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**Atlas of Operational, Environmental,
and Biological Data
from the Gulf of Carpentaria
Prawn Survey, 1963-65
Part 1. Introduction**

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FOREWORD

Although the data in this Atlas series were collected in 1963-65, the survey created history in that it was the first properly conducted scientific investigation in Australia that led directly to the discovery of an important resource, with the subsequent development of a major fishery in the Gulf of Carpentaria. Surveys elsewhere had led to commercial fisheries, namely that of the *Lancelin* in Western Australia and the *Challenge* in eastern Queensland, but these had relied on the trawler masters' initiative in prospecting wide areas. Similar prospecting by commercial vessels had failed in the Gulf of Carpentaria, but the scientific approach, together with systematic observations over a continuous period, tracked the stocks which became the basis of the new Gulf fishery.

This survey was also unique in that the biological and environmental data were collected in an area virtually uninfluenced by man's activities. Not only had there been no commercial fishing in the Gulf, but there had been no urban development, mining or other industrial activities round its shores. Thus we have a base reference line to which future fishery management studies can be referred. The data will also be invaluable for associated studies such as the effects of trawling on fishes and other organisms.

The Gulf Survey data are therefore of both current and historical value. All too often the details of the early history of a fishery become lost and the Atlas will thus give a permanent and detailed record as a reference document.

The research started by the Gulf Prawn Survey was taken up again by the CSIRO Northern Prawn Project which ran from August 1969 to June 1974. This research attempted both to assess the stocks of banana prawns and to predict the coming season's catch. The stock assessment section was successful, but the stock prediction failed due to lack of relevant life-history and environmental data. Consequently, the Northern Prawn Project was ended, and the more comprehensive Tropical Prawn Research Project was started in July 1974. Field work on this Project, which was also concerned mainly with banana prawns, started in late 1975 and ended in early 1979. The stock assessment research continued until the end of 1978, giving 10 years of data and the results were published in 1979.

Models of stock prediction, fishery yield and larval transport were successfully developed and much other biological and environmental data has now been published. Field work is being resumed on tiger and Endeavour prawns.

While the data will always be valuable, it is inevitable that some of the hypotheses developed during the early Gulf Survey have since been modified or even abandoned. Some recent references, some of which incorporate earlier data, but which give the most recent analyses and interpretations of field research are included with the bibliography.

The Atlas employs imperial measurement units for depth (fathoms and feet for map contours and depth group intervals) and weight (pounds for catch quantities and count per pound for prawn size categories) because field measurements were made with instruments calibrated in imperial units and data processing was carried out prior to conversion to the metric system in Australia. (1 fathom = 6 feet \approx 1.829m; 1 pound \approx 0.454kg.)

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ATLAS OF OPERATIONAL, ENVIRONMENTAL, AND BIOLOGICAL DATA FROM THE GULF OF CARPENTARIA PRAWN SURVEY, 1963-65.

PART 1. INTRODUCTION

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Preface

The first part of the Atlas describes the background and operational arrangements of the Gulf of Carpentaria Prawn Survey, an examination of the penaeid prawn resources and their physical and biological environment. The survey was made before exploitation of the area, so the data represent 'base-line' conditions.

The Atlas is being published in five parts -

1. Introduction
2. Survey Operations
3. Physical and Chemical Environment
4. Distribution and Biology of Penaeid Prawns
5. Distribution and Abundance of Associated Benthic Organisms

Parts 2-5 are to be published as *CSIRO Marine Laboratories Reports* No. 152-155 respectively.

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1.1 THE GULF OF CARPENTARIA PRAWN SURVEY 1963-65

(a) Synopsis of the survey operation

During 1963-65 a survey was conducted jointly by the Queensland State and Australian Commonwealth Governments to examine the prawn resources of the south-eastern corner of the Gulf of Carpentaria.

The operation was requested by the Queensland Government, and its primary objective was to determine the extent of prawn fishing opportunity in this relatively remote and unexamined area.

Field survey operations were carried out over a period of twenty four consecutive months using Karumba, a tiny settlement near the mouth of the Norman River, as shore base. A commercial prawn trawler was chartered to carry out experimental fishing and to collect biological and environmental data.

The conduct of the field survey and the processing of data were the responsibilities of CSIRO Division of Fisheries and Oceanography. The direction of field operations and the supervision of scientific investigations were the responsibilities of the author who served as Project Leader.

Personnel comprising graduate zoologists and technical assistants were provided by CSIRO Division of Fisheries and Oceanography and the Queensland Department of Harbours and Marine.

The survey was planned and conducted as far as possible along scientific lines. The work involved the carrying out of 2324 experimental trawls within an area of approximately 25 000 km², and the collection of environmental and biological data relating to these trawl stations.

