spearing by divers (both free-diving and "hookah" are used) and the other based on trawling by prawn boats. The main commercial exploitation is in the Torres Strait, where both methods are used. In this area divers operating from dinghies work to freezer boats. Recent investigations indicate that there are 14 freezer boats operating and 12 of these undertake some fishing as far south as Princess Charlotte Bay (Phillips, pers com.). Specific target fishing for lobsters by prawn trawlers has only occurred since 1981. Most of the fishing has been done in Torres Strait during the migration of lobsters in September and October. There have been only two large catches of lobsters by prawn trawlers on the east coast, both taken in the vicinity of Cape Weymouth (Phillips, pers com.). On the east coast the fishery is mainly a diver fishery, with the main area extending from Cape York to about Mackay, though the bulk of the catch is reported to come from the area within and north of Princess Charlotte Bay. Both commercial and amateur fishermen are involved.

Coral and Shellgrit Collecting

Coral, shellgrit and shell collecting are commercial activities within the Reef Region. Both corals and shells usually enter the tourist market as jewellery and souvenirs. Only a few licences to collect coral are presently held and useful statistical data on production and sales are not available. The number of coral collecting licences held at the time of writing is 16.

Pearl Shell Culture

Pearling (or pearl shell culture) is one of the oldest fisheries in Queensland. It is mainly a Torres Strait fishery which has provided one of the principal means of employment for the island communities. As it is confined generally to areas outside of the Reef Region and useful data are not available on pearling within the Reef Region it is not considered here.

Past and Potential Future Fisheries

Prior to the Second World War, the northern Queensland east coast waters were exploited for beche de mer, trochus shell and green snails. As early as 1827 beche de mer (including the favoured Chinese aphrodisiac, Heh Hai Sau) were being exported from Cooktown waters to Chinese markets. A beche de mer processing plant was established on Green Island in the 1850s. This fishery had died out by the Second World War as a result of lack of demand from China. There is little likelihood that it will be re-established as a commercial fishery.

The trochus shell fishery (harvesting mother of pearl, particularly for button manufacture) took on commercial significance in the 1920s, reaching peak production in 1927. This fishery also collapsed by the Second World War. Recently, interest has developed in commercial exploitation of trochus shell and limited harvesting is occurring. It is yet too early to predict the successful development of this fishery.

Over recent years there has developed an illegal clam meat fishery in the Reef area. This has been exploited mainly by Taiwanese fishermen. While it is obviously an economic proposition for the Taiwanese, the illegal nature of this activity and the recently increased threat of apprehension should result in the cessation of this fishery. Nevertheless, interest is developing in clam culture, with both the meat and the shells being valuable products.

Other minor fisheries may develop, some utilising the by-catch from trawlers. One presently being developed is use of sea-snakes for snake-skin products.

Traditional Fisheries

Fishing by Aborigines, commonly termed "traditional fishing", does not neatly fit into the categorisation of commercial and non-commercial fisheries. It certainly is not recreational fishing in the sense of sports fishing or fishing purely for pleasure. Nor is it commercial fishing if that is interpreted to mean that the produce has to be sold for cash. Nevertheless, fishing to supplement consumption of foods is closer to being a commercial activity — in a non-cash economy — than a recreational activity. It clearly is an economic activity if the catch is exchanged or distributed; of course, completely non-cash economies are a thing of the past.

Today traditional fishing is confined to areas close to Aboriginal communities. Other than Palm Island, large coastal communities are not found south of Cairns. Not a great deal of documentary evidence

is available on the present traditional exploitation of marine resources by Aborigines. Fishes, turtles and dugongs are hunted. It has been claimed that "many thousands of green turtles are harvested annually by Queensland indigenous people" (Limpus and Fleay, 1983). These days modern methods, such as outboard-powered dinghies, are used to gain easy access to the resources. Strictly commercial ventures do exist in some locations, for example prawn trawling and pearling in the Torres Strait, or are in the process of development (oysters at Palm Island).

Section Two: Recreational Fisheries

In most cases the only practical way of categorising recreational fisheries in the Reef Region is according to fishermen's means of access to their preferred fishing grounds, hence, the separation into a fishery accessed by privately-owned pleasure craft and one accessed by charter boat. One recreational fishery can be treated separately on the basis of species sought. It is the black marlin game fishery based on the city of Cairns.

As stated before, fishing from beaches, rocks, jetties, etc., while technically undertaken within the Reef Region is not included in this book. Recreational fishing undertaken from privately-owned pleasure craft (of an average length of about 4.9m) can be called the "small boat fishery" and that from chartered vessels the "charter boat fishery". The data presented below are based on mail surveys of boat owners.

Recreational Fishing Methods

Most recreational fishing, whether from privately-owned boats or charter boats (excluding game boats) is by hand line. Bait is either self-caught ("lower quality" fish) or bought, with Western Australian pilchards being preferred for demersal reef fishing. For pelagic species the method is trolling, that is running lines from a moving boat. The other usual method of fishing is spear-fishing and the usual location for such is reefs and around rocky outcrops.

The Small Boat Fishery

The small boat fishery extends along the whole east coast, though the amount of fishing done north of Cooktown is insignificant. Numerous factors determine where, and when, recreational fishermen fish. Weather conditions and the size of the boat are obviously important factors. The locality of proven fishing grounds is also important in

deciding where a fisherman will go. Factors not necessarily to do with fishing also determine where and when trips are made. This is because for some boat owners fishing is not the primary reason for making a trip. The main reason can be boating for pleasure, snorkelling, diving, shell collecting or island camping.

It is impossible to generalise with regard to species sought and caught. Some fishermen are content with whatever they catch; in fact some are happy with the experience of fishing even if they catch nothing. There are others who seek certain species, for the table, for sport or for both reasons. A list of species sought and or caught would be extensive. The main ones are coral trout, red emperor, sweetlip, cod, mackerel, trevally, jewfish, barramundi, grunter and bream.

One important point should be made here and that is that not all so-called recreational fishermen are genuine amateur fishermen. An unknown percentage set out to catch fish for "black market" sales. Because it is not possible to differentiate between the true amateur and the so-called "professional-amateur" (often referred to as a "pro-am"), the statistics and analyses refer to all fishermen who fish from privately-owned pleasure craft.

Participation

A slightly different approach to that used for description of the commercial fisheries is required in presenting information on participation by recreational fishermen. In the first instance the concept of a home port is not appropriate. Small pleasure craft are usually towed by vehicle from the owner's home to a boat ramp for launching. Owners can, and do, reside anywhere from near the sea to some considerable distance inland. The equivalent to the concept of a home port is a "catchment area", that is, a geographical area from which pleasure craft are brought to local ramps.

It is useful, particularly in view of the later analyses of the regional importance of the fisheries, to allocate catchment areas to economic regions. The precise definition of regions is left for later; all that is necessary here is to point out that, in a like fashion to the delineation of home ports for commercial fishermen, regions can be defined in relation to major coastal cities and towns which are the launching points for the boats. The first region commences at Burrum Heads in the south and extends to St Lawrence (the Rockhampton region). The second region extends from the latter town north to Airlie Beach (the Mackay region). This is followed by a region extending to Cardwell (the Townsville region); and then one from the latter town north to Cooktown (the Cairns region). It should be noted that so few small boats are owned north of Cooktown that for practical purposes that

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Catchment Areas for Small Boats



town is the effective end of the catchment areas for small boats. The catchment areas for each economic region are shown on Map 2 (page 41).

Mobility

The regional catchment areas are contiguous along the mainland adjacent to the Reef Region. Very few boat owners residing outside of the combined catchment areas take their boats into the Reef Region; the majority who do haul their boats from the south-east corner of Queensland to launching ramps providing access to the southern-most part of the Reef Region. An insignificant number of owners haul their boats on extended trips up the Queensland coast. Because most owners of small boats reside on the adjacent mainland it is relatively easy to estimate the approximate population using the Reef, as was done in the previous chapter (See Chapter Two, Table 4).

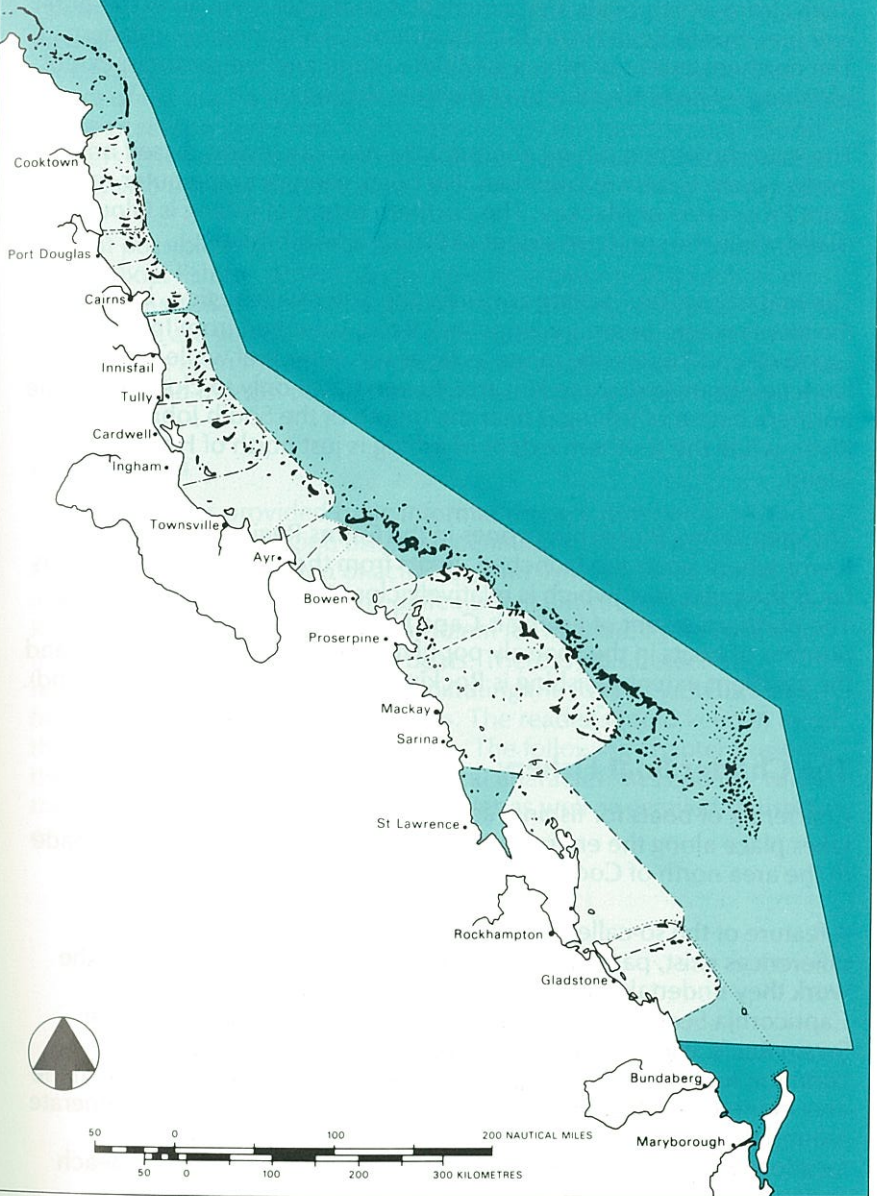
What of inter-regional mobility? This obviously occurs, but not to anywhere near the extent of the commercial fleets. The size and power of pleasure craft limit their ability to travel large distances at sea. Map 3 (page 43) illustrates this. It shows the "usual" area fished from major launching points within the defined regions.

As a general rule, intensity of use of the Reef Region decreases with increasing distance from the coast. This is not unexpected. In all except the Cairns region, over one third of the trips were made within 5 km of the coast: from the Rockhampton region the proportion was 38 percent; from the Mackay region it was 37 percent and from the Townsville region it was 39 percent; in the Cairns region the proportion was a relatively low 23 percent. If trips extending beyond 5 km of the coast are considered, the following statistics apply. From the Rockhampton, Mackay and Townsville regions in the order of 27 percent to 29 percent of boat owners made all their trips further offshore than 5 km. In the Cairns region 42 percent of owners made all their trips to a destination greater than 5 km from the coast.

The average return distance travelled at sea is of some interest. The following figures are based on boat owners' most recent trip (which is the last trip made prior to answering the questionnaire). From the Rockhampton region the average return trip distance was 27 km; from the Mackay region it was 31 km; from the Townsville region it was 37 km; and from the Cairns region it was 51 km.

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Range for Fishing Trips by Recreation Fishermen
(Based on 'usual' place of launching and usual place fished)



Areas Fished

Some discussion on the information shown on Map 3 (page 43) and additional information which is not shown is warranted. The map shows three fishing zones in the Rockhampton region, based on the towns from which boats are launched. Apparently none go to the outer reef (i.e., Swain Reefs) from Rockhampton, Gladstone or Bundaberg. The northern extent of fishing is Middle Island and the southern extent of fishing is Fraser Island (out of the Reef Region).

The map shows two fishing zones for the Mackay region, based on the towns where boats are launched. No boats venture to the outer reef from Prosperine or Mackay. The northern extent of fishing is Gloucester Island while the southern extent of fishing is South Island.

The map shows four fishing zones for the Townsville region, based on the towns where boats are launched. Boats launched from Ingham/Cardwell and Townsville range as far as the outer reef while those launched from Ayr/Home Hill and Bowen travel only to close reefs. The northern extent of fishing is near the mouth of the South Johnstone River, while the southern extent of fishing is just north of Hayman Island.

The map shows four fishing zones in the Cairns Region, based on the towns where boats are launched. Boats from the Cairns region range as far as the outer reef (which is relatively close to the coast in this area). The northern extent of fishing is Cape Flattery (neglecting the small number of boats in the sparsely populated area north of Cooktown) and the southern extent of fishing is Rockingham Bay (south of Dunk Island).

The Charter Boat Fishery

Chartering of boats for fishing, as well as for other off-shore activities, takes place along the entire east coast, though not many trips are made in the area north of Cooktown/Lizard Island.

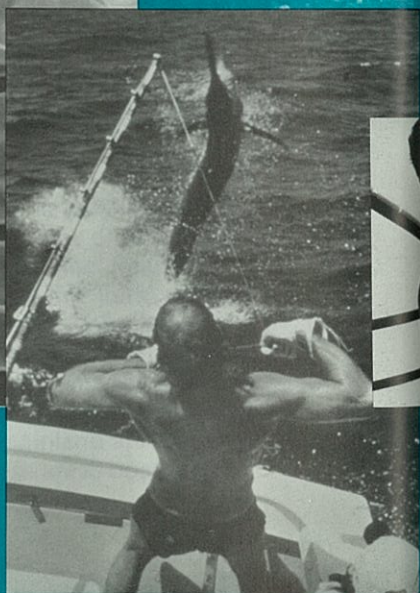
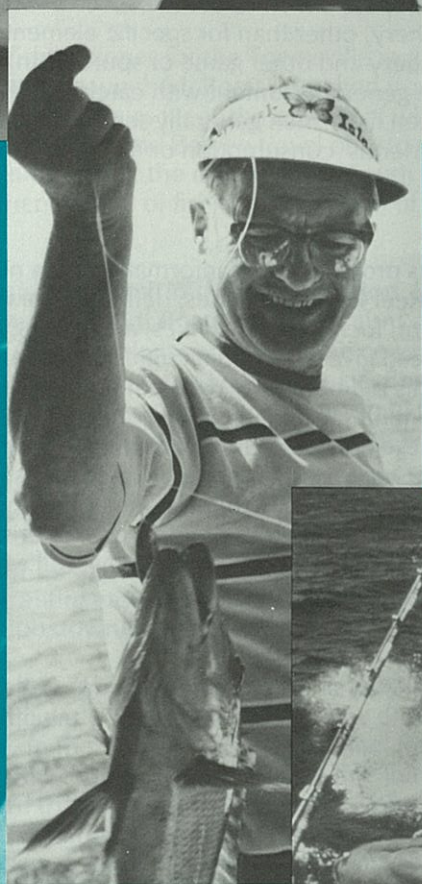
A feature of the so-called "charter boat fishery" is that regional differences exist, particularly with regard to the type of boats and the work they undertake. In the southern area of the Reef Region (the Capricornia Section of the Great Barrier Reef Marine Park) and the Swain Reefs, extended trips (a week or two weeks in duration) are common for people primarily interested in fishing. Further north, in the area centred on Mackay, a large concentration of charter boats operate around the Whitsunday islands. This area is an important tourist location, with holidaymakers staying on the mainland at Airlie Beach and/or at the continental island resorts. In these areas boats are

chartered for many purposes, with scenic tours and pleasure boating being major activities. Nevertheless, the majority of the local charter boats undertake some fishing trips. The next major charter boat centre is at Townsville. Fishing is a minor component of charter boat activity in this area. Day or over-night trips are the most common fishing trips. Cairns is the northern-most major centre for charter boat hire. It is the staging post for the black marlin game fishery and most of the boats are specifically designed and equipped for that purpose. The seasonal nature of the marlin fishery (from September to December) means there is a peak season and some boats have to rely on more general tourist charters in the off-season. A small number of general purpose charter vessels also operate out of Cairns, and day trips for fishing are popular.

It is not possible to say much about the species sought or caught in the charter boat fishery, other than for specific elements of it such as the black marlin fishery and other game or sport fishing activities. Tourists on day trips are generally content with catching fish regardless of the species. The keen fishermen generally seek quality table fish, either for their own and friends' consumption or for "black market" sales.

Conclusion

This chapter has provided basic information on a number of important features of the Reef Region fisheries: definitions of the fisheries in terms of species caught, location of activities, and fishing modes. Some attention has been given to the difficulties in allocating fisheries to the Reef Region. This is a boundary problem for in-shore fisheries and a mobility problem for far-ranging boats. There is no satisfactory resolution to these difficulties in separating the Reef Region fisheries from the rest of Queensland fisheries. The reader should keep in mind the assumptions made in this chapter. The following chapter presents the detailed information on the physical characteristics and the value of the boats engaged in the various fisheries as well as detailed statistics on the number of persons involved.



Chapter Four BOATS AND FISHERMEN

Introduction

In Chapters Two and Three statistics have been presented on the number of boats and fisherman involved in the major Reef fisheries. The description of these fisheries, in terms of the characteristics of the fleets and persons engaged in fishing, is further advanced in this chapter.



It is not possible to present statistics which are completely comparable for each fishery. This is for two reasons. Firstly, there is the obvious different nature of commercial fishing to recreational fishing and, secondly, the amount of data on some fisheries far exceeds that on others. In relation to the second point, it is necessary to aggregate certain fishing modes into general categories so that meaningful statistical data can be presented. Each fishery, or grouping of fisheries, is discussed separately.

Section One: Commercial Fisheries

The Otter Trawl Fishery

The otter trawl fishery includes both the prawn and scallop fisheries. In Chapter Two, Tables 2 and 3, the numbers of Master Fishermen operating out of home ports adjacent to the Reef Region have been given. The number of Master Fishermen is used as a proxy for the number of boats working in the fishery. In 1979 there were 668 Master Fishermen with otter trawl licences and in 1980 there were 709. It was stated in Chapter Two that the mobility of otter trawl fishermen makes it difficult to estimate the number who fish in Reef Region waters. A further complicating fact is that the number of Master Fishermen is not constant over time, nevertheless since the freeze on entry into the east coast trawl fishery in 1979 the fluctuations have not been so significant to cause major statistical problems. There is also the issue of entry, exit and replacement of boats. A fishing fleet is not constant in terms of the physical characteristics of the boats; such parameters as the average length and age of boats (to name but two characteristics) change over time. The data presented below are from the surveys of fishermen in the 1979-80 and 1980-81 years, and therefore the characteristics of boats are as of that period.

If only those otter trawl fishermen with east coast licences are included (that is, those with entitlements to fish in the DMZ are excluded) the size of the fleet at the beginning of 1981 is estimated to have been 485 boats. The regional figures are presented in Table 1.

A figure of 485 boats appears to be reasonably precise: if 200 boats with DMZ entitlements are added to the number of boats with home ports adjacent to the Reef Region the number is 685, which is not markedly different from the numbers quoted above for 1979 and 1980.

Some number greater than 485 boats actually operated in the Reef Region, with the major addition being boats with both east coast and DMZ entitlements; there would also have been a small number of boats

Table 1: East Coast Otter Trawlers with Home Ports Adjacent to the Reef Region: 1981

Region	Number
Rockhampton	129 ^(a)
Mackay	34
Townsville	139
Cairns	183
TOTAL	485

(a) The Rockhampton estimate is for 1979–80 and is probably an underestimation of the 1981 fleet.

with home ports further south in Queensland and interstate boats. Estimation of the actual number in the Reef Region can only be made by taking into account the available, imprecise information on mobility.

In the first instance account can be taken of the split between east coast and DMZ fishing by those boats with entitlements to operate in both fisheries. In Chapter Two information was presented which indicated that in 1981, 163 trawlermen worked both fisheries and that 53 percent of their time was spent on the east coast, but this would include Torres Strait. Converting to boats, this implies that a maximum additional 86 boats could be added to the Reef Region fleet in 1981. Data are not available for the previous year, but it is assumed here that the situation was not different then.

The calculation of the number of Reef Region trawlers is not as straightforward as this. Fishing in the Torres Strait has to be excluded. The available data (Hill, unpublished) show that in 1979, 276 trawlermen worked in the Torres Strait for a total 353 man-months, and in 1981, 283 trawlermen worked there for a total of 740 man-months. These figures can be compared to the man-months worked in the Reef Region waters. As a proportion of Reef Region fishing, Torres Strait fishing was seven percent in 1979 and 11 percent in 1981. With a great deal of reservation, it could be argued that the Reef Region fleet could be reduced by these percentages in those years. This would mean that, assuming the 1981 percentage applied in 1980, the fleet of 485 boats would be reduced by 53 boats. The only other information to assist in this regard is that in the survey of Cairns region fishermen, close to 60 percent did some of their fishing in Torres Strait; that is 110 boats of the 183 boats. If their time was equally divided between Reef Region and Torres Strait fishing, it would be argued that the Reef Region fleet could be reduced by 55 boats. Boats from home ports south of the Cairns

region also fish in the Torres Strait, but as there is no exact data on numbers and duration it is not possible to suggest by how much the Reef Region fleet would have to be reduced. It is possible that the overall result of adding Gulf boats to the Reef Region and subtracting Torres Strait fishing would be a cancelling out of the two influences.

Clearly, estimation of boat numbers in a particular fishery by the process described above is not satisfactory. The situation would be markedly improved with good log-book data, but such does not exist. As it is not possible to resolve the issue of numbers at this point in time, some figure has to be settled on for the purpose of describing the Reef Region otter trawl fleet. The only practical starting point is to accept as a proxy for the Reef Region fleet east coast otter trawlermen with home ports adjacent to the Reef Region; that is, the 485 trawlermen mentioned above. With each operating only one boat the fleet is 485 otter trawlers. In the first instance, the physical and economic characteristics of this fleet will be described. This information will be supplemented by information on the DMZ fleet.

Physical Characteristics

Certain variables are normally used to describe the physical characteristics of vessels. These include length (usually measured as length overall) and main engine power. The average length of Reef Region east coast trawlers was approximately 12.5m, at the time of the surveys. The range of boat lengths was from approximately 7.0m to 17.0m. The average main engine power was approximately 100kw.

The Non-Otter Trawl Fisheries

For most of the analyses that follow in this and future chapters, all non-otter trawl operations are aggregated into one category. This is necessary because the sample sizes are too small for accurate statistical analysis. Much detail is, of course, lost by aggregation, but in meeting the main objective of this study, the analysis of the economic significance of Reef Region fishing, aggregation is necessary. Nevertheless, some disaggregated data can be presented in a few cases.

Boat Numbers

The number of Master Fishermen in various non-otter trawl fisheries have been presented in Chapter Two. The population of boats at the time the surveys were undertaken differs marginally from this number. Population numbers were obtained from (then) QFS at the time the surveys were planned. The Rockhampton region was surveyed in 1980

and the population was estimated at 140 boats. The other regions were surveyed in 1981, and the populations were estimated at: Mackay, 106 boats; Townsville, 149 boats; and Cairns, 195 boats. By adding the 1980 Rockhampton region figure to the 1981 numbers for the other regions a total of 590 boats results.

Mobility of these boats does not cause the difficulties that arise with otter trawlers. The 590 boats can be considered to be the Reef Region fleet, recognising that any fishing in estuaries and rivers by these boats is technically outside of the Reef Region and that in the southern area of the Reef some boats from southern ports would do some fishing in the Reef Region.

Physical Characteristics

Boat lengths for the non-otter trawl fleet cover a wide range. The average length for all types was approximately 7.5m in 1981. At the lower end of the range were boats not much longer than 3m, and at the higher end were boats of approximately 14m. The very small boats were what might be called "land based" operations, in which fishermen tow small dinghies to beach netting or crabbing areas. Many mackerel trolling, demersal reef fishing, and far-ranging netting and crabbing boats were at the higher end of the length range. Mackerel fishermen generally operate with one or two dories from which they troll, using the main boat as a base. Likewise, demersal reef fishermen operate with dories. Net fishermen operating from relatively large boats have one or two dinghies for setting and clearing nets, as do crab fishermen.

The engine power of the main boats also covers a wide range. In 1981, some very small land based boats had engines of no more than 6kw power, but at the other end of the range were boats with engines of over 200kw. The average engine power was 54.5kw.

Attention is now turned to the value of the fleets. The values are for boats plus normal equipment.

Value of Otter Trawlers

The Reef Region otter trawl fleet (as defined here to comprise 485 vessels in 1981) was worth in the order of \$44.6 million in 1981. In 1982 values, this converts to \$49.5 million. These amounts represent estimated market values. If account is taken of (i) fishing in the Reef Region by DMZ boats, and (ii) fishing by the so called Reef Region fleet in Torres Strait, the value of the otter trawl fleet fishing in the Reef Region would be higher — even if the fleet size is assumed to remain

at 485 vessels. This is because the average DMZ boat is worth more than the average east coast boat.

As it is not the average DMZ boat which trawls in the Reef Region, to use its value is to overstate the value. The average DMZ boat had a market price of approximately \$364 600 as of late 1982, early 1983 (Hundloe, 1983). The smaller DMZ boats (15.6 metres to 17.6 metres), and these are the ones more likely to do some trawling in the Reef Region, had a market value at the same time of approximately \$213 700 (Hundloe, 1983). This can be compared to the average value of the east coast boats, approximately \$102 000 in 1982 values (\$92 000 in 1981 values).

As stated before, it is not possible to determine the actual size of the otter trawl fleet operating wholly within the Reef Region; therefore the fleet value of \$44.6 million in 1981 (and \$49.5 million in 1982) must be considered a very conservative estimate of the fleet's value.

Value of Other Boats

The fleet of 590 boats, estimated to have operated in all the non-otter trawl fisheries, was worth in the order of \$11.7 million, in 1981 values. If converted to 1982 values, the figure becomes \$13 million. Again, these figures are estimated market values.

The Total Fleet

By summing the two components of the Reef Region fleet, the total value was \$56.3 million, in 1981 prices, and converted to 1982 values it was \$62.5 million. This is approximately half the value of the entire Queensland fleet. The conversion to 1982 values reflects nothing more than the inflationary change in money values. It is the fleet at the time of the surveys which is being described and not the fleet in 1982, which may have changed in terms of total boat numbers and the physical characteristics of the average vessel. More detailed data on the physical characteristics and values of the fleets are presented Appendix C, in Tables 2, 3 and 4.

The Number of Fishermen

A fishery is not only marine resources and vessels. It also includes the fishermen. Queensland fisheries, other than the Gulf of Carpentaria, can be described as "owner-operator" or "owner-skipper" fisheries. This means that the boat owner is a working fisherman and not someone who contracts an employed skipper. Queensland east coast, and Reef Region, fisheries are dominated by owner-operators.

Company fleets do little fishing on the east coast, preferring instead the Gulf of Carpentaria, though it should be noted in passing that both Townsville and Cairns are the home bases and administrative centres for two of the major companies operating in the Gulf. There are some small private company and partnership fishing enterprises operating in the Reef Region, but the general principle of owner-fisherman prevails.

What number of persons are involved in commercial fishing? At this stage we are only interested in those directly engaged in catching fish, prawns, etc. The shore-based, indirect employment in processing, gear supply, repairs and maintenance etc., is dealt with later. The following numbers are calculated by including the skipper with the crew. It does not matter, for present purposes, whether the skipper is the owner or employed. For the otter trawl fisheries the most common number of persons normally working on one boat is two. The number ranges from one (a skipper with no crew) to five persons. For the other fisheries the most common number is one person, though the range is again one to five people, with the type of operation being the key factor determining the actual number. The average is just under two persons per boat.

On the basis of these figures, the total number of persons gaining employment in the Reef Region otter trawl fishery would have been just over 1 000 persons in 1981 and a similar number would have been engaged in the other fisheries, giving a total of 2 000 persons. This was about half the Queensland total.

Not all these people were in full-time employment in the fisheries; in fact, commercial fishing provides a high proportion of part-time employment. It was not possible to obtain precise information in the surveys of periods of employment in the fisheries, and such information is not available from other sources. On the basis of what is known about the periods of employment it appears that the 2 000 persons engaged in fishing in 1981 would convert to about 1 500 full-time equivalents.

Section Two: Recreational Fisheries

It is not possible or practical to describe the recreational fisheries in the same manner as the commercial fisheries. It is not possible to write of employment in fishing by recreational fishermen, though it is possible to discuss employment in manning charter boats. It is not necessary, or that practical, to describe the small boat component in terms of market value of boats. It is unnecessary because a boat is not a capital item which has to earn a return as is the case with a commercial boat. (This concept is discussed in a future chapter.) It is also not practical to

describe small pleasure craft in terms of their market value, for the reason that many owners cannot provide an accurate estimate of market values, but they do know what they paid for the boats. These boats are therefore valued at their purchase price.

As previously stated, the recreational fisheries are separated into the small boat fishery and the charter boat fishery. Certain general statistics of these fisheries have been presented in previous chapters and they are repeated here before presenting more detailed data.

The Small Boat Fishery: Boat Characteristics

The Reef Region fleet of small pleasure craft comprised 14 887 boats in 1980. The average length of these boats was 4.9m. Lengths ranged from miniscule boats of under 3m to large boats up to 20m. The most common (modal) length was approximately 4m. While boats smaller than the average length can, and did, travel to the Reef proper (particularly where the Reef is relatively close to the mainland), as a general rule most boats taken out to the Reef proper were at least 4.9m in length.

Other than boat length, the most important physical characteristic of boats is engine power. In this case the range was very wide: at the lower end were tiny outboard motors of the 2.2kw, 3.7kw or 4.8kw class, through to very large dual outboards and inboards with a total power of approximately 224kw. The average power was 49kw.

In contrast to commercial fishing boats, which are all equipped with the appropriate gear and storage facilities for their operations, fishing gear and storage equipment are separate items for the small boat fishery. The variety of fishing gear used is too great to describe in any detail here, but includes rods, handlines, nets, pots, tackle, knives etc. Fish storage equipment is either built-in refrigeration or loose, insulated containers, such as "esbies".

The value of boats in this fishery was approximately \$80 million. This includes expenditure on motors, trailers, electrical equipment (such as, radios and sounders) and fish storage equipment. As stated above, this figure represents purchase price, that is, the cost at the time of purchase. It can be put into some perspective by consideration of the age of boats. Over 50 percent of boats had been purchased since 1977. (The survey was conducted in October 1980). In 1979, over \$17.5 million (in 1980 values) was expended on boats and equipment for this fishery. In 1982 values this figure is \$21.6 million. If the same amount was spent in 1978 and 1980 as in 1979, the total expenditure for the three years would have been \$52.5 million (in 1980 prices). While these

figures help put the historic cost of \$80 million into some sort of perspective, they do not clearly suggest what the market value of the fleet was. The actual value would depend on the age of boats, the extent to which they have been used and maintained (that is, the depreciation of the boats), the rate of replacement of existing boats and demand conditions. With adequate data on these variables, and taking into account the change in money values, an estimate of market value could be made. Sufficient data are not available for some of the variables to make this estimation. In the circumstances, a value of \$80 million (as at the end of 1980) can serve as a guide to the value of the fleet. In these terms, the average boat would be worth approximately \$5 400. Converting to values for the end of 1982, the fleet would have been worth nearly \$100 million and the average boat nearly \$6 700.

To complete the picture, expenditure on fishing gear needs to be considered. Boat owners estimated the worth of their gear at approximately \$4.75 million. This amount, at least, can be added to the value of the boats. (In fact, fisherman other than the boat owner would have some gear, but this is not included.) The average value of fishing gear was \$319.

The Small Boat Fishery: Participation

On average there were 2.6 fisherman per boat. This means total participation was approximately 38 700 persons. Some boats took only one fisherman, and the highest number was 5 persons.

Such participation rates do not suggest how much fishing effort was involved. The number of trips and the time spent have to be taken into account. The average number of trips within the Reef Region during the year was 13.2 trips giving a total of nearly 200 000 trips for the year. The average time spent fishing per trip (with "lines in the water") was 6 hours.

The Charter Boat Fishery

The charter boat fishery is the most difficult one to describe in terms of numbers of boats and fishermen. There are two major reasons why this is so. Firstly, there is a problem in separating fishing trips from other charter activities. Some vessels, such as those working the Cairns-based game fishery, are mainly operated as fishing boats, but others, such as many in the Whitsunday area, are largely engaged in ferrying people to islands and sightseeing cruises. There are also charter trips in which a mix of activities, including fishing, take place. To the extent possible, fishing has been separated from other activities in the data presented

below. The other problem arises because of the dynamic nature of the charter boat industry and the difficulty of obtaining accurate statistics on the number of boats participating. The charter boat fleet has grown over recent years and should continue to grow, but not necessarily at a predictable rate. The dynamic nature of this industry is most evident at a regional level, with new services commencing operations in a particular location, in anticipation of tourist demand, only to be relocated elsewhere as a consequence of changed circumstances. The data presented below should be interpreted in light of the above and the fact that the information on charter boat fishing was gathered on a regional basis in different years during the period 1979 to 1981. Consistent with the treatment of the other fisheries, the charter boat fishery is separated into economic regions and, as with commercial fishing, the usual home port of boats is used to allocate them to the regions.

The Number of Boats and Participation

At the time of the surveys, it is estimated that approximately 120 charter boats operated out of the ports adjacent to the Reef Region. The regional breakdown is presented in Table 2. These figures are of limited use in describing the fleet as there was a wide range in the types of boats (for example, game boats, dive boats, ferries, etc.) operating. The value of the fleet in the period 1980 to 1981 is estimated to have been approximately \$30 million. This is an imprecise estimate and cannot be taken to represent investment solely for fishing charters. The following brief discussion elaborates on the information in the table.

From the Rockhampton region home ports (Bundaberg, Gladstone and Rosslyn Bay), 10 vessels worked regularly in 1980. Their major areas of operation were around the cays and reefs of the Capricornia Section of the Great Barrier Reef Marine Park and the Swain Reefs. As these areas are a considerable distance from the coast, fishing trips are usually for

Table 2: Charter Boats Operating in the Reef Region by Region

Economic Region	Number of Boats in Recent Years ^(a)
Rockhampton	10
Mackay	60
Townsville	10
Cairns	39 (including 7 "mother ships")

(a) The Rockhampton region figure is based on 1980 estimates. The Mackay region and Townsville region figures are based on 1981 estimates. The Cairns region figure is based on 1979 estimates.

extended periods of some days. The average fishing trip is about 4 days but the average disguises the fact that about one third were of approximately one weeks duration and the remainder about half that duration. To undertake charters of this nature, the boats have to provide overnight accommodation and other facilities suited for small parties of fishermen. The number of fishermen per boat ranged from six to 12 persons: the average was eight persons. The type of fishing was primarily line fishing for demersal reef fish. The total number of person-days in 1980 was approximately 16 000.

In the Mackay region, charter boat activity is somewhat different from that in the other areas. Much of the activity is related to the tourist industry centred on the Whitsunday islands and Airlie Beach/Shute Harbour. In 1981, 60 charter boats operated out of the ports of Shute Harbour and Mackay, but only 47 of these boats undertook some trips where the primary activity was fishing. Fishing was a secondary activity in many cases. The duration of the average fishing trip in this area was about 2.5 days (where fishing was a primary or secondary activity) and the average number of persons per boat was 10 for primary fishing trips and 9 for trips where fishing was a secondary activity. It is estimated that a total of 25 000 person-days fishing occurred in 1981.

In the Townsville region, the majority of charter work originates from the port of Townsville. Of lesser importance is Cardwell, where trips to and around Hinchinbrook Island, Gould Island and the Brook Islands originate. In 1981, 14 charter boats were operating out of Townsville, but four were not being used for commercial charters. Of the 10 boats engaged in charter work, fishing as a primary activity was relatively insignificant, at about 10 percent to 15 percent of their total charter days. Fishing was a secondary activity for a number of trips. In the Townsville area, the average duration of a fishing trip was two days, and the average number of persons per boat was fourteen. Nearly 6 000 person-days fishing occurred in 1981.

As previously mentioned, the Cairns region charter boat fleet is primarily orientated to black marlin game fishing, and the type of boat reflects the requirements of such fishing with respect to speed and big-game gear. Outside of the black marlin season some of the boats are available for other work, some of which is fishing. There are also a small number of what can be termed conventional charter boats operating in this area, but fishing is a relatively minor component of their operations. In 1979, 32 game boats and 7 "mother ships" operated during the marlin season and a lesser number worked in the off-season. It has been estimated that 8 000 fishing person-days were undertaken in 1979 (Owen, unpublished). The Cairns based game fishery warrants attention in its own right.

The Game Fishery

Game fishing is undertaken from a number of coastal cities and island resorts in Queensland, from Moreton Bay to Lizard Island. With the development of a tourist resort on the tip of Cape York it is anticipated game fishing will be undertaken there. Predominant as a game fishing centre is the city of Cairns. In other areas intensive game fishing is only associated with tournaments, usually held annually. Because of the relative insignificance of game fishing in areas other than the Cairns region, only the latter is of consideration here.

Recognised game fish include the billfish (black, blue and striped marlin, sailfish, spearfish and broadbill), tunas, mackerels, and sharks, as well as certain inshore species. In the Reef Region the interest is generally in the marlins, tunas, mackerels and sharks. The major attraction is the black marlin.

The Cairns based black marlin fishery had its origins in the late 1960s. In 1966 just one game boat was working out of this port. In 1982, there were 39 boats plus 3 or 4 mother ships operating in the peak period, or high season, which is approximately 100 days commencing in mid-September. Not all these boats were registered charter boats, with about one half being private boats catering for the owner and friends. The number of boats varies from year to year. They come from as far afield as Western Australia, Sydney, Brisbane and other coastal Queensland areas such as the Whitsunday area and Townsville. The mother ships, which operate as floating hotels for fishermen, also come from southern ports.

The game fishing boats can be divided into two types, "day boats" and "live-on boats". The first category are not permitted to accommodate anglers overnight and must either return to port or tie up to a mother ship. A typical day boat is about 11.5 metres to 12 metres in length. Approximately two-thirds of the fleet is in this category. The live-on boats are larger, about 18 metres or longer in length. They are so-called because anglers are accommodated overnight. The mother ships are, as stated, floating hotels, providing accommodation, dining and bar facilities and are capable of meeting other entertainment and relaxation needs of wealthy fishermen. A mother ship would have two to three game boats working to it.

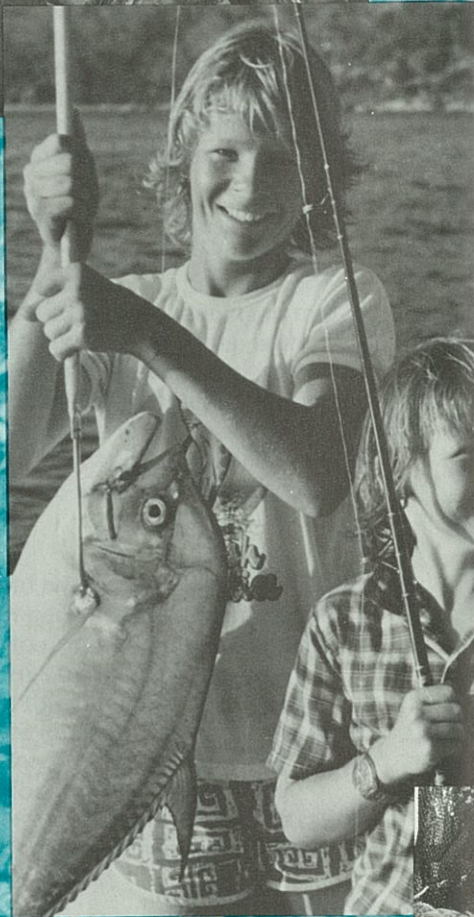
During the off season, some of the owner-operated game boats engage in light-tackle fishing. Some of the boats worked by paid skippers do other charter work. As a general rule only about two to three boats work throughout the year.

Employment

In contrast to the small boat recreational fishery, the charter boat fishery does provide direct employment, to skippers, crew and shore-based support staff. The total direct employment for the Reef Region was in the order of 240 persons, at the time of the surveys.

Conclusion

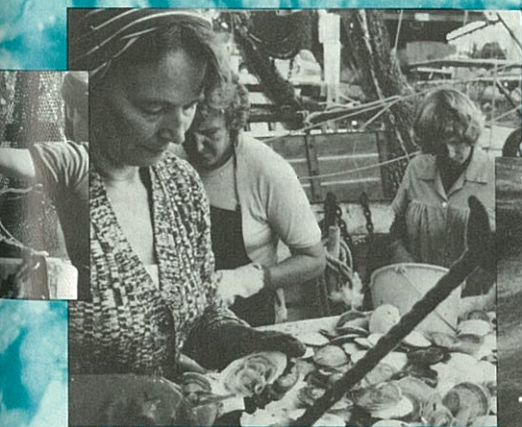
This chapter has provided information on a number of important features of the Reef fisheries: the numbers of boats involved and their basic physical characteristics and monetary value, and the number of people directly associated with the individual fisheries. What has not been dealt with is the volume and value of the catches and the costs associated with taking these catches. These features of the fisheries are discussed in the next chapter.



Chapter Five THE CATCH AND THE COST

Introduction

This chapter presents data on the Reef Region catch and the costs incurred in obtaining it. As the emphasis is on economic characteristics of fishing, most attention is given to the dollar values of the catch and not the quantities (of the total catch or of species).



The differences between commercial and recreational fishing are explicit in this regard. Notwithstanding the fact that the recreational catch would be of significant value if sold, it is generally not marketed. As pointed out previously, some, unknown, proportion of the recreational catch is sold and if the volume were known it would be useful to divide the recreational fishery into a genuine amateur fishery and a commercial fishery. The genuine amateur fisherman seeks a different product to the commercial fisherman. The "fishing experience", of which catching fish is only a component, is the product sought, and paid for, by the genuine amateur.

The difference between the commercial and recreational fisheries means that income and expenditure data will be presented for the former and only expenditure data will be presented for the small boat fishery while the charter boat fishery will be treated as a tourist business. It is possible, particularly for the small boat fishery, to present information on the quantity of the recreational catch, and this is done. It is a different matter for the charter boat fishery: the diversity of the fishery and the lack of data are as frustrating in this matter as they have been in other regards.

Section One: Commercial Fishing

The commercial fisheries are discussed in terms of the value and quantity of the catch and the costs of fishing. The Reef Region fleet (as defined previously) is firstly treated as a whole. It is then separated into the otter trawl and "other fishing" categories and finally into its regional parts.

The value of the catch is the starting point. Data were not gathered in the surveys on the quantity of the catch. This was for two very good reasons; first, such data would have been superfluous in meeting the essential objective of this study (an analysis of the economic significance of the Reef Region fisheries); and, second, it would have been impractical to expect fishermen to provide such data — even if they could. It is possible, though, to estimate the quantity of the catch on the basis of the value of the catch, and this is done.

The following data are from the surveys of commercial fishermen undertaken in 1980 and 1981. By its nature economic data on income and costs have to pertain to a past period. The most recent data available are for the financial year preceding the surveys.