The pattern of experimental trawling was designed to achieve two goals.

Initially the plan was to examine the whole area and to obtain coverage by area, season and time of day, working to a system of traverses and division of the area according to a grid square pattern. As the area became mapped, certain areas and times were observed to be productive for certain species, so a fishing strategy was adopted to test for commercial yields in selected areas. This approach concentrated trawl stations in three areas, namely:

(1) night trawling for tiger, king and Endeavour prawns in the sector between Bountiful, Sydney and Bentinck Islands,

(2) search by echo-sounder for banana prawn concentrations in the gutter systems wide of the Smithburne River, and

(3) day fishing off river mouths for smaller greentail, York, rainbow and juvenile banana prawns.

Environmental studies included mapping of the sea floor in respect to depth, topography and sedimentation; hydrological observations concerning water temperatures, salinities, colour, tidal behaviour, water circulation, and some meteorology. Biological studies related to distribution, abundance, behaviour and general biological characteristics of 17 species of commercial and non-commercial penaeid prawns, and the composition, distribution and abundance of associated benthic organisms.

In addition some inshore investigations were undertaken during the second year. These were:

(1) plankton collections in the Norman River to study prawn larval stages,

(2) beam trawling in the Norman River to study size and sex composition and recruitment of

juvenile banana prawns in nursery areas, and

- (3) testing of dye marking techniques on live prawns and observation of growth of prawns penned in floating cages.

(b) Support operations of commercial vessels during 1963-65

About the middle of 1963 Craig, Mostyn and Co. Pty Ltd began construction of a prawn processing plant and facilities at Karumba. Their six commercial prawn trawlers arrived on or before 29 July, the day on which the Government survey vessel *Rama* commenced trawling, and their motor refrigerated lighter *Laakanuki* arrived on 11 August. None of the trawlers was refrigerated and ice was not available until 1 September. Two trawlers returned to the east coast almost immediately. *Kestrel* made 18 experimental trawls in areas north of Mornington Island and north-east of Groote Eylandt during 1-9 September. *Abigail*, *Marina* and *Restless* trawled alongside *Laakanuki* in the environs of Weipa between 15 April and 26 May 1964, but did no trawling in the survey area. During September 1963 a fleet of seven Western Australian freezer boats rigged for prawn trawling made a brief visit to the Gulf and made some exploratory trawls in the survey area. On 15 September 1964 *Toowoon Bay* was brought to Karumba by the Mostyn company to work side by side with the Government survey vessel. Also in association with the Mostyn company, two trawlers *Lottami* and *Avis* worked with *Rama* and *Toowoon Bay* during June and July 1965 in testing commercial production in the areas where banana prawns were schooled in large concentrations.

(c) Extension of scientific investigations after 1965

Collection of size and sex composition data for juvenile banana prawns in the Norman river was begun

too late during the 1963-65 survey period to obtain complete seasonal coverage. It has been necessary to supplement data collected during January to July 1965 with those obtained between August 1967 and May 1968, and between September 1969 and December 1970.

Commercial fishing operations had followed on from the last few months of the survey. During the 1966, 1967 and 1968 fishing seasons CSIRO Division of Fisheries and Oceanography, with assistance from the Queensland Department of Harbours and Marine, maintained a small program to monitor the developing fishery and to collect data in the south-eastern corner of the Gulf. This bridged the gap until August 1969 when the five year term Northern Prawn Project was launched with the setting up of a new research centre at Karumba by CSIRO Division of Fisheries and Oceanography.

(d) Fishing results of the survey

The survey demonstrated the presence in the area of seven species of prawns with some commercial potential. Results of experimental trawling by the Government survey vessel and supporting commercial trawlers demonstrated the existence of three kinds of potential fishery.

The least important for the particular area was a fishery based on mixed small species comprising greentail, York, rainbow and juvenile banana prawns. These were generally found close to shore, mainly congregating in water less than 5.5m (3 fathoms) depth, particularly in the vicinity of river mouths. The main period of abundance corresponded with the wet season and immediately prior to it, namely November to March. Catch rates of up to 245 kg (540 lb) per hour were noted. Concentrations of jellyfish made catching and handling very difficult. Fishing would need to be a daylight operation because the shallow water and the monotonous

configuration of shoreline made navigation at night difficult.

In common with most other offshore prawning grounds in Australia, areas were found which carried a mixed population of tiger, blue-leg king, banana, and Endeavour prawns and these formed the second potential fishery. The tiger prawns were the most abundant species which yielded catch rates up to 10 kg (22 lb) per hour with single rig. The catch of tiger prawns supplemented with lesser quantities of the other species, represented catches of 45 to 90 kg (100 to 200 lb) per night. Size varied within the 8 to 20 count (per lb, heads on) range. The grounds were in areas with depths of 13m (7 fathoms) or more. From September to December they were taken mainly in the area between Bountiful, Sydney and Bentinck Islands; during May to August they were taken in the central part of the survey area. The fishery was basically a night operation because of the nocturnal behaviour of the species and their response to moon phases.