An important practical and theoretical problem arises with the study of any industry subject to economic fluctuations. Most fisheries fit into this

category. The issue faced was to determine how many years data would be necessary to adequately describe the economics of the fisheries. It has been pointed out that the surveys of fishermen on which this book is based were the first ever done for the Reef Region fisheries and furthermore log book data did not exist. That is, there was no historical information, certainly of a detailed nature, available. If the most recent year was a typical year, data for that year would suffice. But what is a typical year in a fishery? If a fishery is fully developed and if the amount of physical effort is reasonably stable, it is easier to define a typical year than if the fishery is still developing. But other factors are also relevant, the most important being price fluctuations for the catch and increasing real costs. Fluctuations in prices (for product sold and inputs) can be permanent or seasonal oscillations. In recent years two changes have been noticeable and permanent. Firstly, in real terms the value of Queensland catch has increased: this is most notable in prawn production. (See Appendix B, Table 9.) The second is the increase in fuel prices. These facts should be kept in mind when considering the approach adopted. The usual way of attempting to account for fluctuations is to gather data for a number of years. This was the approach, with some exemptions, adopted for this research. In most cases data were collected covering the three year period immediately prior to the date of the surveys.

Value of the Catch

The Reef Region fleet (as defined previously) caught product valued at approximately \$26.6 million in 1979–80. (For comparison with other data presented this figure can be converted to 1982 values of \$35.9 million.) For the three year period 1977–78 to 1979–80, the average annual catch was worth approximately \$27.8 million in 1979–80 values.

There are insignificant differences between the 1979–80 value and the three year average. This fact warrants some scrutiny. The value of production for Queensland as a whole can be used as the yardstick. The three year average was approximately \$57.6 million in 1979–80 values and the production in 1979–80 was \$62.8 million. Again, there is not a significant difference. The three year average is lower because the value of production in 1977–78 was considerably lower than that for the following two years, which were both approximately the same (see Appendix B, Tables 8 and 9). If the value of production by the Reef Region fleet was to be in line with that of the Queensland fleet, the former's production in 1979–80 would have to be marginally higher than the three year average, but this is not the case. The available data do not suggest any explanation for this apparent inconsistency. The differences are relatively insignificant and need not concern us here.

The earnings data can be separated into the amount earned by otter trawlers and that by other commercial boats. The otter trawl component was approximately \$20.5 million in 1979–80. This figure relates to the prawn, scallop and incidental catches of otter trawlers. The other boats, which encompass all the other Reef Region fisheries, caught product valued at approximately \$6.1 million in 1979–80. The data are presented on a regional basis in Table 1; the data pertain to boats with home ports in the defined regions and do not imply that the product was necessarily caught in waters adjacent to the home ports. Table 2 presents the three year average data.

The data indicate that the Reef Region fleet caught between 42.3 percent and 48.3 percent of the Queensland catch in value terms depending on whether the calculation is based on one year or the three year average. Because precise data on the composition of the catch are not available it is only possible to indicate the relative proportion of the various species caught by the Reef Region fleet in order of magnitude terms. At least 40 percent of the prawn catch and over two-thirds of all other species (as a group) were taken by the fleet.

The income data should be considered a conservative estimate of the value of catch. For the purpose of the analyses which follow in this chapter and the next, the average for three years will be used rather than the 1979–80 figures.

Volume of Catch

While data were not gathered on the quantity of the catch, it is possible to arrive at a reasonably accurate estimate using the value as a proxy for quantity. The total Queensland catch averaged approximately 18 000 tonnes (live weight) for the three years 1977–78 to 1979–80, and it was marginally greater than 17 600 tonnes (live weight) in 1979–80. As stated, the Reef Region fleet caught between 42.3 percent and 48.3 percent of the Queensland catch in value terms. If the volume of the catch was proportional to the value, the fleet would have caught between 7 600 tonnes and 8 700 tonnes (live weight). (See Appendix B, Table 8 for Queensland catch.) It is not possible to present reliable figures for the various species; nevertheless, the prawn component would be in the order of 4 500 to 5 000 tonnes (live weight), with the remainder comprising all other species.

The Costs

In considering the costs of catching approximately \$27.8 million (three year average) worth of product, a distinction has to be made between the financial costs and the economic costs to the fishermen. Financial

Table 1: Value of Commercial Catch 1979-80

Region	Otter Trawlers \$	Other Boats \$	Total \$
Cairns	8 332 356	1 492 725	9 825 081
Townsville	4 007 370	1 614 415	5 621 785
Mackay	1 093 542	1 589 258	2 682 800
Rockhampton ^(a)	7 069 062	1 400 938	8 470 000
TOTAL	20 502 330	6 097 336	26 599 666

(a) Based on 1978-79 catch, adjusted to 1979-80 values.

Table 2: Value of Commercial Catch: Average for Three Years in 1979-80 Prices

Region	Otter Trawlers \$	Other Boats \$	Total \$
Cairns	9 508 863	1 280 565	10 789 428
Townsville	5 044 449	1 388 978	6 433 427
Mackay	687 820	1 400 366	2 088 186
Rockhampton ^(a)	7 069 062	1 400 938	8 470 000
TOTAL	22 310 194	5 470 847	27 781 041

(a) Based on 1978-79 catch, adjusted to 1979-80 values.

costs are those expenditure items used for taxation accounting purposes. They include crew payments, fishing operating costs (for example, fuel and repairs), business costs (for example, harbour dues, licences, boat insurance), depreciation, interest on borrowed funds, plus a variety of other, generally minor, costs associated with a fishing enterprise. Economic costs differ from financial costs in that they should reflect the "opportunity costs" of the labour, managerial skill, and physical resources used. This concept can be easily explained by the way of two very important examples. Owner-operators (and virtually all the Reef Region fleet fits this category) do not, in most cases, pay themselves a salary for their work as skippers and managers of their business. They, of course, expect to earn sufficient income from fishing to keep them in the business. If they do not earn a desired level of income from fishing they would consider leaving the fishery. One factor

that would enter into their considerations would be the level of income they could obtain in their next best alternative occupation; for example, for any one otter trawler operator (but obviously not for the full complement) a feasible alternative would be to work as a contracted skipper on a company-owned boat which means the opportunity cost for an owner-operator is the amount he could earn as a paid skipper. The other example pertains to the return on investment. A fisherman's boat is his capital, and he would hope to achieve a "normal" market rate of return on his capital. For example, if he purchased the boat with his own funds various alternatives would have been open to him, such as placing the money in an interest bearing account or buying into an entirely different business. In the case where a fisherman has borrowed money to purchase his boat, the same principle applies only that in this case the lender can be thought of as the owner of the boat and what he charges in the way of interest should at least equal the return that could be obtained by lending to someone else. These examples should suffice to explain one important difference between financial costs and economic costs — there are other differences — and further discussion of this issue can be left until later.

Initially, the financial costs for the Reef Region fleet can be considered. The data presented are based on averaging the costs for the three years 1977-78 to 1979-80 and are given in 1979-80 values. It should be noted that the three year average does not differ significantly from the 1979-80 costs. In constant prices, the total costs were marginally higher for 1979-80 than for the average of the three years. A particular influence in this regard is the fact that the total fuel bill for the Reef Region fleet increased in 1979-80 by over one-third of the three year average.

Financial Costs

The total financial cost for the fleet was approximately \$21.5 million, in 1979-80 values. The difference between this expenditure and the income of \$27.8 million is \$6.3 million. It is this amount of money which has to be shared among the 1 075 boat owners as "profits" from the Reef Region fishery. This means the average fisherman would have obtained a pre-tax net income of under \$6 000, in 1979-80 values. This average figure hides a considerable amount of information. In the first instance, it is the average for all the types of fishing operations (ranging from otter trawling to beach netters and crabbers) and therefore does not distinguish between the "profitability" of the various fisheries. In the second instance, the average is based on the assumption that all fishermen are engaged full-time in fishing, which is not true. Probably of most interest is the fact that the range of net incomes is wide, with

some operators earning relatively large net incomes and others making substantial losses.

In Table 3 the fleet costs are disaggregated into broad categories. Also given is the percentage each category is of the total cost. These percentages for the fleet as a whole obscure various pieces of interesting information which a disaggregated description would show. Appendix D presents more detailed data, on a regional basis and with otter trawling separated from the other fishing categories.

Economic Costs

For the purpose of subsequent analysis of the Reef Region fisheries it is necessary to adjust the financial costs so that they more closely reflect the true economic costs of fishing.

The concept of opportunity cost has been described and illustrated above. To the extent that it is practical all expenditure items should be measured at their opportunity cost. This approach is adopted in the appropriate circumstances in adjusting the financial cost data. Other types of adjustments are sometimes necessary; for example, if any of the inputs (typical ones in fisheries are boats and fuel) are subsidised (or, for that matter, taxed at a higher rate in that industry than in other industries) account has to be taken of these distortions to what otherwise would be market-determined prices. (The point being here that free markets will result in prices which are optimal in the sense that inputs will be used in their most economically efficient manner.) Factors in addition to subsidies and taxes can result in a misallocation of resources: monopoly control of an industry is one; legal requirements that prescribed technologies (for example, fishing gear) be used is the other. There is no need to dwell on these, or other such influences, here: for two reasons, first, factors such as subsidisation of boats (which is very important in some other Australian fisheries) and monopoly pricing have insignificant bearing on the Reef Region fisheries and, second, in the situation where distortions might be occurring it would be extremely difficult, if not impossible, to ascertain the extent of the effects. The final type of adjustment to financial data relates to the fact that some cost items are arbitrarily set at certain levels by the taxation authorities; a pertinent case is depreciation. Real depreciation, which is a function of numerous variables (for example, the amount of use made of the boat and equipment, the level of maintenance, etc.), can differ from the amount used for accounting purposes. These issues are taken into account, and discussed, in relation to the major expenditure items. Table 4 presents the adjusted cost data for the fleet.

Owner-Operators' Earnings

It has been shown above that the difference between the reported income and the financial costs for the fleet was approximately \$6.3 million, which amounts to less than \$6 000 on average to each fisherman as a payment for his labour, managerial skills and as a return on his capital investment. It has also been stated that it could be expected that fishermen would seek to earn the equivalent of what they could in their next best alternative occupation. With some qualifications this appears to be a sound theoretical proposition. The reported difference between earnings and costs falls far short of what would be a reasonable opportunity cost of labour and management and a "normal" rate of return on capital. This is true notwithstanding the often made claim that fishermen earn a non-material income from fishing and hence do not need to achieve their full opportunity cost earnings. This reward is usually referred to as "psychic income" or "worker satisfaction bonus". It is not appropriate to single out fisheries in this regard, as numerous other occupations can, or do, have elements of psychic income. It is also not appropriate to refer to the existence of psychic income to explain the fact that the average fisherman in most fisheries achieves a low income. The reason for low incomes is the common property nature of most fisheries. This is discussed in the next chapter.

One conclusion which could be drawn from the cost and earnings data presented above is that the reported income of fishermen is lower than that actually achieved. Whether or not this is the case, some adjustment has to be made to the cost data so that it more accurately reflects the economics of fishing. The only practical approach is to impute a salary for owner-operators. To arrive at a reasonable estimate is not easy. There are many factors to be taken into account in determining what a feasible opportunity cost of labour and managerial skill would be. For some fishermen, particularly otter trawler operators, there would be some opportunities to gain employment as contracted skippers on company-owned trawlers. Such opportunities are not unlimited. For fishermen engaged in the variety of other fisheries there is virtually no scope to gain employment as contracted skippers in their present fisheries, which means their next best occupation would have to be in other industries or business undertakings. Any individual's chance of entering a different occupation depends on a host of personal factors, such as professional skills, entrepreneurial ability, age and mobility, as well as the general level of demand for labour. The continuing, relatively high levels of unemployment in the Australian economy mean that for some fishermen the alternative to continuing in the present business is unemployment.

What, then, might be realistic estimations of owner-operators' opportunity earnings? Ultimately, subjective estimates have to be made, taking into account whatever objective information is available, such as income of paid skippers in similar fisheries, wage rates in various industries, and the level of unemployment in the economy. On the basis of what was known about income levels of paid skippers (in the otter trawl fisheries) and general wage rates in 1979-80, the imputed annual earnings for a full-time otter trawler operator were set at \$12 000, and those for the other fishermen at \$10 000 per annum for the purpose of adjusting the financial data. To calculate the total earnings for the Reef Region fleet it was necessary to take into account whether owner-operators were fully-employed as fishermen. Information was gathered on this aspect and the total number of operators were converted to full-time equivalents. In this manner, the 1 075 fishermen in the defined fleet were deemed to be 951 full-time equivalents. Both the earnings and the participation estimates may be over-estimates; and, of course, they are interdependent. The result of these imputations is an addition of \$10.7 million to the total cost of the Reef Region fleet. (See expenditure category "skipper and crew payment" in Table 4.)

Return to Capital

There is quite a substantial investment in the Reef Region fleet. In 1981 values the market value was between \$50 million and \$60 million. In 1979-80 prices (to be consistent with the cost and earnings data), the market value of the fleet was probably in the order of \$50 million. It should be emphasised that it is market value of boats, not purchase price or replacement value, which represents the true value of the capital. This can be understood in the following terms. A fisherman has the option of selling his boat and the money received could be put to other uses, for example, placed in an interest-bearing account or "invested" in another business. In an alternative use it would earn a return to capital, which would be some percentage of the amount of money received from the sale of the boat.

There is no such thing as a normal return to capital, as a variety of factors (an important one being the risk associated with the business) determine that different rates will be earned in different businesses. Fishing, for a host of reasons (the vagaries of nature; the fluctuations in demand for the product; the general, but not universal, lack of price-support schemes for the product; the inherent nature of common property resources; and the physical risks of damage or loss of boats) is a high risk business. It could be argued, therefore, that the rate of

return on capital in a fishery should be higher than the average for other industries. The absence of useful information correlating rates of return to degrees of risk mean that some arbitrary rate has to be selected for the Reef Region fisheries. Of course, a range of rates can be used for illustrative or sensitivity analysis purposes. A rate of return of 10 percent applied to the fleet would mean that in 1979–80, an amount in the order of \$5 million would have needed to have been earned. Calculations based on other rates can be readily made.

To adjust the financial cost data in Table 3 to take into account the cost of the capital involved requires two steps. Firstly, the amount of interest actually paid has to be removed and then a new expenditure category, return on capital, has to be inserted. Interest has been omitted in Table 4. An imputed rate of return has not been added to the table. This is simply because the fleet as a whole did not earn a positive return on capital. In fact, if the total adjusted cost of \$31.3 million is compared to the total income of \$27.8 million, a loss of \$3.5 million results. If the market value of the fleet was \$50 million, a negative rate of return of seven percent was achieved. Even if the imputed owner-operators' income is reduced to \$7.2 million (which means the reported income would be equal to the costs), no return on capital was earned. At \$7.2 million total earnings the average fisherman would have earned approximately \$7 600 for a year's fishing (and this would have been the average over three years) which would appear to be unrealistically low.

Table 3: Financial Costs, Reef Region Fleet: Average for Three Years: 1979–80 Prices

Expenditure Category	Cost (\$)	As a Percentage of Total Costs
Crew Payments	3 989 056	18.6
Food (for Crew)	886 682	4.1
Fuel	3 355 756	15.6
Boat Repairs/Maintenance and Gear Repairs/Replacement	6 404 473	29.8
Boat Insurance	696 136	3.2
Boat Depreciation	2 969 539	13.8
All Other Items (Including Interest, Business Expenses, etc.)	3 172 077	14.8
TOTAL	21 473 719	99.9

Table 4: Adjusted Costs, Reef Region Fleet: Average for Three Years: 1979-80 Prices

Expenditure Category	Cost (\$)
Skipper and Crew Payments	14 701 154
Food	886 682
Fuel	3 355 756
Boat Repairs/Maintenance and Gear Repairs/ Replacement	6 404 473
Boat Insurance	696 136
Boat Depreciation	2 969 539
All Other Items, Less Interest	2 292 962
TOTAL	31 306 702

Boat Depreciation

As stated, depreciation of boats and fishing gear as reported in Table 3 represents the sum allowable for taxation purposes, and in theory the amount used for an economic assessment should reflect real depreciation. Calculation of real depreciation for all boats in the fleet was not undertaken and therefore reported figures will have to suffice as a proxy. This does not appear to distort the cost data, as fortuitously the reported depreciation (as a percentage of adjusted total costs) does not differ markedly from percentages calculated in studies of other Australian fisheries.

Other Cost Items

In the absence of information which suggests that the financial costs for other expenditure items (as presented in Table 3) diverge significantly from economic costs, no adjustments have been made. Fuel and repairs/maintenance of boats, plus gear replacement/repairs are the only major items. The price of fuel to the fishing industry would not appear to be significantly different to that paid by other industries. With regard to repairs and maintenance, the inputs used such as labour and materials, would not be priced differently for the fishing industry than for other industries.

Summary

So far in this chapter data on three aspects of commercial fishing have been presented; the value and volume of the catch, the financial costs of taking that catch, and the economic costs of such. Further description and analyses of the commercial fisheries are left to a following chapter.

Section Two: Recreational Fisheries

Consistent with the earlier treatment of recreational fishing, the small boat fishery is separated from the charter boat fishery. There is also a practical reason for this because for the former fishery there is no direct measure of the value of the fishing experience, but for the latter the payment of charter fees is an observed measure. As emphasised before, the difference between commercial and recreational fisheries is that the product of the former is product sold while for the latter it is the fishing experience. It follows that it is not possible to write in terms of value of the recreational catch.

The different nature of the small boat fishery and the charter boat fishery means that the emphasis varies in the following descriptions. Attention is given to the volume of the small boat catch, but for the charter boat fishery it is the fees paid which are the important factor. On the other hand, the treatment of costs can be along similar lines, notwithstanding the fact that in one case it is private expenditure on running a boat (and associated costs) which is involved, and in the other it is normal business costs which are considered.

One final introductory point is necessary. The data on which the following descriptions are based are different in an important sense to most of the commercial fishing data. In gathering information on catches it is necessary to take into account the difficulty recreational fishermen have in recalling events in the past. Other than for fishing club records, very few fishermen keep records of their catch. For this reason the catch information for the small boat fishery is based on the most recent trip undertaken. Such information is considered more reliable than that for the "usual" trip. The recall problem is not as important when it comes to some expenditure items (such as purchase of fishing gear) but can be for items such as boat fuel. For those items where recall could be a problem the most recent trip information is used. Data over an extended period (such as the three years for commercial fishing) were not gathered for the small boat fishery. In theory it would have been possible to gather data covering a number of years from the charter boat owners. For practical reasons this was not done. In the first instance the dynamic nature of the industry, with new boats entering, others leaving or changing their operational base, would have made it extremely difficult to obtain data from a sufficient number of operators to be reasonably confident about the results. Second, there would have been the difficulty for operators to separate fishing trip information from their other charter work. The approach adopted was to gather data for the most recent year and complement it with any available information for a "normal" year. These points made, the catch and costs information can be presented.

The Small Boat Fishery Catch

The Reef Region fleet of an estimated 14 887 boats caught over 6.5 million kilograms of fish in the Reef Region waters in 1980. If catches outside of the Reef Region are included, that is in rivers, estuaries and other inland water-bodies, the total catch was over 8.75 million kilograms.

In terms of fish caught the Reef Region catch was over 3 million fish. This means the average fish weighed over 2 kilograms. Table 5 presents the catch on a regional basis.

One interesting fact is worth drawing to attention. It is the comparative success rate of fishermen. Overall about 40 percent of the small boat fish catch was taken by the top 10 percent of fishermen. In the order of 80 percent to 90 percent of the total catch was taken by half the fishermen. This situation is generally the case for all regions. Figure 1 (page 74) details the success rate for small boat fishermen. It is clear from the following figure that there are either vast differences in the fishing abilities of fishermen or that catching fish is not as important for some.

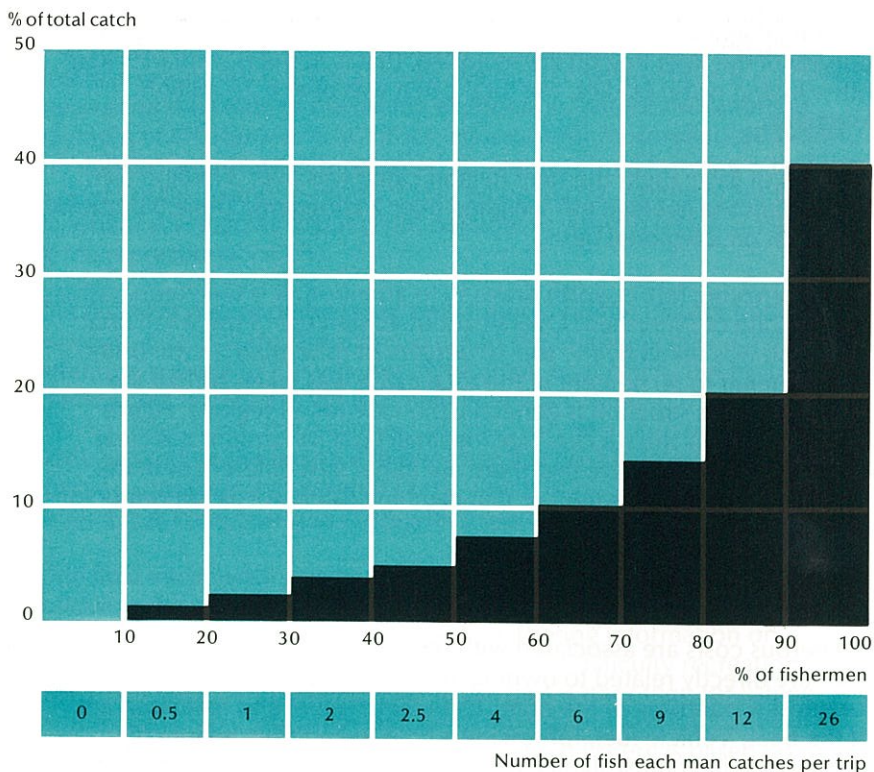
Small Boat Fishing Costs

Numerous costs are associated with recreational fishing. The major ones are directly related to owning and running a boat. First and foremost is purchase of the boat. Then there is fuel and maintenance of the boat. Vehicle fuel, for towing a boat to and from a launching ramp, is the next most significant cost. Fishing gear, bait, boat insurance and licence fees are also major expenditure items. Various other minor items (for example, ice) add to the costs of fishing. There is also considerable expenditure on food and drinks associated with fishing trips, but such expenditure cannot be deemed to be a cost of fishing:

Table 5: Small Boat Catch by Region

Region	Number of Fish	Average Weight (kg)	Total Catch (kg)
Cairns	864 292	2.67	2 308 830
Townsville	818 876	2.30	1 881 383
Mackay	497 793	2.22	1 103 655
Rockhampton	951 442	1.34	1 277 889
TOTAL	3 132 403	2.1	6 571 757

Figure 1: Success Rate for Small Boat Fishermen



it is expenditure which would have occurred anyway. For the total Reef Region fleet of small boats the direct fishing costs (that is, excluding food and drinks) was over \$16 million in the 1980 calendar year.

In any year, in addition to the fishing costs of the existing fleet there will be substantial expenditure on new or replacement boats, motors, trailers, electronic equipment, and fish storage equipment. In the 1979 calendar year (the last year for which detailed data are available), approximately \$18.2 million (in 1980 prices) was spent on these items for the Reef Region fleet of small boats. Expenditure of this nature would be considered investment in capital equipment for a commercial fishery and would not be treated as an annual cost on the same basis as the direct fishing cost items. However, there are regular annual purchases of boats and other equipment by the owners of the Reef Region small boat fleet and these purchases have been consistent from

Table 6: Annual Costs for the Reef Region Small Boat Fleet: 1980 Prices

Expenditure Category	Cost (\$)
Boats, motors, trailers	17 500 233
Boat equipment	748 862
Boat maintenance	4 005 918
Fishing gear	986 037
Boat insurance	909 410
Boat licence fees	742 674
Vehicle fuel	2 382 492
Boat fuel	5 128 231
Bait	1 087 761
Ice	459 858
Incidentals	265 638
Food for fishing trip	2 882 938
TOTAL	37 100 052

year to year in recent times. For this reason, such purchases are treated as annual expenses in the analysis of the economic significance of the small boat fishery, presented in Chapter Seven.

In Table 6 below the total costs associated with the small boat recreational fishery are presented by category of expenditure. The cost of food and drinks consumed during fishing trips is included here, but this expenditure is not taken into account in the later analyses. The same type of information on a regional basis is presented in Appendix D, Table 11.

It is important to note that not all this expenditure was made for fishing in the Reef Region. It includes the total expenditure by the defined Reef Region fleet for all fishing trips during the year regardless of where they were made. The following information on the percentage of trips into the Reef Region helps put this into perspective. For the Cairns region fleet, 74 percent of trips were into the Reef Region, the remainder were in rivers or other inshore water-bodies; for the Townsville fleet 72 percent of trips were into the Reef Region; for the Mackay fleet, 60 percent and for the Rockhampton fleet, 54 percent. (The relatively low percentage for the Rockhampton fleet is probably due to the distance Rockhampton is from the coast and the opportunities for river fishing in that area.) It is obvious that not all the expenditure by the small boat fleet can be attributed to fishing in the Reef Region, but without making various assumptions it is not possible to separate expenditure for fishing

in the Reef Region from that made for fishing elsewhere. It is safer not to make assumptions in this regard. This means that the total cost of approximately \$34.2 million (which excludes food) was the expenditure associated with the estimated catch of 8.75 million kilograms of fish taken in all locations.

The Charter Boat Fishery

It has been mentioned previously that certain features of the charter boat fishery (the difficulty of establishing the number of boats working at any point in time, the near impossibility of separating fishing charters from other charters, and the marked difference between the various elements of the charter boat fishery) make it extremely difficult to provide quantitative data.

As it is a recreational fishery, it is the volume of the catch that is of interest, not its monetary value. (It should be noted in passing that some unknown percentage of the catch of demersal reef fish is sold by fishermen chartering boats.) Volume of catch is not a relevant statistic for the big game fishery where catch is released in the majority of cases. Another point to note is that there are marked differences between the catch of day trippers primarily engaged in fishing and those for whom fishing is a secondary or lower order reason for the trip.

Volume of Catch

With respect to the volume of the catch, the catch and release game fishery (which is dominated by the Cairns based marlin fishery) can be neglected in this book.¹ Some estimate of the volume of the catch by the non-game fishing charter sector can be made. At least 700 000 kilograms of fish were caught by persons undertaking charter trips in 1980. The volume could be considerably higher and only detailed investigations over a period of time would give a better estimate.

The Costs

Whatever the volume of the catch, it is not of direct concern in a book dealing with the economic significance of the Reef Region fisheries. What is of relevance is the level of economic activity associated with the charter boat fishery. The appropriate measure is the total income of charter boat operators (which is the same thing as the total fees paid by

1. The interested reader is referred to various relevant publications, two being **Gamefish Tagging**, newsletter of the New South Wales State Fisheries Gamefish Tagging Programme and **Australian Record Fishes**, published by the Game Fishing Association of Australia.

charter boat clients), or, what is the same measure if profits and losses are taken into account, the total expenditure by charter boat operators.

For all charter work (of which fishing charters are only one component), the Reef Region charter boat fleet earned marginally less than \$20 million in 1980. This is the best available estimate. The major contributor to this total income was the Mackay region fleet (accounting for approximately 64 percent of the total); this reflects the relative importance of this area for tourism. The Cairns region fleet contributed approximately 23 percent of the total revenue generated, which emphasises the relative importance of the marlin game fishery. The remainder of the revenue was split approximately equally between the Townsville region and Rockhampton region fleets.

This income to the charter boat sector equals the cost of the operations, including profit. Because the expenditure and income data for the charter boat sector was gathered in a form suitable for analysis of the sectoral flows of transactions rather than for a strict cost and earnings analysis, it is not possible to present detailed expenditure data comparable to that given for the other fisheries. It is emphasised, once again, that the economic data pertain to all charter boat operations and not just fishing. It is not possible to separate satisfactorily fishing from the other activities.

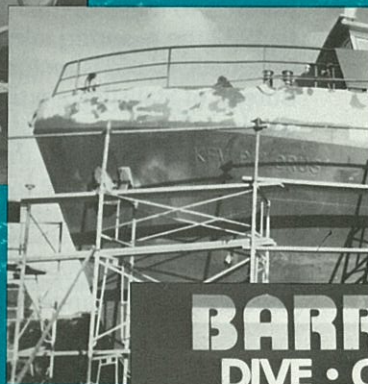
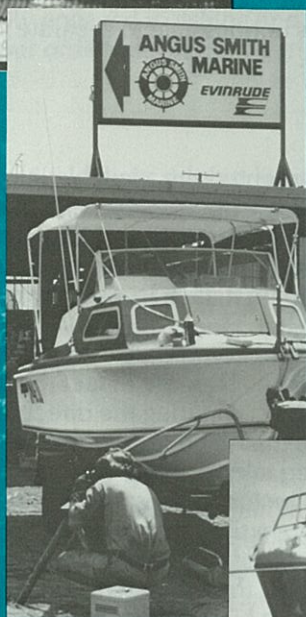
Conclusion

This chapter has presented the available information on the catch in terms of its value where appropriate and in terms of volume where reasonable estimates are possible and the total expenditure involved. Because the three fisheries are very different types of industries it has not been possible to treat each in a strictly comparable manner.

The data show that the combined fisheries are a very important industry within the Reef Region. They are in fact the most important industry. This is highlighted by comparing the direct receipts of the combined fisheries to those of the island tourist-resort sector in the Reef Region. In 1982 the reported takings of the 22 major resorts in the Reef Region (Magnetic Island is included) was approximately \$16 million (Australian Bureau of Statistics). In the same year it is estimated the fisheries produced in the order of \$100 million in direct receipts. This figure is arrived at by summing the estimated sales by the commercial fisheries, the direct expenditure by the small boat sector, and all fees earned by the charter boat industry, and converting to 1982 values.

The next chapter gives a theoretical background to the analyses of the economic significance of these industries.

Charts & Maps



Chapter Six A GUIDE TO UNDERSTANDING ECONOMIC IMPACT

Introduction

The previous chapters have described the Reef Region fisheries in terms of their important economic characteristics. The following chapter presents the results of analyses which aim to show the economic impact, particularly at a regional level, of these fisheries.



BOAT BUILDERS
MARINE ENGINEERS SALVAGE DIVING TOW

ER REEF
USE • TRAVEL

This is done with reference to the total output, income and employment generated by the fisheries. To make the results meaningful to the non-economist some discussion of concepts is necessary. In presenting this discussion it is useful to range beyond the subject matter of this book and briefly outline some central features of economic analyses which would be pertinent in another context. This will allow the reader to put the results of this study into perspective.

A Comment on Economic Analyses

Economic analyses come in many forms. Different types of analyses are used to address different questions or solve particular problems. It is necessary at this stage to say something about the nature of economics. Economics is concerned with the allocation of scarce resources. The everyday phrase "to economise" (if it means to save on resources) implies the same thing to the professional economist as it does to the layman. The economist would put this concept into formal terms, which can be summarised as a requirement to meet two criteria simultaneously: (i) productive efficiency, and (ii) allocative efficiency. The criteria require that the most technically efficient means are used to produce goods or services, that in production the least cost combination of inputs is used, and in the distribution of goods and services that the relative strength of consumers' preferences determine what goods and services are produced in what quantities. Taken together this is what is meant by economic efficiency. In measuring economic efficiency the economist goes much further than the accountant or businessman does in their analysis of profit and loss. On the cost side, the economist (and presumably the average person) is concerned with the opportunity cost of using a resource to do one thing rather than another. The resource can be labour, physical capital, land or time, to name some scarce resources. This issue has already been discussed with respect to the resources used in the commercial fishery. On the demand side, the economist takes as the measure of the value of a good or service the amount people are willing to pay to use or consume the commodity. Commercial and non-commercial activities are therefore evaluated in terms of their costs and benefits.

The three very different types of fisheries discussed in this book could be assessed in these terms. Such an undertaking is not the focus of this book. If it were, at least one of the fisheries, the commercial fishery, would be very difficult to analyse adequately because of data limitations: sufficient historical catch and effort data do not exist. Notwithstanding that, the dissimilar nature of the three fisheries would require the application of different techniques. Brief comment is warranted.

QUEENSLAND

Economic Regions



Of the three, the charter boat fishery is the closest to the type of business most people are familiar with. There are a number of operators providing a commercial service, in a reasonably competitive market, and the profits (or losses) of the individual operators are determined by the level of consumer demand given the prices for charter trips. The commodity purchased by people hiring charter boats is not necessarily a tangible product such as fish, but rather "the fishing experience". As an industry it can be considered as part of the broader tourist industry. The charter boat industry could therefore be analysed by the methods applied to other industries which operate according to market forces and in which private property rights exist. This overlooks the fact that the use of the marine environment and the fish caught are unpriced. Put another way, the resources of the Great Barrier Reef, in terms of its aesthetic appeal to charter boat users as well as its productive capacity as a fishery, are essential for the profitability of the charter boat industry, but the industry is not charged for these services of the environment.

The small boat fishery is furthest removed from a normal industry. While it is an economically important activity, given the money spent on boats, fuel, etc., it does not produce a marketable product, but rather tangible and intangible benefits (fish and pleasure) to participants. It is somewhat akin to other outdoor recreation activities (such as camping, bushwalking, etc.) and similar to recreational hunting. Like those involved in these types of pleasure pursuits, the recreational fisherman does not pay an "entry fee" to use the natural environment.¹ This central feature of recreational fishing means that an economic evaluation cannot be based on direct willingness-to-pay, rather it has to be based on a surrogate measure. The best practical approach is the derivation of demand for a fishing location by using known information on the number of trips per unit of population for increasingly distant destinations, and the costs associated with travel. This, so-called, travel-cost methodology can do no more than provide a minimum estimate of the valuation of a fishing location. Numerous factors other than distance travelled (and its cost) are involved in users' valuation of a location. Of considerable importance are alternative fishing areas (and their relative costs of access) and, for the person for whom catching fish is the main motive, the expected success rate. Success rate in recreational fishing is affected by the common property nature of fisheries, in the same way that commercial fishing is: that is, there will be, ultimately, too many fishermen seeking a limited resource.

1. In certain circumstances outdoor recreationists do pay a fee, but this is usually a nominal charge, arbitrarily set, and it has no semblance to a market determined charge, such as is paid for entry to commercial sporting events, zoos and other services bearing some similarity to un-priced recreation.

It is with commercial fishing that the common property nature of fisheries is most obvious. Profits and livelihoods are affected by it. An economic analysis designed to determine whether or not a commercial fishery was wasteful of resources (for example, boats, labour; the products of the marine environment) would have to address a series of empirical questions, pertaining to the relationship of the cost of effort to the catch. The theory is clear, and invariably proven to be correct in empirical studies around the world. It is that each and every commercial fisherman has a financial incentive to catch as much as he can as quickly as he can, before someone else does. This inevitably leads to over-capitalisation (too many boats and gear) the elimination of a profit for the fishery (or what is otherwise termed the dissipation of resource rent). It must be emphasised that what holds true for the fishery does not necessarily hold true for any individual fisherman. Some will have more efficient boats and gear, be more capable managers and skippers, or be more lucky, than others and hence make profits. Ultimately, the economic efficiency of a commercial fishery has to be judged by the benefits gained by fish consumers (the "consumers' surplus" in formal terms), the profits gained by the owners of the factors of production (in formal terms the "quasi-rents" or "producers' surplus") and the resource rent generated by the environment.

The few paragraphs above have sketched the key issues which would be involved in determining whether or not the Reef Region fisheries were operating at levels of effort consistent with optimising the use of scarce resources (boats, labour and the resource itself). This book addresses a different issue to the costs and benefits of the fisheries. It deals with one of the other concerns of economists.

Societies have multiple objectives. While to economise in the use of resources might be considered to be the predominant goal in improving the material and non-material benefits of life, others such as regional development, improving the balance of trade, self-sufficiency, creating employment and equity enter into the calculus. In the long term many of these "minor" goals can be viewed as a sub-set of the efficiency goal, but some might always be at odds with that goal. In the short term there is often conflict between attempts to achieve one objective and another.

The aim of this book is to present as comprehensive a description of the Reef Region fisheries as the available data allow. Its approach to this task is to analyse the contribution the Reef Region fisheries make to the regional economies with which they are associated. It presents measures of the "economic impact" or flow-on effects (in terms of output, income and employment) that arise. The measures can be used to estimate the overall impact of increases or decreases in expenditure

by the Reef Region fisheries. In other words it describes what is likely to happen to regional and state-wide output, income and employment if these fisheries expand or contract in the short run. Herein is its value to those agencies involved in managing the Reef Region fisheries.

Measuring Economic Impacts

It is appropriate now to discuss the theoretical issues pertinent to the measurement of economic impacts. The economic impacts presented in this book have been calculated by the use of input-output analysis and multipliers derived by this method.

An input-output table describes the flow of goods and services between the individual sectors of an economy over a specific period of time, which is usually one year. The economy is represented by a matrix of industry groups (the sectors) and traces the transactions in monetary terms between the industry groups. Sectors sell goods and services (the output) to other sectors and consumers and purchase inputs from other sectors and households. The number of sectors (the degree to which like industries are grouped) is determined by, among other things, the level of detail required.

The flow of inputs and outputs, in matrix form, are presented in what is called a transactions table. From the data in this table input-output coefficients are derived. A coefficient shows the percentage of the total purchases bought by one sector from another sector. These purchases represent the "direct" or "first round" outputs required from a particular sector to meet the requirement of an increase in output in another sector.

Following the first round effect will be subsequent effects. These are measured by calculation of input-output multipliers. A multiplier measures the relationship between an autonomous injection of expenditure in the economy (a stimulus) and the overall change which results. In the use of input-output multipliers the unit in which the stimulus is usually expressed is an increase of one dollar in sales to final demand (that is, expenditure by the ultimate consumers of the goods or services). There are three types of multipliers: output, income and employment.

An output multiplier for any of the fisheries relates a unit of expenditure in the particular fishery to the resultant increase in the level of output in the economy. An income multiplier shows the relationship between a unit of additional expenditure and the changes which result in the level of income to the households in the economy. The employment multiplier shows the effect on employment in the economy resulting

from an increase in output generated by the increased expenditure in the fishery. The economy referred to can be the local one (a city for example), the regional one (based on geographical, political or administrative boundaries), or the economy of a state or the nation.

There are a number of elements of the total multiplier and these are defined next. First there is the "initial impact" of one dollar in output. This can be a dollar increase or decrease in sales by the industry, or simply relate to a per dollar of sales. Directly associated with this dollar increase in sales is an increase in income (wages, salaries, etc.) caused by the production of that dollar of output. This is termed the "own sector" increase in household income. Each dollar of initial increase in output produces a "first round" of purchases by the sector providing the initial stimulus. This is followed by second and subsequent round effects as successive rounds of output increases follow as a consequence of the initial increase in output. These impacts are termed "industrial support effects". These do not include any increases occurring because of increased consumption of households. Added together the first round and industrial support effects are termed the "production-induced effect", which is self-explanatory terminology. Finally there is a "consumption-induced" effect. This results from the increased spending by households who have benefitted from an increase in income associated with the initial dollar stimulus in output and its successive output effects.

Together the initial, first round, industrial support and consumption-induced effects add up to the total impact. By subtracting the initial impact (the dollar increase) from the total impact the so-called "flow-on" impact is found.

Output, income and employment multipliers are calculated on the basis of a "per unit initial effect", that is, on a per dollar change in output. It can be useful to consider per unit changes in income and employment. This can be done through the use of so-called "type II" multipliers, of which there are two categories. A type IIA income multiplier is the ratio of total impact (of income) to the initial impact (of income). A type IIB income multiplier is the ratio of the flow-on impact (of income) to the initial impact (of income). The same procedure is used for the calculation of type IIA and type IIB employment multipliers.

As well as the per dollar of output basis measure of impacts, impacts can also be measured in terms of aggregate effects. That is, they can be shown as the total value of output, income or employment opportunities produced by the sector. The following chapter concentrates on the aggregate impacts, that is, the flow-on effects

associated with the total expenditure in the fisheries. The per dollar impacts are presented as multipliers.

A considerable amount of data are required for the construction of transactions tables. The analyses presented in this book are based on the augmentation of existing input-output tables for the relevant regions of the Queensland economy. These tables, titled **Regional Input-Output Tables for Queensland 1978-79**, were produced by Morison, West and Jensen, of the Department of Economics, University of Queensland, in 1982. Augmentation of the tables required constructing new sectors (for each of the fisheries) on the basis of the survey data.

The essential data for construction of the new sectors were the annual expenditure (or sales) of the fisheries and the place of purchase of inputs and the location of final sales (households consuming the product or enjoying the services produced by the fisheries). It is obvious that the magnitude of a regional multiplier will be inversely proportional to the "leakages" of money out of the regional economy in the successive rounds of transactions.

Data were gathered on the location of purchases and sales. Some adjustment of the data was necessary to provide consistency with the original transactions tables. Those tables are based on what are called "basic values", while the data gathered were in "purchasers' prices". The latter are the prices actually paid by the fishermen, which include commodity taxes, delivery and distribution charges. Therefore, it was necessary to reallocate these charges to the appropriate sectors in converting to basic values.

Having briefly outlined the method by which the economic impact of the fisheries were measured, as a guide to understanding the information presented in Chapter Seven, it would be remiss not to say something about the limitations of the approach.

Limitations to the Measurement of Impacts

Input-output modelling is, like all modelling, an abstraction from reality. While we can only readily understand the way economies work by seeking and understanding the important relationships — economies are far too complex for anything else — there are limitations to all models and the reader should be aware of the relevant ones in this case.

First of all, there is a need to be cautious in using the impact measures. It cannot be assumed that multiplier effects will occur immediately or simultaneously. The time dimension is ignored in the input-output model and it is difficult to predict the time it will take for all the effects

to be felt. The model also assumes that it is possible for firms to adjust to changes in the economy. This is important if there is an expansion in a sector. Firms may not be able to expand production sufficiently if the economy is fully employed.

It is necessary to understand the assumptions that have to be made in constructing a transactions table. The table is based on linear relationships. That is to say it is assumed any additional production by a particular sector will require purchases of inputs from other sectors in the same proportions as expressed in the table.² This will not necessarily be the case as an increase (or for that matter a decrease) in production might result in economies or diseconomies of scale in the other sectors. Both the production and consumption functions (as they are called in economics) are assumed to be linear in form. What are neglected are the changes in the input and output patterns that can, and ultimately will, occur as relative prices and technologies change. For this reason the transactions tables which are based on the configuration of the economy at a point in time (a specific base year), can only be considered reliable for a few years. Some further elaboration is warranted. Input-output analysis is based on the notion that supply is "elastic" in all sectors of the economy. What "elastic" means is that suppliers of inputs (to meet an increased demand) can produce more without an increase in unit price. This will not always be the case. Increased demand from local suppliers can push up the price, which can lead to the substitution of inputs or the import of such from outside the local economy, or both. If inputs are imported the magnitude of the multiplier is reduced. If what is being considered is a reduction in the level of economic activity by a sector, supply constraints will obviously not occur.

The model also assumes that increases in income will be spent on the same goods and services and in the same proportions as before the change. (In formal terms this is known as a "linear homogeneous consumption function".) The assumption will not necessarily hold in practice. As income either increases or decreases it is likely that patterns of consumption will alter: the type and quantity of commodities purchased will probably change.

The limitations discussed above are relevant in using input-output multipliers to predict changes that result from a stimulus or contraction in the economy. They are not of such concern if the task is to describe the impacts of a particular sector at a point in time. If that point in time is the year in which the transaction tables were constructed, an impact

2. In formal terms this means that average rather than marginal coefficients are used in the analysis.

analysis based on input-output flows will present the best possible description of the economy (in terms of total output, income and employment) as it then was. In this regard the impacts of the Reef Region fisheries as presented in the following chapter can be considered reasonably accurate. The original tables are based on 1978–79 data and they were augmented with data obtained from the fishing industries in a period extending from 1978–79 to 1980–81. Significant changes did not occur to the relevant economies during that period.

Defining the Regional Economies

One further issue requires discussion before concluding this theoretical background to the next chapter. An important part of any study of economic impact is to define identifiable regions where the impact is likely to occur and to do so in a way which allows economic analysis.