The most important discovery was large concentrations of banana prawns. Banana prawns occurred all over the survey area but the larger sizes were found mainly in depths over 11m (6 fathoms), and were most abundant from March until October or November. Behaviour of banana prawns in the survey area was found to differ from that on the east coast of Queensland. In the Gulf concentrations were located in 15-22m (8-12 fathoms), 32 to 48 km (20 to 30 miles) from the coast, and the prawns were generally somewhat larger than the east coast banana prawns which occur closer to the shore and in much shallower water. In the Gulf these prawns were taken at night as well as by day. Big concentrations were recorded during slack tide periods and the larger catches were made during or close to the neap tides. The concentrations of prawns were found in offshore

gutters which are apparently continuations of the mainland rivers. This gutter system, extending over 1300 km² (500 square miles), constituted the most productive banana prawn fishing grounds within the survey area. Lifts up to 771 kg (1700 lb) were recorded including one of 680 kg (1500 lb) taken in 5 minutes. When the larger catches were made the prawns were in ball-like concentrations which could be detected by echo-sounder. Much time was spent in searching for these concentrations but the search became more efficient when several vessels worked together in the same general area.

(e) Establishment of commercial prawn fishing in the Gulf

The present prawn fisheries within the Queensland and Northern Territory sectors of the Gulf developed directly from the joint Government-Industry survey of 1963-65 supplemented by exploratory fishing in other areas such as Groote Eylandt and Weipa by Australian and foreign vessels. Commercial operations were virtually under way in 1965 during the final few months of the survey operation. Six vessels operated out of Karumba in 1966, and the fishery developed quickly in that region after some good catches in 1967. During the 1970s the Gulf became established as one of Australia's richest prawn producing areas.

The earlier history has been summarized by Ruello (1975) and developments can be traced through numerous articles published by *Fisheries Newsletter* and its successors, *Australian Fisheries Newsletter* and *Australian Fisheries* (1966-1974).

(f) Role of Government surveys in the development of the Australian prawning industry

The chance finding of school prawns in coastal waters off Stockton Bight, NSW in 1947-48 was the event which brought the change in

Australian prawn fishing from the estuaries to offshore waters. Since then there has been enormous expansion in prawn production. Figure 1, derived from catch statistics published in *Fisheries Newsletter* (1949-81), shows that the major increases have been in the states of Queensland, Western Australia, South Australia and Northern Territory. It also shows the principal events in this history of expansion.

The most spectacular increases have been achieved during the period 1970-80 during which the combined production of Queensland and Northern Territory has, except for 1974-75, greatly exceeded production of all other states combined. It is also important to note (Fig. 2) that the catch contribution from the Gulf of Carpentaria for the period 1970-79, according to catch statistics collected by CSIRO (Somers and Taylor 1981), accounts for more than half of the total production of these two states combined. The breakdown into species reveals that banana prawns have largely dominated the prawn catch from the Gulf until 1977.

As stated in Section 1.1(e) the establishment and subsequent expansion of the Gulf of Carpentaria prawn fishery both in Queensland and Northern Territory stemmed from the Government sponsored Gulf Prawn Survey of 1963-65. Ruello (1975) observed that "The history of the Gulf fishery clearly demonstrates how a thoroughly planned Government survey carried out in consultation with industry and at an opportune time (*i.e.* in relation to technology and markets) can quickly lead to the development of a thriving industry".

The Gulf of Carpentaria Prawn Survey was only one of several Government sponsored surveys which led to establishment of large offshore trawling operations in several states. However it differed from all the earlier ones in that it was planned and conducted along

scientific lines. The previous surveys were basically prospecting operations by experienced trawlermen.

The first of the earlier surveys was conducted in Western Australia using the State Fisheries and Fauna Department's patrol vessel *Lancelin* (see Bibliography). That department and CSIRO Division of Fisheries and Oceanography carried out the survey rather sporadically in 1952-56, and the results led to establishment of commercial fisheries in Shark Bay in 1962 and Exmouth Gulf in 1965.

Although offshore prawn trawling in Queensland dates back to 1950 for Moreton Bay and the capture of 22 000 kg of banana prawns off Bundaberg (Hervey Bay) in June 1954, the east coast fishery owes its origin principally to a second Government sponsored survey. The Australian Commonwealth Government chartered *Challenge* which made 982 trawls between Moreton Bay and Princess Charlotte Bay in July to December 1957 and February to August 1958. This survey was responsible for the discovery of king prawn trawling grounds off Fraser Island and Cape Moreton (see Bibliography).