Preliminary investigations of the Reef Region fisheries suggested identifiable patterns of economic impact and that impacts were restricted largely to a few coastal urban areas with the major ports being the focii. Given the limited number of centres on the mainland providing services at a significant level to the fisheries, it would have been desirable to restrict the examination of local impact to these urban areas. This would have necessitated the preparation of input-output tables for the major cities (Rockhampton, Mackay, Townsville and Cairns) or, preferably, somewhat larger areas encompassing a number of geographically close and economically linked cities and towns. This was not done for the study of the Reef Region fisheries, as such an undertaking would have been a major task in its own right and, more importantly, it was not warranted. As mentioned previously input-output tables were in existence for defined regions within Queensland and these could be easily utilised to study the fisheries, without any significant loss of precision. These regions are described next, using the names given to them previously in this book. All the regions are based on Statistical Divisions employed by ABS. The regions are shown on Map 1 (page 81).

The Rockhampton Region

The Rockhampton region referred to in this book has been constructed by combining the Fitzroy and Wide Bay-Burnett Statistical Divisions as defined by ABS. This region extends from Tewantin in the south to just south of St Lawrence in the north and westward to include the hinterland serviced by the major coastal cities in the area.

The Mackay Region

The Mackay region is the Mackay Statistical Division as defined by ABS. It is contiguous with the Rockhampton region southern boundary, extends north to just beyond Proserpine and encompasses the major hinterland serviced by Mackay.

The Townsville Region

The Townsville region is exactly the same as the Northern Statistical Division as defined by ABS. Its southern boundary is contiguous with the Mackay region and commences at about Bowen on the coast. The northern extremity is Cardwell and it extends inland to include the western area serviced by Townsville.

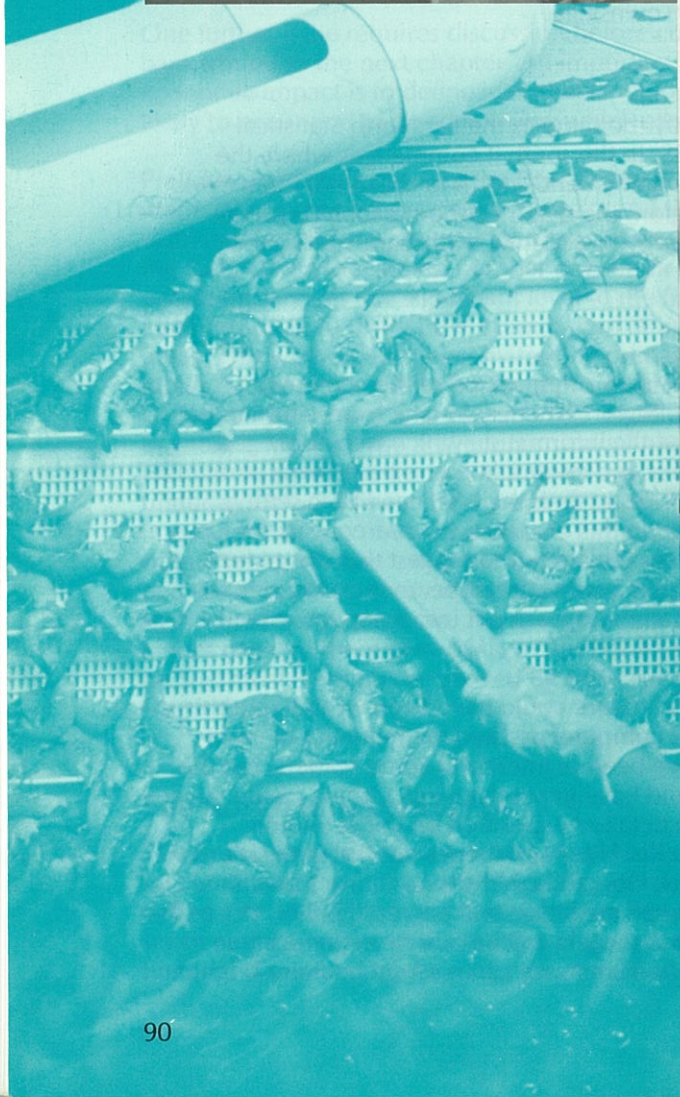
The Cairns Region

The Cairns region is exactly the same as the Far North Statistical Division as defined by ABS. In the south it commences where the Townsville region finishes and extends north to the top of Cape York. While it is a very large region, the major economic focus is on the coastal cities and their nearby hinterlands, with Cairns being the dominant centre.

Conclusion

This chapter has digressed from a description of the economic characteristics of the Reef Region fisheries, to which we return in the following chapter. Because the information which is to come goes beyond descriptive statistics and comment and is based on a particular type of analysis of the fisheries in their regional economic settings, the theoretical issues discussed in this chapter are a prerequisite for a clear appreciation of what follows. This is not to suggest that the general findings presented in Chapter Seven cannot be understood without reading this chapter, but rather they are put into perspective by the type of background given here.

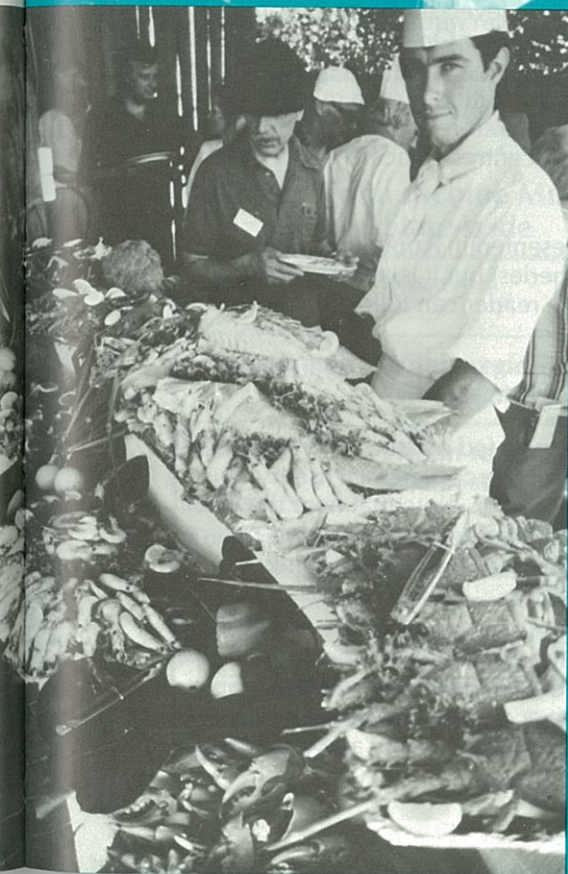
Much more of a theoretical nature could have been written, but this is not the place for that. The computer assisted mathematics of input-output modelling may have been of interest to some readers, but the author doubts if such would have general appeal. Others would have been interested in a more detailed exposition on the economic efficiency measures of the Reef Region fisheries but the orientation of this book is not to that end. Hopefully in the near future a data base adequate to address this neglected issue will be put together. When that day arrives fisherman and managers will be in a far better position to make decisions. Having stated that, we can return to matters at hand.



Chapter Seven **BEYOND DIRECT MEASURES: FLOW-ON EFFECTS**

Introduction

This chapter presents the results of the analysis of the economic impacts of the Reef Region fisheries. The impacts are measured in terms of the additional output, income and employment generated by the fisheries.



There are two purposes served by the impact analysis. In the first place, the total contribution by the fisheries to output, income and employment at a regional and state-wide level can be estimated. In the second place, the multipliers (by which the impacts are estimated) can be used as a guide to the likely effects of an expansion or contraction (resulting for whatever reason) in the fisheries. This second use of the multipliers can provide very useful information to managers who by their decisions can alter the level of economic activity in the fisheries. As pointed out in the previous chapter, some caution is warranted in estimating impacts, particularly as time passes and the structure of economies change.

This chapter will be confined to describing the impact of the fisheries at the time they were researched. By explaining the method used to do this the procedure will be made clear to anyone wishing to estimate changes which may occur in the future.

The impact measures have been calculated to allow analysis at the regional level (the regional economies defined in Chapter Six) and at a state-wide level (that is, the effects occurring throughout Queensland). No heed is paid to effects beyond the state level; such was beyond the aims of this study. It has been stated in Chapter One that the major issue was to determine the economic significance of the Reef Region fisheries for the purpose of providing valuable information for the management of the Great Barrier Reef. The emphasis therefore is placed rightly on the impacts of the fisheries on the major centres adjacent to the Reef Region.

Much of the detailed information is presented in Appendix E (the disaggregated multipliers for all the fisheries) but it is necessary to present some measures here so that the reader can follow the calculations.

Applying Multipliers

Tables 1, 2 and 3 below present the aggregated output, income and employment multipliers, respectively, for the commercial fishery, the small boat fishery, and the charter boat sector. Note that here the latter is not described as a fishery because, as stressed previously, it is not practical (given the available data) to attempt to separate fishing charters from other charter operations.

Key features of the tables need to be understood. The "regions" are the economic regions used through this book and defined in Chapter Six. The "impact area" relates to where the economic impacts occur: within the region means inside the defined regional economy and within the

state means inside Queensland generally, including the relevant regional economy. Put another way, the difference between the "within the region" multiplier and the "within the state" multiplier is the effect

Table 1: Total Output Multipliers:^(a) Within the Region and State-wide

Region	Impact Area	Commercial Fishery	Small Boat Fishery	Charter Boat Sector
Rockhampton	Within region	1.756	1.709	1.682
	Within state	2.105	1.946	2.048
Mackay	Within region	1.740	1.694	1.750
	Within state	2.033	2.114	2.007
Townsville	Within region	1.776	1.724	1.765
	Within state	2.039	1.984	2.057
Cairns	Within region	1.772	1.540	1.543
	Within state	2.088	2.208	1.874

(a) Per one dollar of output.

Table 2: Total Income Multipliers:^(a) Within the Region and State-wide

Region	Impact Area	Commercial Fishery	Small Boat Fishery	Charter Boat Sector
Rockhampton	Within region	0.762	0.280	0.496
	Within state	0.834	0.340	0.573
Mackay	Within region	n.a.	0.221	0.586
	Within state	n.a.	0.327	0.689
Townsville	Within region	0.722	0.272	0.540
	Within state	0.765	0.348	0.594
Cairns	Within region	0.714	0.208	0.382
	Within state	0.774	0.363	0.439

(a) Per one dollar of output.
n.a. not available.

Table 3: Total Employment Multipliers:^(a) Within the Region and State-wide

Region	Impact Area	Commercial Fishery	Small Boat Fishery	Charter Boat Sector
Rockhampton	Within region	0.073	0.030	0.052
	Within state	0.080	0.036	0.059
Mackay	Within region	n.a.	0.035	0.036
	Within state	n.a.	0.036	0.040
Townsville	Within region	0.072	0.029	0.058
	Within state	0.076	0.037	0.063
Cairns	Within region	0.069	0.023	0.038
	Within state	0.073	0.037	0.042

(a) Per \$1 000 of output.

n.a. not available.

felt within parts of Queensland other than the region being discussed. A final point is to reiterate the meaning of the various multipliers. The output and income multipliers relate to a per dollar of output, while the employment multiplier relates to a per \$1 000 of output. All the multipliers in Tables 1, 2 and 3 include the "initial" impact. Income is household income, and the initial income is that earned by fishermen and crew in the commercial fisheries and charter boat operators and crew in that sector, but for the small boat (recreational) fishery there is no direct income (or employment).

Section One: Commercial Fisheries

The multipliers in the preceding tables can now be used to estimate the total contribution of the fisheries at both regional and state-wide level. Output is not considered in the detailed calculations here as income and employment are the more relevant measures of economic activity. Nevertheless, attention is drawn to the output multipliers, which are all over 2; and this indicates that associated with the total expenditure of approximately \$30 million in 1979-80 for the fleet there was an additional output throughout the Queensland economy of at least another \$30 million.

Total Income

Rather than working through the calculations for all fisheries in every region one example will be used to show the simple procedure involved. The results for the others can then be presented without comment. The Cairns region commercial fleet is used as the example.

The Cairns region commercial fleet generated in total \$8.61 million household income in 1979-80. This figure is arrived at by the simple mathematics of multiplying the total output (\$11.119 million) by the "within state" income multiplier (0.774). Some of the \$8.61 million is the direct income to the fishery: it is in fact approximately \$4.78 million (see item "salaries and wages" in Appendix D, Table 2). This means that the flow-on effect (or indirect income) was \$3.83 million.

The majority of the total income was earned by households in the Cairns region. This is calculated by multiplying the total output (\$11.119 million) by the "within region" income multiplier (0.714), which gives a figure of \$7.94 million. As all the direct income was earned by Cairns region households, the flow-on into that economy was \$3.16 million (that is, the difference between \$7.94 million and \$4.78 million); and the flow-on to the "rest of the state" was \$0.67 million.

The total household income generated by the Townsville region commercial fleet was \$5.5 million. Of that amount, \$3.46 million was income going to those directly engaged in fishing, which means the flow-on was \$2.04 million. Within the regional economy the total household income was \$5.19 million, and \$1.73 million was the flow-on in the region. The flow-on to the "rest of the state" was therefore \$0.31 million.

The total household income generated by the Rockhampton region commercial fleet was \$8.23 million. Those directly engaged in fishing earned \$4.86 million and the flow-on was \$3.37 million. Within the regional economy the total household income was \$7.52 million, which means the regional flow-on was \$2.66 million.

Precise income multipliers are not available for the Mackay region commercial fleet. It is reasonable to assume they would not differ greatly from those for the other regions. The total household income generated by the fleet would have been in the order of \$2.5 million, of which \$1.6 million would have gone to fishermen and crew and \$0.9 million would have been the flow-on effect.

These household income multiplier effects can be put into perspective by considering all the Reef Region commercial fisheries. It is estimated

that in 1979–80 fishermen and crew earned (in the form of wages, salaries for managerial skill and labour) approximately \$14.7 million. Associated with this direct income to the fishermen was a total flow-on of income in the state of over \$10 million, and within all the combined regional economies the flow-on was at least \$8.3 million.

Total Employment

Total employment directly involved in commercial fishing has been estimated at approximately 2 000 persons, but as fishing is not a full-time activity for all a figure of approximately 1 500 skippers and crew, in terms of full-time equivalents, is considered reasonably accurate. By applying the employment multipliers in Table 3 it is possible to calculate the total employment (both direct and indirect) which results from the existence of the commercial fisheries. The employment multipliers show the number of jobs per \$1 000 of output or expenditure. These can obviously be converted to more meaningful measures such as jobs per \$1 million of output or expenditure.

The total flow-on of employment in the state was over 1 000 jobs. Within the combined regions the flow-on was in the order of 870 jobs. At a regional level the figures are as follows: Rockhampton, 267 flow-on jobs; Townsville 194 flow-on jobs; Cairns, 322 flow-on jobs; and in Mackay (for which the multipliers are not available) the number was most probably 80 to 90 flow-on jobs. These figures show the regional importance of the fisheries; only a small number of jobs flow-on to the rest of the state.

Summary

The total effects of the Reef Region fisheries have been calculated on the basis of what was known about them in 1979–80. The output and income effects are presented in terms of 1979–80 values. At the time of writing those monetary values would be considerably higher, due to inflation. To estimate what the total output (direct and indirect) would be in 1983, the output multipliers presented in Table 1 could be used and the total income effect could be estimated from Table 2.

Section Two: Recreational Fisheries

The recreational fisheries can be dealt with in less detail than the commercial fisheries as the principles in applying the multipliers are the same. The total effects are summarised below.

The Small Boat Fishery

The output multipliers for the small boat fisheries are generally in the order of 2. This means that the total expenditure of \$34 million in 1980 could be multiplied by 2 to obtain the total output effect in that year, giving a total of \$68 million. Of more relevance are the income and employment multipliers.

The small boat income multipliers, in Table 2, are considerably smaller than those for commercial fishing and the charter boat sector. This is due to the obvious fact that recreational fishing itself does not produce any direct income (or employment) and all the effects are therefore indirect, or, in other words, flow-on income.

For the total Reef Region fleet of small boats the income flow-on generated throughout the state was \$12.88 million in 1980. Within the combined regional economies the flow-on income was \$9.31 million. This was distributed according to region as follows: Rockhampton, \$3.49 million on a state-wide basis and \$2.86 million within that economy; Mackay, \$1.48 million and \$1 million; Townsville, \$4.29 million and \$3.36 million; Cairns, \$3.61 million and \$2.07 million.

The employment effects, similar to the income effects, are confined to flow-ons. Associated with the Reef Region fleet were 1 358 jobs throughout Queensland. Within the combined regional economies there were 1 054 jobs. These were distributed by region as follows: Rockhampton, 308 jobs; Mackay, 159 jobs; Townsville, 358 jobs; Cairns, 229 jobs.

The Charter Boat Sector

Two points made previously can be reiterated here. First, the charter boat sector includes all charter work of which fishing charters are a component. Second, the data on this sector are not precise but rather indicative of the situation in 1980. The estimate of the expenditure by the charter boat sector in that year was approximately \$20 million. The output multipliers presented in Table 1 suggest that the total output (direct and indirect) was in the order of \$40 million.

The direct household income earned by charter boat operators and crew was in the order of \$6.5 million. The flow-on income effect was \$5.8 million throughout the state. The total (direct plus indirect) income was therefore \$12.3 million. The flow-on within the combined regions was \$4 million.

The direct employment in the charter boat sector was in the order of 240 persons. Associated with this sector was a relatively large flow-on

in employment, being over 600 jobs throughout the state, of that number over 500 jobs flowed-on to the combined regional economies.

Given the lack of precision with the charter boat data, the flow-on impacts are not presented for the individual regions, though it can be noted that they would be approximately proportional to the absolute levels of charter boat income and expenditure in each region.

Summary

The economic significance of the Reef Region fisheries can be summarised in terms of their total impact on output, household income and employment. Table 4 presents the summarised information. Certain points are reiterated. First, output relates to the total amount of expenditure on inputs (such as fuel, repairs, labour, etc.) made by the fishing sector plus flow-on expenditure (within Queensland) on inputs into all sectors, as a consequence of the existence of the fisheries. Output can alternatively be viewed as the value of the goods and services provided, initially directly by the fisheries, and then as flow-ons. Viewed from this alternative approach two points should be emphasised: first, the small boat fishery does not itself sell a good or service, and second, for the commercial fishery the reported value of product sold is less than the direct expenditure made by that sector and it is the value of the latter which has been taken to be the direct output. Therefore, in all cases the value of total output is defined as being equal to the value of total expenditure.

Second, household income is defined as the total amount of money in the form of wages and salaries earned by operators and crew (for the commercial fishery and the charter boat sector) plus flow-on wages and salaries to other sectors. Household income is gross receipts less the cost of all inputs other than labour and managerial skill. It is, therefore, significantly less than the value of output (expenditure in, or sales by, a sector).

Third, total employment comprises direct employment in the fisheries (noting that there is not direct employment in the small boat sector) plus flow-on employment in all sectors. It is important to note that employment is being measured as full-time jobs; because of the part-time nature of many jobs in the commercial fishery, more people are employed than shown in the table.

The final point relates to the estimates for 1982–83. These estimates are based on taking into account the most recent available information pertaining to the prices of outputs and inputs as well as inflationary effects. Inflationary changes are easy to incorporate and, if these were

the only changes since the time of the surveys, the 1982-83 figures would be reasonably precise. For both the commercial fishery and the charter boat sector, other factors could influence the 1982-83 estimates; the small boat fishery estimates are probably reasonably accurate.

With regard to the commercial fishery, consideration has been given to any changes in the quantity and value of product landed and the cost of inputs, in real terms. The data that are available for this purpose are very general in nature. At the time of writing, the Bureau of Agricultural Economics' overview of the Australian fisheries published in early 1983 is the best available guide (BAE, 1983). Given the dominance of the prawn fishery in the Reef Region, its fortunes in the past two years are of prime interest. The Bureau's analysis shows marked fluctuations in the quantity of catch and per unit prices for prawns in the period from mid 1979-80 to mid 1981-82. The intervening year was a record year for Australian prawn landings and per unit prices fell as a consequence of overseas economic factors with the result that for the value of total production the changes were counter-balancing. By 1981-82, prawn landings were back to "normal" and per unit prices had increased, in nominal terms to at least mid 1979-80 values. On the basis of the Bureau's analysis, it would appear reasonable to conclude that the value of sales by the Reef Region prawn fleet in 1982-83 would at least equal the 1979-80 value in real terms; that is, the latter value could be increased by at least the rate of inflation from 1979-80 to 1982-83. Overall, marked changes do not appear to have occurred to the cost of inputs, other than in the case of fuel which increased significantly between 1977-78 and 1980-81. Fuel prices rose 9 percent in 1981, but this rate of increase was considerably less than the 30 to 40 percent rises in the previous two years. (**Australian Fisheries**, March 1982).

Very little new information is available on the charter boat sector and, given the diverse and dynamic nature of this industry, only detailed investigations would show how accurate the 1982-83 estimates are.

While the factors discussed above have been taken into account, the end result is that the estimates do little more than reflect changes in values caused by inflation. The employment numbers are shown as not changing, which would be the case if there was no expansion in the fisheries in real terms.

Disaggregated Impacts and Sectoral Incidence

The presentation above has been in terms of the aggregated flow-on effects. It was explained in the previous chapter that the total multipliers are comprised of a number of parts. The interested reader can use the

Table 4: Summary of Aggregated Impacts

	Commercial Fisheries		Small Boat Fishing		Charter Boat Sector	
	1979-80	1982-83	1979-80	1982-83	1979-80	1982-83
Total Output	\$60m	\$84m	\$74m	\$90m	\$40m	\$49m
Total Household Income	\$25m	\$33m	\$13m	\$16m	\$12m	\$15m
Total Employment	2 500	2 500	1 358	1 358	840	840

tables in Appendix E to calculate the absolute effect at each stage (the first round, industrial support, consumption induced) of the successive rounds. Certain sectors of the regional and state-wide economy benefit more than others from the flow-on effects of the Reef Region fisheries. This is called sectoral incidence. The patterns of incidence are reasonably obvious given the nature of the fisheries.

The main sectors to benefit from flow-ons from the commercial fisheries were: trade (wholesale and retail trade and repairs); finance (banking, insurance and other business services); entertainment (restaurants, hotels, clubs and other entertainment and recreational services); machinery, appliances and equipment (which includes boat building and repairs as well as other types of machinery manufacture); and, food manufacture (includes processing and manufacture of all foodstuffs). Approximately two-thirds to three-quarters of the flow-on effects (output, income and employment) accrued to these sectors.

In the small boat fishery the trade sector was the major beneficiary from the flow-on effects. The other sector to gain a significant percentage of the flow-on effects was the machinery manufacture sector. The finance sector was a minor beneficiary and all others were insignificant.

The main sectors to gain in flow-ons from the charter boat sector were, in terms of output and income: transport (of all types); trade; finance; entertainment and food manufacture. In terms of employment the main sectors to gain were trade and machinery manufacture.

Finally, the Reef Region fisheries can be put into perspective with regard to their relative contribution to the Queensland regional economies. The fisheries are obviously very minor elements of what are large regional economies. This fact is of little significance. Economies such as

Queensland's and those of its regions are comprised of a multitude of industries, most of which are insignificant in their own right.

As a percentage of the gross regional product none of the regional fisheries (that is, the combination of the three types in each region) exceeded one percent. In the Cairns region the fisheries accounted for 0.9 percent of the gross regional product; 0.7 percent in the Mackay region; 0.6 percent in the Townsville region; and, 0.3 percent in the Rockhampton region.

Conclusion

Notwithstanding the relative insignificance of the Reef Region fisheries in terms of the total economic activity in the major regional economies along the Queensland coast, they are the most important industries within the Reef Region. The information in this chapter has illustrated that importance in terms of the indirect, or flow-on, effects. These have been shown to be significant.



Chapter Eight CONCLUSION

The ultimate aim of this book has been to present data on the economic significance of the major fisheries in the Great Barrier Reef. It has done this in terms of the direct and flow-on effects.



The latter result from the contribution which fishing expenditure and sales have on other sectors of the regional and Queensland economy. The flow-on effects have been estimated by economic input-output modelling and the use of multipliers derived from these models. The multipliers presented have a use other than for the estimation of the total impact of the fisheries at a point in time and that is they can be used to predict what will happen to regional and Queensland-wide output, income and employment if the fisheries contract or expand. It is this predictive capacity which makes the multipliers useful for those concerned with the management of the fisheries.

As a precursor to the analysis of the economic significance of the fisheries, data have been presented to describe the economic characteristics of the fisheries. In doing that, the fisheries have had to be defined. In the first instance the geographical boundaries for the Great Barrier Reef fisheries had to be established. The Great Barrier Reef has been defined as the area described in the *Great Barrier Reef Marine Park Act* as the Great Barrier Reef Region (or simply the Reef Region). The mobility of otter trawl fishermen and net and crab fishing in estuaries and rivers make the delineation between Reef Region fisheries and other Queensland fisheries a difficult matter. In allocating fisheries to the Reef Region certain assumptions have been made, and clearly stated.

The Reef Region fisheries have been categorised into three major groups: (i) a commercial fishery; (ii) a recreational fishery based on individuals using private motor boats; and (iii) a charter boat fishery. The commercial fishery comprises a number of very different fisheries, in terms of target species, type of boat and gear. The dominant fishery is the prawn otter trawl fishery. The recreational fishery (called the "small boat" fishery in this book) is reasonably homogeneous in terms of type of boats and gear used but diverse with regard to species sought and caught. The charter boat fishery comprises two major elements, one, a big game fishery mainly centred on the port of Cairns and, two, charters by line fishermen seeking demersal Reef fishes. As it has not been possible to clearly separate fishing charters from other charters, the term charter boat "sector" is used in the economic analyses to indicate that some amount of expenditure in this sector is for non-fishing activities.

To the extent that the available data allow, the Reef Region fisheries have been put in an Australian and Queensland context. In terms of geography the Reef Region fisheries are adjacent to approximately 85 percent of the Queensland east coast. In terms of fishermen, boats and value of product landed, the Reef Region commercial fisheries account for about one half the Queensland total. Similar comparisons have not been able to be made for the other two fisheries.

Detailed descriptions of the fisheries have been provided in Chapters Two to Four inclusive. The various fisheries have been described with regard to species caught, areas fished and modes of fishing. They have then been discussed in terms of the number of participating boats and fishermen. In presenting this information the Reef Region has been separated into four economic regions based on the major ports on the adjacent coast. They are from south to north, the Rockhampton region (based on the ports of Bundaberg, Gladstone and Rosslyn Bay), the Mackay region, the Townsville region and the Cairns region.

The total Reef Region commercial fleet has been estimated at 1 075 boats, in 1981, having a market value in that year of \$56.3 million. Of the total the otter trawl fleet was 485 vessels, valued at \$44.6 million. Operating these boats were 2 000 skippers and crew, though this includes a proportion of part-time fishermen.

The small boat recreational fishery has been estimated at just under 15 000 boats in 1980, having a value of approximately \$80 million. These boats made nearly 200 000 trips into the Reef Region during that year. On average each boat took 2.6 fishermen.

The charter boat fishery comprised approximately 120 boats in the period 1979 to 1981. The value of this fleet was approximately \$30 million. Approximately 240 persons were directly employed. On an annual basis approximately 55 000 person-days in charter boat fishing were involved.

Data on the catch and costs associated with obtaining it have been provided in Chapter Five. The value of the commercial catch has been estimated to have averaged at least \$27.8 million for each year from 1977-78 to 1979-80, in 1979-80 prices. This is a conservative estimate and the value was probably higher. The cost in taking this catch has been estimated at \$31.3 million, which is a figure which might be a more accurate representation of the value of the catch. In terms of volume, the Reef Region commercial catch of all species has been estimated at between 7 600 and 8 700 tonnes (live weight) of which the prawn catch was in the order of 4 500 to 5 000 tonnes (live weight).

The volume of the small boat fishery catch in the Reef Region waters in 1980 has been estimated at 6.5 million kilograms of fish, for approximately 3 000 000 fish. The cost of obtaining that catch has been estimated at \$34.2 million, in 1980 prices.

Excluding the catch and release game fishery component of the charter boat fishery, the best estimate is that at least 700 000 kilograms of fish

were taken by the non-game fishing component in 1980. The earnings by the entire charter boat fleet have been estimated at \$20 million in 1980.

The figures presented above summarise the direct importance of the Reef Region fisheries. As stated, the fisheries have economic impacts beyond their own importance. This has required going beyond measures of direct expenditure in fishing and sales of product. The significance of the fisheries has been estimated by use of economic input-output modelling to calculate multipliers. Multipliers show the economic flow-on effects that result from direct expenditure and sales. Fishermen purchase goods and services from various industries in the regional and wider economy and, if they are commercial fishermen, they sell product to various other sectors. By this process output, income and employment are created in other industries. By calculating the total output, income and employment generated the economic significance of the fisheries is shown.

The output multipliers for all fisheries in each region are approximately the same, at about 2. This means that for one dollar of expenditure in, or sales by, any of the fisheries an additional dollar of output is generated in the Queensland economy.

The income multipliers vary and are lowest in the small boat recreational fishery because in this case there are not skippers and crew engaged to earn direct income from fishing.

For the commercial fisheries the income multipliers are reasonably similar in all regions, ranging from 0.77 to 0.83. These income multipliers are used to estimate the amount of household income, that is wages and salaries, that result from one dollar of output (total expenditure or sales by the fishery). The total Reef Region commercial fleet generated an estimated \$14.7 million in 1979-80 as salaries and wages to skippers and crew. (A salary for an owner-operator has been imputed.) An additional \$10 million was generated as flow-on salaries and wages in Queensland.

The income multipliers for the small boat fishery have been estimated to be similar across the economic regions, ranging from 0.33 to 0.36. Because there are no direct payments in the form of fishing income to participants, all the impacts are of a flow-on nature. The flow-on income generated in 1980 was nearly \$13 million.

The income multipliers for the charter boat sector show a greater range across the regions, from 0.44 to 0.69. The direct household income earned in the form of salaries and wages by this sector was in the order

of \$6.5 million in 1980 and an additional \$5.8 million was earned as flow-on income.

The employment multipliers vary across the fisheries. They are highest in the commercial fishery and lowest in the small boat fishery in which there is no direct employment. Within each fishery they are reasonably consistent across the regions.

For the entire Reef Region commercial fishery the flow-on has been estimated at over 1 000 full time jobs in Queensland, most of which were in the regional economies. The small boat fishery only generates flow-on employment, which has been estimated at over 1 300 jobs throughout Queensland. Most jobs were in the regional economies. The flow-on of employment in the charter boat sector generated over 600 jobs in Queensland and again most were in the regional economies.

The above paragraphs have summarised some of the important conclusions. The body of the book has dealt with these and other subjects in detail.

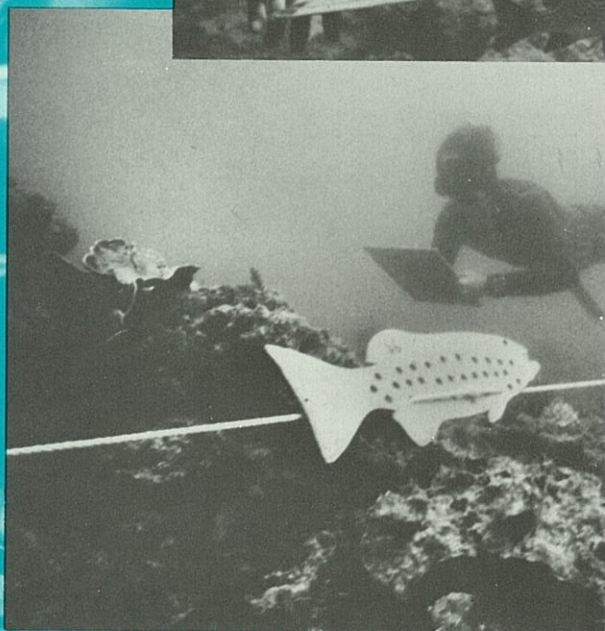
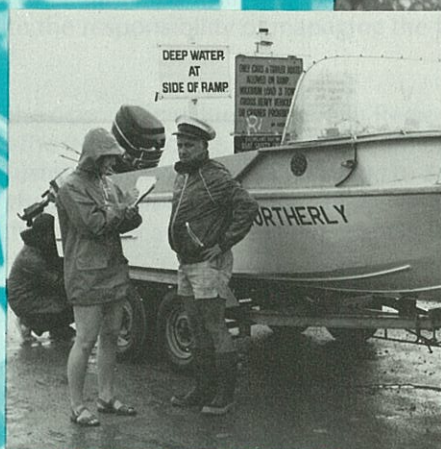
At this point in time, little else than that presented throughout this book could be written about the economic characteristics and significance of the Reef Region fisheries. While some finer detail could have been presented on some aspects, this probably would not have been warranted. The broad picture is the appropriate point of commencement. The detail can come later.

There are some gaps in the information on the fisheries, which has meant that either some features have been completely omitted or that broad generalisations have had to have been made. Considerably more investigation is required before a more thorough account can be given of all the Reef Region fisheries. This book establishes a base line on which future research can build.

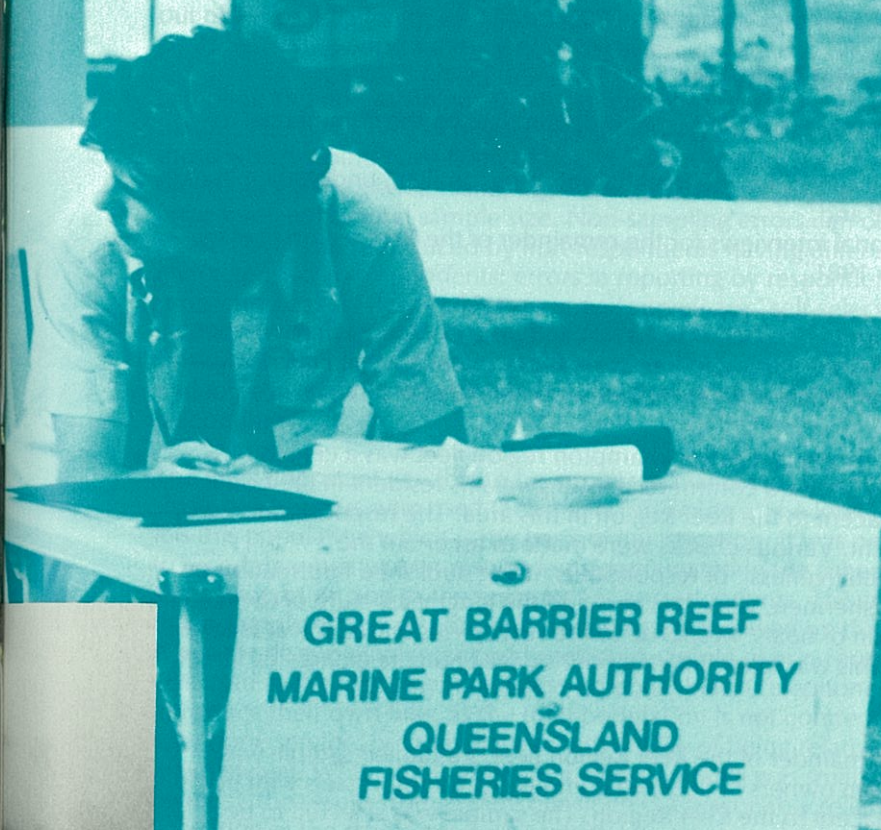
The data and analyses presented suggest that these fisheries have an economic significance most probably well beyond that which the casual observer might assign to them. Be that as it may, the author would not wish the reader to be solely concerned with the measures of economic significance presented herein. Such measures tell us little about the economic costs and benefits of the fisheries. For example, it is important to know how profitable the commercial fisheries are and, more importantly, by what management decisions could they be made more profitable. What number of commercial fishermen and what number of boats would be optimal, given the available resources? What are the optimum numbers of charter boats and recreational fishermen?

These and many more questions are obviously of interest, and hopefully of concern, to all participants in the fisheries and to those agencies charged with the responsibility of managing the fisheries of the Great Barrier Reef.

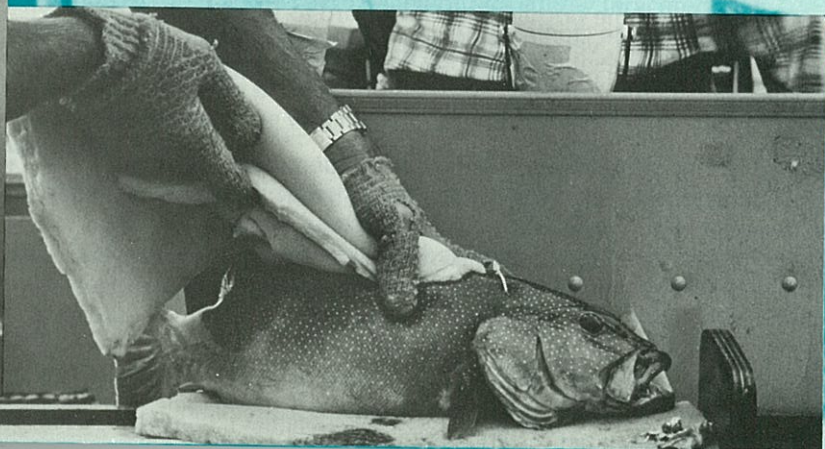
Ultimately the economic value of the Reef Region fisheries (that is, the net benefits the fisheries can provide to fishermen, consumers and the people of Australia) will depend on answers to the questions raised above and the management decisions made on the basis of those answers. It was not the author's task to address these issues. Someone must.



APPENDICES



GREAT BARRIER REEF
MARINE PARK AUTHORITY
QUEENSLAND
FISHERIES SERVICE



Appendix A DATA COLLECTION

The primary data on which most of the analyses in this book are based were gathered by use of normal data collection instruments; questionnaires administered as personal interviews, and by mail and by telephone.

Commercial Fisheries

Two surveys were undertaken to obtain data on the commercial fisheries:

- (i) a mail survey for the Rockhampton region fleet, undertaken in early 1980; and
- (ii) personal interviews for the remainder of the Reef region fleet in early 1981.

The different approaches used resulted from contractual requirements to provide information to the Great Barrier Reef Marine Park Authority at different points in time and within budgetary constraints.

The mail survey of the Rockhampton region fleet was a census of owners of licensed commercial fishing vessels resident in the home ports adjacent to the Reef Region in this area. The response rate was 46 per cent. Various checks were made to ascertain the "representativeness" of respondents, using published information on Master Fishermen, vessel owners and the length structure of the target population of boats. Response to the survey was biased towards larger vessels. This was taken into account by weighting responses by length strata.

For the remainder of the Reef Region fleet, a stratified sample was drawn from owners of licensed commercial fishing vessels with home ports adjacent to the Reef Region. The sample was selected to be representative of the population with regard to home port, type of fishing undertaken, vessel length, and period of operation in the fisheries, but vessel owners with an entitlement to fish in the DMZ were excluded.

A total of 150 personal interviews were undertaken. Information pertaining to boat characteristics, areas fished, places where fishing expenditure was made, and socio-economic characteristics of fishermen and crew were obtained from the owners or skippers. Financial data on costs and earnings were obtained, in virtually all cases, from owners' accountants.

The Small Boat Fishery

The data for the small-boat fishery were gathered by a mail survey and supplemented by personal interviews of fishermen at launching points (boat ramps). The mail survey sample was selected from Queensland Marine Board records of private boat registrations within the defined catchment area, as at December 1980. Every tenth boat was selected out of the population of 25 774 boats. The response rate was 28.5 per cent. No "follow-up" survey was undertaken.

Sampling and non-sampling errors can occur with any survey of this nature. There can be a difference in estimates based on the sample and those which would have been obtained from a census. These differences are known as sampling errors, and the scale of sampling error is related to total sample size. Non-sampling errors can occur as a result of biases introduced by non-respondents having different characteristics to respondents; errors in reporting by respondents; or processing errors. Respondents to a mail survey are "self-selecting", and it is thought that the degree of interest in the subject matter of the survey can be a factor determining response. Therefore, the issue that had to be resolved is whether respondents were representative of non-respondents.

The most important variable to be measured was the proportion of small-boat owners who used their boats for fishing in the Reef Region: it is this population which is the basis of investigation. It was necessary to ascertain whether non-respondents participated in the fishery in the same proportion and to the same extent as respondents. This meant that a sample of non-respondents had to be interviewed on this subject. A telephone survey of a randomly selected sample of non-respondents was used as the instrument to assess potential bias. (Telephone surveys introduce their own bias, as the total population is not connected to the telephone service, but they have an advantage of being relatively inexpensive). While the sample of non-respondents was small (61 boat owners), the results from it were considered a reasonably reliable validation of the mail survey. The telephone survey indicated that approximately four percent more non-respondents participated in the fishery than respondents to the mail survey, with the number of trips per annum being the same for both non-respondents and respondents. This marginal difference was not of concern, given the potential sampling error.

The potential sampling errors in estimating the proportion of boat owners who fished in the Reef Region were calculated on a regional basis. It was found that at the 95 percent confidence interval, the statistical error ranged from a low of plus or minus three percent to a high of plus or minus five percent.

Personal interviews of small-boat fishermen were undertaken at selected boat ramps, and the data gathered were used for comparison with the mail surveys. Various variables were investigated (for example, cost of boat, boat length, expenditure, and number of fishing trips) and, in all cases, only marginal differences were found to occur.

The Charter Boat Sector

Charter boat owners in all but the Cairns region were surveyed by mail questionnaire as the main instrument. Prior to the administration of the questionnaire, some operators were interviewed personally. The Cairns region fleet was subject to investigation by another researcher in 1979, and information gathered for that study was complemented by personal interviews in 1983.

The populations of charter boat operators were obtained at the time of the surveys from Harbour Masters at the relevant ports. All operators identified as undertaking some fishing charter work were surveyed. The response rate was 41 percent. Given the small number of operators and the lack of homogeneity (in terms of type of boat and services provided), it was not possible to determine with any reasonable degree of statistical validity the representativeness of the respondents. In this situation, respondents in each region were assumed to be representative of the populations in their respective regions.

Appendix B COMPARATIVE FISHERIES STATISTICS

Table 1: Australia: production of fish, crustaceans and molluscs, by principal types and quantity: 1969-70 and 1976-77 to 1980-81 (tonnes live weight)

Species	1969-70	1976-77	1977-78	1978-79	1979-80(a)	1980-81(a)
Fish						
Tuna	8 468	10 111	12 306	11 266	13 573	18 164
Australian Salmon	4 774	3 704	3 255	2 390	2 469	2 398
Shark	7 312	6 795	7 935	7 399	5 275	5 708
Mullet	5 285	5 664	6 095	5 600	5 930	6 471
Flathead	2 395	2 039	1 966	2 169	1 372	1 494
Whiting	—	2 803	2 382	2 566	2 173	2 337
Gemfish	—	2 187	2 493	4 648	3 806	4 024
Snapper	1 603	2 175	2 128	2 042	2 251	2 254
Other	25 614(b)	23 166	24 533	23 364	20 198	20 881
Total Fish	55 451	58 644	63 093	61 444	57 047	63 731
Crustaceans						
Rock Lobster	11 475	12 875	14 485	15 358	14 469	14 794
Prawns	13 393	23 095	19 272	21 724	21 994	26 921
Other	478	908	898	818	906	982
Total Crustaceans	25 346	36 878	34 653	37 900	37 369	42 697
Molluscs						
Oysters	9 379	10 793	8 786	6 740(c)	8 251(d)	8 277(d)
Scallops	5 562	4 396	9 121	10 548	5 594	7 261
Abalone	6 136	6 313	5 057	6 197	4 970	5 505
Other	592	1 128	1 579	1 800	2 563	1 664
Total Molluscs	21 669	22 630	25 543	25 285	21 378	22 707
Total Fish, Crustaceans and Molluscs	102 466	118 152	123 289	124 629	115 794	129 135

(a) Excludes South Australia (b) Includes whiting (c) Excludes Victoria
(d) Excludes Queensland and South Australia

Source: *Report of the Senate Standing Committee on Trade and Commerce, 1982* — based on *Fisheries Australia*, ABS, Cat. No. 7603.0, various issues.

Table 2: Australia: production of fish, crustaceans and molluscs, by principal types and gross value: alternate years 1972-73 to 1980-81 (\$ 000)

Species	1972-73	1974-75	1976-77	1978-79	1980-81(a)
Fish					
Tuna	4 736(a)	3 349	4 474	5 316	16 138
Australian Salmon	584(a)	1 065	1 147	993	1 339
Shark	787(a)	2 640	6 466	8 429	5 295
Mullet	1 686(a)	2 076	2 745	3 396	3 919
Flathead	796(a)	1 630	1 557	1 895	1 724
Whiting	2 041(a)	3 190	4 638	6 900	5 794
Gemfish	—	—	835	2 281	2 491
Snapper	1 317(a)	2 860	3 452	3 932	5 103
Morwong	498(a)	941	1 380	1 356	2 371
Other (b)	10 884(c)	12 232	17 313	22 003	23 115
Total Fish (b)	23 329	29 983	44 007	56 501	67 289
Crustaceans					
Rock Lobster	30 332	29 933	58 047	73 624	82 761
Prawns	23 122	24 682	65 781	100 648	127 393
Other	777	1 339	1 853	2 179	3 455
Total Crustaceans	54 231	55 954	125 681	176 451	213 609
Molluscs					
Oysters	6 838(d)	6 197(e)	12 998(e)	14 121(f)	21 011(e)
Scallops	5 728	1 884	1 988	5 381	8 184
Abalone	4 872	4 923	11 333	11 316	19 021
Other	174	333	745	1 537	2 184
Total Molluscs	17 612	13 337	27 064	32 355	50 400
Total Fish, Crustaceans and Molluscs	95 172	99 275	196 752	265 307	331 298

(a) Excludes Victoria (b) Includes value of seaweed harvested in Tasmania
(c) Includes Victorian production of all above species (d) Excludes Queensland
(e) Excludes Queensland and South Australia (f) Excludes South Australia

Source: *Report of the Senate Standing Committee on Trade and Commerce, 1982* — based on *Fisheries Australia*, ABS, Cat. No. 7603.0, various issues.

Table 3: Australia: production of fish, crustaceans and molluscs by State: 1980-81

	Tonnes live weight							Aust. (b)
	N.S.W.	Vic.(a)	Qld.	S.A.	W.A.	Tas.	N.T.	
Fish	28 025	10 000	4 864	14 721	11 961	2 527	1 634	63 732
Crustaceans	3 215	400	15 294	5 227	13 121	1 553	4 287	42 697
Molluscs	10 003	11 400	2 800(c)	1 338(c)	1 207	7 314	46	22 708
Total	41 243	21 800	22 958	21 286	26 289	11 394	5 967	129 137
	\$A 000							
Fish	27 893	15 500	7 036	16 311	10 128	3 654	2 267	67 289
Crustaceans	15 608	3 000	75 590	26 183	70 648	8 385	17 195	213 609
Molluscs	26 526	11 100	3 666(c)	3 688(c)	1 988	14 476	57	50 401
Total	70 027	29 600	86 292	46 182	82 764	26 515	19 519	331 299

(a) Department of Primary Industry estimate

(b) Excludes Victoria

(c) Excludes oysters

Source: *Report of the Senate Standing Committee on Trade and Commerce, 1982* — based on *Fisheries Australia*, ABS, Cat. No. 7603.0, various issues.

Table 4: Australia: production of prawns by State: estimated live weight

Year	N.S.W.	Vic.	Qld.	S.A.	W.A.	N.T.	Aust.
	t	t	t	t	t	t	t
1972-73	2 128	14	6 892	1 789	3 059	2 875	16 757
1973-74	2 755	4	11 222	2 921	3 101	4 489	24 491
1974-75	2 075	64	4 414	2 530	3 898	3 346	16 327
1975-76	2 472	59	6 646	2 679	4 432	3 191	19 478
1976-77	2 619	3	11 702	2 842	3 047	2 882	23 095
1977-78	2 430	33	8 428	2 276	3 940	2 165	19 272
1978-79	1 981	4	10 044	2 475	3 471	3 749	21 724
1979-80	2 436	4(a)	10 576	2 445	3 387	3 147	21 995(a)
1980-81	2 736	5(a)	14 448	2 395	3 083	4 259	26 926(a)
1981-82(a)	2 700	20	10 000	2 700	2 955	3 000	21 375

(a) Department of Primary Industry preliminary estimates

Source: BAE, *Situation and Outlook 1983: Fish Products* based on *Fisheries Australia*, Cat. No. 7603.0, Canberra, various issues.

**Table 5: Australia: production of finfish: by State^(a):
Live weight**

Year	N.S.W.	Vic.	Qld.	S.A.	W.A.	Tas.	N.T.	Total
	t	t	t	t	t	t	t	t
1972-73	14 606	7 537	5 396	4 295	4 781	1 764	618	38 997
1973-74	16 129	7 439	5 579	4 688	5 031	3 013	846	42 725
1974-75	15 167	8 298	5 943	3 594	4 893	2 104	781	40 780
1975-76	14 920	6 609	5 299	4 918	6 614	1 743	978	41 081
1976-77	17 261	9 487	5 397	4 220	5 724	1 555	1 483	45 127
1977-78	16 675	8 686	5 673	4 003	8 185	2 449	1 451	47 122
1978-79	19 115	9 053	5 056	4 210	6 617	2 097	1 634	47 786
1979-80	21 341	9 850(b)	4 758	4 495	7 153	1 874	1 352	50 823(b)
1980-81(b)	21 370	9 840	4 640	4 130	7 085	2 180	1 555	50 800(s)
1981-82(s)	21 450	9 880	4 660	4 150	7 110	2 190	1 560	51 000

(a) Figures exclude tuna and Australian salmon, anchovies, pilchards and sprats for Victoria and the estimated catch landed at Triabunna (Tasmania) for fish meal production in 1973-74.

(b) Department of Primary Industry preliminary estimates.

(s) Estimated by BAE.

Source: BAE, Situation and Outlook 1983: Fish Products based on ABS, *Fisheries Australia*, Cat. No. 7603.0, Canberra (various issues); Victorian Department of Fisheries and Wildlife.

**Table 6: Australia: production of scallops: by State:
Live weight**

Year	N.S.W.	Vic.	Qld.	S.A.	W.A.	N.T.	Total
	t	t	t	t	t	t	t
1972-73	114	11 807	4 082	151	283	515	16 952
1973-74	8	7 110	3 349	736	64	1 158	12 425
1974-75	—	3 010	1 497	143	151	1 261	6 062
1975-76	—	2 792	912	—	248	690	4 642
1976-77	—	2 888	494	—	510	498	4 390
1977-78	—	5 107(a)	2 737	N.A.	876	400	9 120(a)
1978-79	2	5 841(a)	3 232	N.A.	396	1 077	10 548(a)
1979-80	104	6 942(b)	1 394	N.A.	260	3 829	12 529(b)
1980-81	626	9 010(b)	2 596	N.A.	665	3 359	16 256(b)
1981-82(b)	700	18 000	2 266	N.A.	645	7 600	29 211

(a) Victorian figures not comparable with previous years.

(b) Department of Primary Industry preliminary estimates.

N.A. — Not Available.

Source: BAE, Situation and Outlook 1983: Fish Products based on ABS, *Fisheries Australia*, Cat. No. 7603.0, Canberra, various issues.

Table 7: Edible Fisheries Production by Species, Queensland: Fish, Crustaceans, and Molluscs (Live Weight) (Tonnes)

Species (common name)	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
Fish									
Bream, including tarwhine	227	256	275	311	280	274	244	158	229
Butterfish	30	59	51	56	36	27	25	—	—
Cod, including coral trout	269	252	165	247	174	174	174	—	—
Emperor and red emperor	263	327	289	288	223	163	205	—	—
Flathead	90	103	111	96	80	83	80	69	61
Garfish	68	65	42	42	36	39	54	—	—
Giant perch (barramundi)	400	217	428	304	381	560	524	227	263
Kingfish	(a)	21	8	5	5	8	14	—	—
Luderick	61	83	152	84	127	125	86	—	—
Mackerel: School	133	95	43	107	144	58	29	—	—
Spanish	1 111	986	1 096	964	924	1 029	734	786	824
Mullet	1 448	1 684	1 543	1 466	1 358	1 557	1 315	1 380	1 514
Mulloway	34	50	47	44	51	55	58	—	—
Parrot	(a)	10	11	11	12	13	16	—	—
Pearl perch	(a)	1	1	10	34	28	28	—	—
Queenfish	(a)	18	41	27	22	28	32	—	—
Dart	(a)	66	59	60	60	47	55	—	—
Ray	(a)	4	39	19	26	20	34	49	—
Shark	(a)	71	118	93	158	153	129	138	N.A.
Snapper	61	296	419	178	202	183	247	114	114
Tailor	277	147	156	231	153	301	292	178	165
Threadfin	(a)	22	19	18	21	23	21	—	—
Trevally	(a)	23	22	14	28	24	29	4	13
Tuna	(a)	324	389	380	406	354	317	318	297
Whiting	482	306	366	336	416	371	343	1 283	1 384
Other and unspecified									
Total	5 424	5 602	5 971	5 313	5 425	5 697	5 085	4 762	4 864

Table 7: Continued

Species (common name)	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
Crustaceans									
Crabs: Mud Sand	176	225	222	190	214	224	185	431	550
Unspecified	206	168	210	190	211	258	240	—	—
Lobsters	173	44(b)	104	60(b)	48(b)	126(b)	278	247(b)	296(b)
Prawns: Banana King	3 401	6 947	2 109	3 747	7 153	2 380	3 658	—	—
Tiger	1 041	1 183	972	816	997	1 193	1 262	—	—
Endeavour	1 373	1 296	624	1 107	2 066	3 198	3 358	10 579	14 448
Greentail	366	346	224	329	967	981	1 058	—	—
Other and unspecified	490	1 119	365	413	328	(a)	(a)	—	—
	221	331	121	234	191	676	708	—	—
Total	7 447	11 659(b)	4 951	7 086(b)	12 183(b)	9 035(b)	10 748	11 258(b)	15 294
Molluscs (c)									
Cuttlefish	—	—	—	—	—	—	1	—	—
Octopus	—	—	—	—	—	1	1	1	—
Scallops	4 082	3 349	1 497	912	494	2 737	3 232	1 394	2 596
Squid	98	65	106	90	82	120	113	197	204
Total	4 181	3 414	1 603	1 002	576	2 858	3 346	1 593	2 800

N.B. The totals in this table do not always agree with those in Tables 4, 5 and 6. The most significant differences are between Table 5 and this table.

(a) Included with "Other and unspecified".

(b) Excluding tropical rock lobsters: comprises Moreton Bay lobster only.

(c) Excluding oysters, for which data are not available.

Source: ABS, *Fisheries Statistics*, Queensland. Cat. No. 7601.3 (Queensland Office), various issues.

Table 8: Quantity and Value of Fisheries Production in Queensland

Year	Fish		Prawns		Other Crustaceans(a)		Scallops		Other Molluscs(b)		All Fisheries Total Value (\$M)
	Quantity (tonnes)	Value (\$M)	Quantity (tonnes)	Value (\$M)	Quantity (tonnes)	Value (\$M)	Quantity (tonnes)	Value (\$M)	Quantity (tonnes)	Value (\$M)	
1972-73	5 424	3.2	6 892	7.4	555	0.6	4 082	0.9	98	—	12.1
1973-74	5 602	3.3	11 222	10.1	437	0.5	3 349	0.6	65	—	14.5
1974-75	5 971	4.1	4 414	6.5	537	0.8	1 497	0.4	106	0.1	11.9
1975-76	5 313	4.7	6 646	10.5	440	0.8	912	0.4	90	0.1	16.5
1976-77	5 425	5.3	11 702	26.9	480	1.1	494	0.2	82	0.1	33.6
1977-78	5 697	6.1	8 428	30.0	607	1.4	2 737	1.5	121	0.1	39.1
1978-79	5 085	6.4	10 044	47.7	703	1.9	3 232	1.8	115	0.2	58.0
1979-80	4 758	7.1	10 576	51.9	682	1.7	1 394	1.8	199	0.3	62.8
1980-81	4 864	7.0	14 448	73.1	846	2.5	2 596	3.4	204	0.3	86.3
1981-82	4 660		10 000								

(a) Tropical rock lobsters are excluded for the years 1972-73, 1973-74, 1975-76, 1976-77, and 1977-78. (b) Oysters are excluded.

Source: ABS, *Fisheries Statistics*, Queensland. Cat. No. 7601.3 (Queensland Office), various issues; and Bureau of Agricultural Economics: 1981-82 estimates.

Table 9: Value of Fisheries Production in Queensland in Constant Prices (1980-81 Prices)

	Fish	Prawns	Other Crustaceans	Scallops	Other Molluscs	Total
1972-73	7.8	18.0	1.5	2.2	—	29.4
1973-74	6.8	21.7	1.1	1.3	—	31.1
1974-75	7.6	12.0	1.5	0.7	0.2	22.0
1975-76	7.6	17.0	1.3	0.6	0.2	26.7
1976-77	7.5	38.1	1.6	0.3	0.1	47.6
1977-78	7.9	38.9	1.8	1.9	0.1	50.6
1978-79	7.7	57.3	2.3	2.2	0.2	69.7
1979-80	7.8	56.7	1.9	2.0	0.3	68.6
1980-81	7.0	73.1	2.5	3.4	0.3	86.3

Dollar values are rounded off to the nearest \$100 000. The totals do not necessarily equal the sum of the parts as a consequence of rounding.

The values in Table 9 have been converted to constant prices by using the Consumer Price Index for all State capital cities.

Table 10: Value of Fishing Boats^(a) and Gear: Australia and Queensland

Year	Australia		Queensland	
	Number of Boats	Value of Boats and Gear (\$M)	Number of Boats	Value of Boats and Gear (\$M)
1972-73	10 760	114	2 204	30
1973-74	10 532	142	2 314	34
1974-75	9 830	191	2 627	48
1975-76	9 110	226	2 318	53
1976-77	9 515	248	2 081	58
1977-78	10 920	N.A.	2 209	75
1978-79	12 923	413	3 829(b)	118

(a) Boats used for oyster fisheries, pearl-shell and trochus-shell fisheries, and whaling are excluded.

(b) Tenders are included.

Source: The figures for Australian fisheries are from: ABS, *Fisheries Australia*, Cat. No. 7603.0 Canberra, various issues.

The Queensland figures are from ABS, *Fisheries Statistics Queensland*, Cat. No. 7601.3 (Queensland Office), various issues.

Table 11: General Fisheries^(a), Queensland: Boats^(b), Equipment, and Employment at 31 December 1973 to 1978

Classification		1973	1974	1975	1976	1977	1978
Registered boats(c)	No.	2 314	2 627	2 318	2 081	2 209	3 829
Value of Boats	\$ 000	31 162	44 269	49 515	53 637	69 603	105 935
Value of Equipment	\$ 000	2 608	3 461	3 859	4 056	5 424	11 980
Tender Boats	No.	988	1 001	1 159	1 220	N.A.	N.A.
Value of Tender Boats	\$ 000	403	456	596	854	N.A.	N.A.

(a) Excluding pearl-shell, trochus-shell, and oyster fisheries.

(b) The figures for 1978 are not comparable with figures for previous years. This is because "tender boats" ceased to be a separate category in 1978.

(c) Decrease in 1975 due principally to changes in requirements associated with registration of boats.

Source: ABS, *Fisheries Statistics, Queensland*, Cat. No. 7601.3 (Queensland Office), various issues.

Table 12: Persons Employed on Fishing Boats

Year	Australia	Queensland
1972-73	19 208	4 346
1973-74	19 072	4 674
1974-75	18 403	5 417
1975-76	17 037	4 633
1976-77	17 613	4 091
1977-78	N.A.	4 285
1978-79	N.A.	4 500

The number of persons excludes those engaged in pearl-shell and trochus-shell fisheries, whaling and oyster fisheries. Included are all persons, including skippers and part-time crew, usually employed on the boats. There is some double counting involved, because persons usually employed on more than one boat for a particular year are counted more than once for that year.

Source: ABS, *Fisheries Australia*, Cat. No. 7603.0, Canberra, various issues and *Fisheries Statistics*, Cat. No. 7601.3 (Queensland Office), various issues.

Table 13: Private Motor Boat Registrations Queensland 1968-83

Date	Total Number of Registrations			
	Speed Boats	Motor Boats	Total	Increase
As at 30.6.68	14 981	5 747	20 638	—
As at 30.6.69	18 504	6 136	25 640	24%
As at 30.6.70	21 849	6 711	28 560	11%
As at 30.6.71	24 840	7 284	32 124	12%
As at 30.6.72	29 015	8 354	37 269	16%
As at 30.6.73	33 355	9 223	42 578	14%
As at 30.6.74	38 467	9 979	48 446	14%
As at 30.6.75	44 058	10 752	54 810	13%
As at 30.6.76	49 879	11 267	61 146	11½%
As at 30.6.77	55 222	11 341	66 563	9%
As at 30.6.78	58 687	11 442	70 129	5%
As at 30.6.79	60 865	11 936	72 801	4%
As at 30.6.80 (a)	—	—	72 057	—
As at 30.6.81 (a)	—	—	74 429	2%
As at 30.6.82 (a)	—	—	78 970	6%
As at 30.6.83 (a)	—	—	84 252	7%

(a) From 1980 on the figures are not strictly comparable to those in previous years. In previous years some number of cancelled registrations are included.

Source: Queensland Marine Board, published statistics.

Appendix C DETAILED STATISTICS ON BOAT NUMBERS AND FISHERMEN

Table 1: Otter Trawl Fishermen: Number Working and Period Worked

Region ^(a)	Number of Fishermen Working		% Change	Total Months Worked		% Change
	1979	1981		1979	1981	
Southern	808	760	-6	5 776	4 488	-22
Gladstone	315	492	+56	1 454	1 805	+24
Mackay	350	387	+11	603	1 016	+68
Townsville- Cairns	616	686	+11	2 339	2 674	+14
North Coast	356	447	+26	575	1 070	+86
Torres Strait	276	283	+2	353	740	+110
Gulf of Carpentaria	217	209	-4	1 128	1 048	-7
TOTAL	1 345	1 489	+11	12 228	12 841	+5

(a) The regions as defined here are different from the definitions used in this book: Southern is south of the Reef Region; Gladstone is the same as the Rockhampton region; Mackay is the same as the Mackay region; Townsville-Cairns encompasses the Townsville region plus the Cairns region as far north as Cooktown; the North Coast is part of the Cairns region.

Source: Hill, B., 1983, unpublished.

Various interesting factors can be gleaned from Table 3. Probably the most striking is the wide range in both boat lengths and values. While length differences in otter trawlers are not too pronounced (though at the lower end some are very small), the range in market values is extreme. There are some old, small boats with little resale value. Some of the net fishing and crab boats are tiny, little more than an aluminium shell with a small outboard, and if both the hull and engine are old their resale value is very low. Others are large and high-powered, and if near new they would command a high market price.

Some minor regional differences are obvious. Consider the length of boats in the otter trawler fleets at regional levels. With regard to the minimum and maximum lengths and the average lengths there are not

Table 2: Estimated Values^(a) for the Reef Region Fleets, According to Area: 1981

Economic Region	Otter Trawlers	
	Number of boats ^(b)	Market Value (\$ million)
Rockhampton	129	10.3
Mackay	34	1.7
Townsville	139	12.3
Cairns	183	20.3
TOTALS	485	44.6
Economic Region	Other Boats	
	Number of boats ^(b)	Market Value (\$ million)
Rockhampton	140	N.A.
Mackay	106	1.5
Townsville	149	2.3
Cairns	195	5.1
TOTALS	590	8.9 +
Economic Region	Regional Totals (\$ million)	
Rockhampton	10.3 +	
Mackay	3.2	
Townsville	14.6	
Cairns	25.4	
TOTALS	53.5 +	

(a) Values are to the nearest \$100 000.

(b) These are estimates of boat numbers at the time the surveys were undertaken: 1980 for the Rockhampton region and 1981 for the other regions.

great differences though the Mackay based fleet does not include boats as large as the more northern fleets. This difference in length is reflected in a lower average market value for the Mackay based boats, but of course other factors, for example age of boats, play a role. With regard to the size of boats other than otter trawlers, again there is not much difference between areas, though the Cairns based fleet has the longest boats on average. Where there are regional differences they pertain to the value of boats. Given the significant difference between the comparatively high average value of the Cairns based boats and those from other home ports, it is necessary to look beyond differences in average length for explanation.

Table 3: Boat Length and Market Value: the Range and Average, According to Area: 1981

Economic Region	Otter Trawlers			
	Length (metres)		Market Value (\$' 000)	
	Range	Av.	Range	Av.
Rockhampton	N.A.	13.0	N.A.	80
Mackay	8.9-13.7	11.4	15-110	51
Townsville	7.0-16.5	12.4	9-250	89
Cairns	8.5-17.1	12.6	15-325	111

Economic Region	Other Boats			
	Length (metres)		Market Value (\$' 000)	
	Range	Av.	Range	Av.
Rockhampton	N.A.	N.A.	N.A.	N.A.
Mackay	3.2-12.8	6	2-80	14
Townsville	4.1-12.2	7.3	1-80	16
Cairns	3.9-14.3	7.7	1-68	26

Table 4: Average Length and Main Engine Power, (a) According to Area

Economic Region	Otter Trawlers		Other Vessels	
	Av. Length (metres)	Av. Main Engine Power (kw)	Av. Length (metres)	Av. Main Engine Power (kw)
Rockhampton	13.0	N.A.	N.A.	N.A.
Mackay	11.4	100	6.0	40
Townsville	12.4	100	7.3	50
Cairns	12.6	110	7.7	70

(a) Engine power has been rounded to the nearest 10kw.

The information in Table 4 is self explanatory. The only comment which is warranted pertains to information which is hidden by using averages. The table does not show the range for engine power, which for both classes of vessels and for all regions is considerable. The most powerful boats in both categories have engines up to 250kw. The least powerful boats are obviously in the "other" category, with the modal (most common) engine power in all areas being between 15kw and 20kw.

The size of a boat (generally measured in terms of length) and its main engine power determine what climatic conditions a boat can fish in, how far it can travel from its home port (or the port it is temporarily

operating from), how much gear it can stow (in the case of small boats), how many nets it can tow if trawling, and the quantity of catch it can hold. Boat size and engine power are also very important factors in the running costs of a boat, moreso in recent years with fuel costs increasing relative to many other costs.

Appendix D DETAILED COST AND INCOME DATA

**Table 1: Financial Costs and Income for Cairns Region Fleet:
Average for Three Years: 1979-80 Prices**

Item	Otter Trawlers		Other Boats		Total Fleet	
	Inside Region	Outside Region	Inside Region	Outside Region	Inside Region	Outside Region
Crew Payments	1 067 805		119 730		1 187 535	
Commission and Selling Costs	38 613		19 305		57 918	
Freight and Cartage	16 653		780		17 433	
Food	261 141	7 137	12 090		273 231	7 137
Fuel	1 052 616	22 875	133 380		1 185 996	22 875
Bait	3 843		0		3 843	
Boat Repairs and Maintenance	1 359 507	49 410	255 450		1 614 957	49 410
Gear Replacement and Repairs	353 922	14 457	123 045		476 967	35 907
Boat Insurance	68 991	219 051	5 070	21 450	74 061	229 386
Vehicle Cost	177 327		59 475		236 802	

Table 1: Continued

Item	Otter Trawlers		Other Boats		Total Fleet	
	Inside Region	Outside Region	Inside Region	Outside Region	Inside Region	Outside Region
Harbour Dues and Licences	89 670	6 954	42 315		131 985	6 954
Accountancy	39 528	9 150	13 065		52 593	9 150
Banking and Postage	115 839		20 280		136 119	
Travel	160 308		2 535		162 843	
Subscriptions	1 464		1 950		3 414	
Rates and Land Taxes	4 575		5 850		10 425	
Rental and Hire	78 690	20 313	3 510		82 200	20 313
Miscellaneous	55 266		3 900		59 166	
Interest	341 478	167 079	26 715	49 920	368 193	216 999
Packing Costs	5 856		20 865		26 721	
Depreciation	976 854		341 835		1 318 689	
Other	12 444		14 625		27 069	
Expenditure: Sub-Total	6 282 390	516 426	1 225 770	81 705	7 508 160	598 131
Total Expenditure	6 798 816		1 307 475		8 106 291	
TOTAL INCOME					10 789 428	

**Table 2: Adjusted Costs^{(a)(b)}, Cairns Region Fleet:
Average for Three Years: 1979-80 Prices**

Expenditure Category	Amount Spent in Cairns Region \$	Amount Spent Outside Cairns Region \$
Wages and Salaries ^(a)	4 785 535	
Commission	57 918	
Freight and Cartage	17 433	
Food	273 231	7 137
Fuel	1 185 996	22 875
Bait	3 843	
Boat Repairs and Maintenance	1 614 957	49 410
Gear Replacement and Repairs	476 967	35 907
Boat Insurance	74 061	229 386
Vehicle Cost	236 802	6 954
Harbour Dues and Licences	131 985	9 150
Accountancy	52 593	
Banking and Postage	136 119	
Travel	162 843	
Subscriptions	3 414	
Rates and Land Taxes	10 425	
Rental and Hire	82 200	
Miscellaneous	59 166	20 313
Packing Costs	26 721	
Depreciation	1 318 689	
Electricity and Water	27 069	
Sub-Total	10 737 967	381 132
TOTAL	\$11 119 099	

(a) Includes an imputed value for owner-operators' salary, totalling \$3 598 000. The number of owner-operators in the Cairns region fleet was 378. On the basis of time spent fishing in a normal year, the number converts to 326 full-time equivalents: 169 other trawl fishermen and 157 other fishermen.

(b) Excludes interest payments.

**Table 3: Financial Costs and Income for Townsville Region Fleet:
Average for Three Years: 1979-80 Prices**

Item	Otter Trawlers		Other Boats		Total Fleet	
	Inside Region	Outside Region	Inside Region	Outside Region	Inside Region	Outside Region
Crew Payments ^(a)	607 569		77 182		684 751	
Commission and Selling Costs	16 958		22 797		39 755	
Freight and Cartage	4 170		4 172		8 342	
Food	102 721	7 784	17 731	447	120 452	8 231
Fuel	506 794	27 522	120 541	1 490	627 335	29 012
Bait	1 807	1 946	1 937		3 744	1 946
Boat Repairs and Maintenance	783 404	145 394	130 226	30 247	913 630	175 641
Gear Replacement and Repairs	173 055	95 632	30 843	18 476	203 898	114 108
Boat Insurance	84 929	38 225		5 215	84 929	43 440
Vehicle Cost	92 713		39 634		132 347	

Table 3: Continued

Item	Otter Trawlers		Other Boats		Total Fleet	
	Inside Region	Outside Region	Inside Region	Outside Region	Inside Region	Outside Region
Harbour Dues and Licences	54 766		30 992		85 758	
Accountancy	24 186	7 089	7 301		31 487	9 324
Banking and Postage	40 032	4 309	15 645	2 235	55 677	4 309
Travel	48 094		7 450		55 544	
Subscriptions	1 390		745		2 135	
Rates and Land Taxes	3 197		8 046		11 243	
Rental and Hire	118 567		4 768		123 335	
Miscellaneous	40 449		26 075		66 524	
Interest	156 375		34 568		190 943	
Packing Costs	2 085		4 470		6 555	
Depreciation	540 710		147 212		687 922	
Other	27 800		57 961		85 761	
Expenditure: Sub-Total	3 431 771	327 901	790 296	58 110	4 222 067	386 011
TOTAL EXPENDITURE		3 759 672		848 406		4 608 078
Income: Sub-Total	4 816 489	227 960	1 098 428	290 550	5 914 917	518 510
TOTAL INCOME		5 044 449		1 388 978		6 433 427

(a) Excludes skippers' Income

**Table 4: Adjusted Costs^{(a)(b)}, Townsville Region Fleet:
Average for Three Years: 1979-80 Prices**

Expenditure Category	Amount Spent in Townsville Region \$	Amount Spent Outside Townsville Region \$
Wages and Salaries ^(a)	3 458 751	
Commission	39 755	
Freight and Cartage	8 342	
Food	120 452	8 231
Fuel	627 335	29 012
Bait	3 744	1 946
Boat Repairs and Maintenance	913 630	175 641
Gear Replacement and Repairs	203 898	114 108
Boat Insurance	84 929	43 440
Vehicle Cost	132 347	
Harbour Dues and Licences	85 858	
Accountancy	31 487	9 324
Banking and Postage	55 677	4 309
Travel	55 544	
Subscriptions	2 135	
Rates and Taxes	11 243	
Rental and Hire	123 335	
Miscellaneous	66 524	
Packing Costs	6 555	
Depreciation	687 922	
Electricity and Water	85 761	
Sub-Total	6 805 224	386 011
TOTAL	\$7 191 235	

(a) Includes an imputed value for owner-operators' salary, totalling \$2 774 000. The number of owner-operators in the Townsville region fleet was 288. On the basis of the time spent fishing in a normal year, this number converts to 252 full-time equivalents: 127 otter trawl fishermen and 125 other fishermen.

(b) Excludes interest payments.

**Table 5: Financial Costs and Income for Mackay Region Fleet:
Average for Three Years: 1979-80 Prices**

Item	Otter Trawlers		Other Boats		Total Fleet	
	Inside Region	Outside Region	Inside Region	Outside Region	Inside Region	Outside Region
Crew Payments ^(a)	145 452		354 676		500 128	
Commission and Selling Costs	6 120		77 274		83 394	
Freight and Cartage	442		636		1 078	
Food	22 848		92 962		115 810	
Fuel	84 762		241 680		326 442	
Bait	1 462	5 202	2 968	25 228	4 430	30 430
Boat Repairs and Maintenance	129 200		192 920		322 120	
Gear Replacement and Repairs	952	12 648	32 330	2 226	33 282	14 874
Boat Insurance	680	10 642	8 480	4 770	9 160	15 412
Vehicle Cost	8 398		50 138		58 536	

Table 5: Continued

Item	Otter Trawlers		Other Boats		Total Fleet	
	Inside Region	Outside Region	Inside Region	Outside Region	Inside Region	Outside Region
Harbour Dues and Licences	16 932		33 814		50 746	
Accountancy	2 278		5 088		7 366	1 194
Banking and Postage	12 206	1 088	12 508	106	24 714	
Travel	544		4 346		4 890	
Subscriptions	340				340	
Rates and Land Taxes	8 942		2 544		11 486	
Rental and Hire	13 702		1 696		15 398	
Miscellaneous	4 488		21 624		26 112	
Interest	15 742		17 278		33 020	
Packing Costs	3 196		2 332		5 528	
Depreciation	122 978		180 094		303 072	
Other	7 548		8 268		15 816	
Expenditure: Sub-Total	609 212	73 644	1 343 656	32 330	1 952 868	105 974
Total Expenditure	682 856		1 375 986		2 058 842	
TOTAL INCOME	687 820		1 400 366		2 088 186	

(a) Excludes skippers' Income

Table 6: Adjusted Costs^{(a)(b)}, Mackay Region Fleet: Average for Three Years: 1979-80 Prices

Expenditure Category	Amount Spent in Mackay Region \$	Amount Spent Outside Mackay Region \$
Wages and Salaries ^(a)	1 598 128	
Commission	83 394	
Freight and Cartage	1 078	
Food	115 810	
Fuel	326 442	
Bait	4 430	30 430
Boat Repairs and Maintenance	322 120	44 064
Gear Replacement and Repairs	33 282	14 874
Boat Insurance	9 160	15 412
Vehicle Cost	58 536	
Harbour Dues and Licences	50 746	
Accountancy	7 366	1 194
Banking and Postage	24 714	
Travel	4 890	
Subscriptions	340	
Rates and Taxes	11 486	
Rental and Hire	15 398	
Miscellaneous	26 112	
Packing Costs	5 528	
Depreciation	303 072	
Other	15 816	
Sub-Total	3 017 848	105 974
TOTAL	3 123 822	

(a) Includes an imputed value for owner-operators' salary, totalling \$1 098 000. The number of owner-operators in the Mackay region fleet was 140. On the basis of the time spent fishing in a normal year this figure converts to 104 full-time equivalents: 29 otter trawl fishermen and 75 other fishermen.

(b) Excludes interest payments.

Table 7: Financial Costs and Income for Rockhampton Region Fleet: 1978-79

Item	Inside Region \$	Outside Region \$	Total \$
Crew Payments ^(a)	1 470 000		1 470 000
Food	296 000	33 000	329 000
Fuel	952 700	105 800	1 058 500
Boat Repairs and Maintenance/Gear Replacement and Repairs	1 876 100	311 300	2 187 400
Boat Insurance	218 000		218 000
Depreciation	600 000		600 000
All Others (Including interest, licence fees, general business expenses)	229 800		229 800
Total Expenditure	5 462 600	450 100	6 092 700
TOTAL INCOME			7 704 500

(a) Excludes skippers' Income

Table 8: Adjusted Costs^{(a)(b)}, Rockhampton Region Fleet: 1978-79

Item	Amount Spent in Rockhampton Region \$	Amount Spent Outside Rockhampton Region \$	Total \$
Crew Payments ^(a)	4 418 000		4 418 000
Food	296 000	33 000	329 000
Fuel	952 700	105 800	1 058 500
Boat Repairs and Maintenance/Gear Replacement and Repairs	1 876 100	311 300	2 187 400
Boat Insurance	218 000		218 000
Depreciation	600 000		600 000
All Others	166 100		166 100
TOTAL	8 526 900	450 100	8 977 000

(a) Includes an imputed value for owner-operators' salary, totalling \$2 948 000. The number of owner-operators in the Rockhampton region fleet was 269. In this case conversion to full-time equivalents was not undertaken.

(b) Excludes interest payments.

Table 9: Financial Costs and Income for Rockhampton Region Fleet: 1979-80 Prices^(a)

	Inside Region \$	Outside Region \$	Total \$
Expenditure	6 205 506	495 002	7 700 508
Income			8 470 000

(a) Table 7 totals converted to 1979-80 values

Table 10: Adjusted Costs for Rockhampton Region Fleet: 1979-80 Prices^(a)

	Inside Region \$	Outside Region \$	Total \$
Expenditure	9 377 544	495 002	9 872 546

(a) Table 8 totals converted to 1979-80 value

Table 11: Annual Costs for the Reef Region Small Boat Fleet, by Region: 1980 Prices

Expenditure Category	Cairns	Townsville	Mackay	Rockhampton	Reef Region
	Cost (\$)	Cost (\$)	Cost (\$)	Cost (\$)	Cost (\$)
Boats, motors, trailers	4 917 290	7 136 640	2 023 063	3 423 240	17 500 233
Boat equipment	154 100	297 608	168 964	128 190	748 862
Boat maintenance	1 461 420	1 054 080	296 058	1 194 360	4 005 918
Fishing gear	261 220	228 960	158 417	337 440	986 037
Boat insurance	162 380	367 200	77 910	301 920	909 410
Boat licence fees	187 090	211 680	119 462	224 442	742 674
Vehicle fuel	285 718	449 280	368 774	1 278 720	2 382 492
Boat fuel	1 242 560	1 339 200	734 951	1 811 520	5 128 231
Bait	353 000	241 920	137 641	355 200	1 087 761
Ice	109 430	133 920	54 537	161 971	459 858
Incidentals	82 531	66 960	20 776	95 371	265 638
Food for fishing trip	737 770	812 160	373 968	959 040	2 882 938
TOTAL	9 954 509	12 339 608	4 534 521	10 271 414	37 100 052

Appendix E DISAGGREGATED MULTIPLIERS

Table 1: Output^(a) Multipliers for the Commercial Fishery

Region	Impact Area	Initial Impact	First Round	Industrial Support	Production Induced	Consumption Induced	Total	Flow-on
Rockhampton	Within Region	1.000	0.184	0.053	0.237	0.519	1.756	0.756
	Within State	1.000	0.201	0.104	0.305	0.800	2.105	1.105
Mackay	Within Region	NA	NA	NA	NA	NA	1.740	0.740
	Within State	NA	NA	NA	NA	NA	2.033	1.033
Townsville	Within Region	1.000	0.177	0.043	0.220	0.555	1.776	0.776
	Within State	1.000	0.206	0.100	0.306	0.733	2.039	1.039
Cairns	Within Region	1.000	0.219	0.059	0.278	0.495	1.772	0.772
	Within State	1.000	0.235	0.110	0.346	0.742	2.088	1.088

(a) Per dollar of output. Rounding errors occur.

Table 2: Income^(a) Multipliers for the Commercial Fishery

Region	Impact Area	Initial Impact	First Round	Industrial Support	Production Induced	Consumption Induced	Total	Flow-on	Type IIA	Type IIB
Rockhampton	Within Region	0.492	0.067	0.017	0.084	0.185	0.762	0.270	1.549	0.549
	Within State	0.492	0.060	0.027	0.087	0.255	0.834	0.342	1.695	0.695
Mackay	Within Region	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Within State	NA	NA	NA	NA	NA	NA	NA	NA	NA
Townsville ^(b)	Within Region	0.439	0.073	0.014	0.087	0.195	0.722	0.283	1.645	0.645
	Within State	0.439	0.066	0.026	0.092	0.234	0.765	0.326	1.742	0.742
Cairns	Within Region	0.430	0.087	0.018	0.105	0.178	0.714	0.284	1.659	0.659
	Within State	0.430	0.077	0.030	0.107	0.237	0.774	0.344	1.799	0.799

(a) Per dollar of output. Rounding errors occur.

(b) In the calculation of the flow-on effects at regional and state-wide levels the Townsville region multipliers presented here give marginally different results to those presented in the text.

Table 3: Employment^(a) Multipliers for the Commercial Fishery

Region	Impact Area	Initial Impact	First Round	Industrial Support	Production Induced	Consumption Induced	Total	Flow-on	Type IIA	Type IIB
Rockhampton	Within Region	0.046	0.007	0.002	0.009	0.018	0.073	0.027	1.570	0.570
	Within State	0.046	0.006	0.003	0.009	0.024	0.080	0.034	1.717	0.717
Mackay	Within Region	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Within State	NA	NA	NA	NA	NA	NA	NA	NA	NA
Townsville	Within Region	0.045	0.007	0.001	0.008	0.018	0.072	0.027	1.610	0.610
	Within State	0.045	0.007	0.003	0.010	0.022	0.076	0.031	1.710	0.710
Cairns	Within Region	0.040	0.010	0.002	0.012	0.017	0.069	0.029	1.716	0.716
	Within State	0.040	0.008	0.003	0.011	0.023	0.073	0.033	1.836	0.836

(a) Per \$1 000 of output. Rounding errors occur.

Table 4: Output^(a) Multipliers for the Small Boat Fishery

Region	Impact Area	Initial Impact	First Round	Industrial Support	Production Induced	Consumption Induced	Total	Flow-on
Rockhampton	Within Region Within State	1.000	0.422	0.097	0.519	0.190	1.709	0.709
		1.000	0.450	0.170	0.620	0.326	1.946	0.946
Mackay	Within Region Within State	1.000	0.498	0.009	0.507	0.187	1.694	0.694
		1.000	0.558	0.239	0.797	0.317	2.114	1.114
Townsville	Within Region Within State	1.000	0.414	0.111	0.525	0.209	1.724	0.724
		1.000	0.470	0.181	0.651	0.333	1.984	0.984
Cairns	Within Region Within State	1.000	0.316	0.079	0.395	0.144	1.540	0.540
		1.000	0.579	0.280	0.860	0.348	2.208	1.208

(a) Per dollar of output. Rounding errors occur.

Table 5: Income^(a) Multipliers for the Small Boat Fishery

Region	Impact Area	Initial Impact	First Round	Industrial Support	Production Induced	Consumption Induced	Total	Flow-on	Type IIA (b)	Type IIB (b)
Rockhampton	Within Region	--	0.178	0.034	0.212	0.058	0.280	0.280	--	--
	Within State	--	0.184	0.052	0.236	0.104	0.340	0.340	--	--
Mackay	Within Region	--	0.145	0.035	0.180	0.041	0.221	0.221	--	--
	Within State	--	0.189	0.051	0.240	0.087	0.327	0.327	--	--
Townsville	Within Region	--	0.160	0.039	0.199	0.074	0.272	0.272	--	--
	Within State	--	0.186	0.055	0.241	0.106	0.348	0.348	--	--
Cairns	Within Region	--	0.131	0.025	0.156	0.052	0.208	0.208	--	--
	Within State	--	0.179	0.073	0.252	0.111	0.363	0.363	--	--

(a) Per dollar of output.

(b) Meaningless (division by zero). Rounding errors occur.

Table 6: Employment^(a) Multipliers for the Small Boat Fishery

Region	Impact Area	Initial Impact	First Round	Industrial Support	Production Induced	Consumption Induced	Total	Flow-on	Type IIA (b)	Type IIB (b)
Rockhampton	Within Region	—	0.020	0.003	0.023	0.007	0.030	0.030	—	—
	Within State	—	0.020	0.005	0.025	0.010	0.036	0.036	—	—
Mackay	Within Region	—	0.024	0.005	0.029	0.006	0.035	0.035	—	—
	Within State	—	0.018	0.006	0.024	0.010	0.036	0.036	—	—
Townsville	Within Region	—	0.018	0.004	0.022	0.007	0.029	0.029	—	—
	Within State	—	0.021	0.006	0.027	0.010	0.037	0.037	—	—
Cairns	Within Region	—	0.015	0.003	0.018	0.005	0.023	0.023	—	—
	Within State	—	0.019	0.007	0.026	0.011	0.037	0.037	—	—

(a) Per \$1 000 output.

(b) Meaningless (division by zero). Rounding errors occur.

Table 7: Output^(a) Multipliers for the Charter Boat Sector^(b)

Region	Impact Area	Initial Impact	First Round	Industrial Support	Production Induced	Consumption Induced	Total	Flow-on
Rockhampton	Within Region	1.000	0.268	0.077	0.345	0.337	1.682	0.682
	Within State	1.000	0.328	0.170	0.498	0.550	2.048	1.048
Mackay	Within Region	1.000	0.208	0.049	0.257	0.493	1.750	0.750
	Within State	1.000	0.254	0.084	0.338	0.670	2.007	1.007
Townsville	Within Region	1.000	0.281	0.069	0.350	0.415	1.765	0.765
	Within State	1.000	0.336	0.152	0.488	0.569	2.057	1.057
Cairns	Within Region	1.000	0.206	0.072	0.279	0.265	1.543	0.543
	Within State	1.000	0.269	0.184	0.453	0.420	1.874	0.874

(a) Per dollar of output.

(b) The Charter Boat Sector includes other charter work in addition to fishing. Rounding errors occur.

Table 8: Income^(a) Multipliers for the Charter Boat Sector^(b)

Region	Impact Area	Initial Impact	First Round	Industrial Support	Production Induced	Consumption Induced	Total	Flow-on	Type IIA	Type IIB
Rockhampton	Within Region	0.239	0.110	0.026	0.136	0.121	0.496	0.257	2.074	1.074
	Within State	0.239	0.113	0.047	0.160	0.175	0.573	0.334	2.400	1.400
Mackay	Within Region	0.390	0.073	0.014	0.087	0.109	0.586	0.196	1.503	0.503
	Within State	0.390	0.092	0.024	0.117	0.183	0.689	0.299	1.753	0.753
Townsville	Within Region	0.258	0.112	0.023	0.135	0.146	0.540	0.282	2.091	1.091
	Within State	0.258	0.112	0.042	0.154	0.181	0.594	0.334	2.299	1.299
Cairns	Within Region	0.190	0.074	0.023	0.097	0.095	0.382	0.192	2.012	1.012
	Within State	0.190	0.066	0.049	0.115	0.134	0.439	0.249	2.311	1.311

(a) Per dollar of output.

(b) The Charter Boat Sector includes other charter work in addition to fishing. Rounding errors occur.

Table 9: Employment^(a) Multipliers for the Charter Boat Sector^(b)

Region	Impact Area	Initial Impact	First Round	Industrial Support	Production Induced	Consumption Induced	Total	Flow-on	Type IIA	Type IIB
Rockhampton	Within Region	0.027	0.011	0.003	0.014	0.012	0.052	0.025	1.943	0.943
	Within State	0.027	0.011	0.005	0.016	0.017	0.059	0.032	2.218	1.218
Mackay	Within Region	0.007	0.010	0.003	0.013	0.016	0.036	0.029	5.143	4.143
	Within State	0.007	0.008	(c)	0.008	0.022	0.040	0.033	5.714	4.714
Townsville	Within Region	0.031	0.011	0.002	0.013	0.014	0.058	0.027	1.884	0.884
	Within State	0.031	0.011	0.004	0.015	0.017	0.063	0.032	2.064	1.064
Cairns	Within Region	0.017	0.009	0.002	0.011	0.009	0.038	0.021	2.157	1.157
	Within State	0.017	0.007	0.005	0.011	0.013	0.042	0.025	2.392	1.392

(a) Per \$1,000 of output.

(b) The Charter Boat Sector includes other charter work in addition to fishing.

(c) Insignificant. Rounding errors occur.

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