Exploratory trawling in South Australia during 1957 by the Department of Fisheries and Fauna Conservation vessel *Weerutta* led eventually to commercial prawning in Spencer Gulf and St. Vincent Gulf.

An important feature of the Gulf Prawn Survey operation of 1963-65 is that it set a new precedent in the history of Australian fisheries, in that scientific research led to the establishment of a new industrial operation. Usually fisheries become established almost entirely by commercial endeavour, and it is only later, when need for management measures becomes evident, that Government or Industry itself

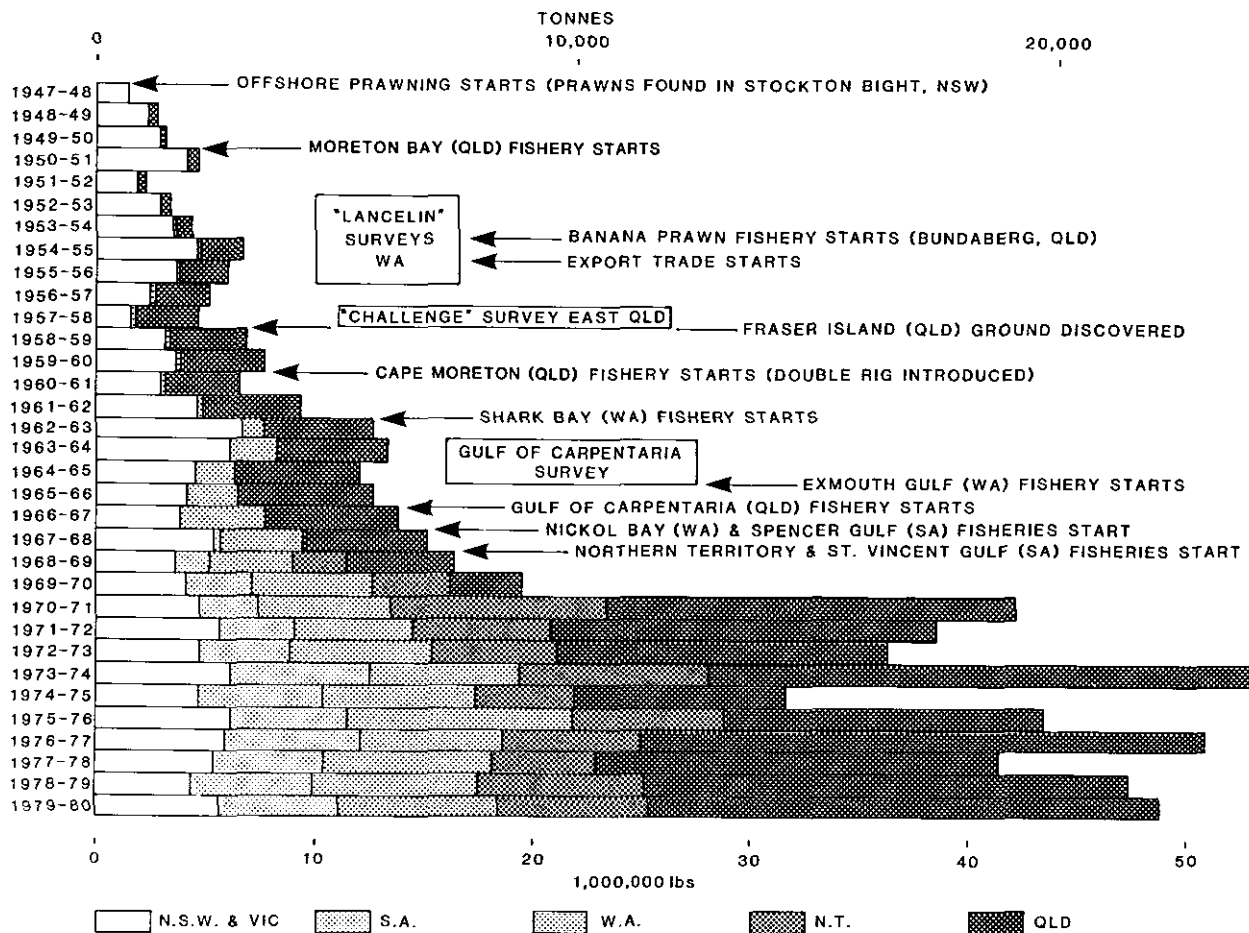


Fig. 1 Australian offshore prawn production (all species) according to States for years 1947 to 1980. The more important events in the development of the offshore trawl fishery, including three government sponsored surveys, are marked according to date. Statistical data are from Fisheries Newsletter (1949-81).

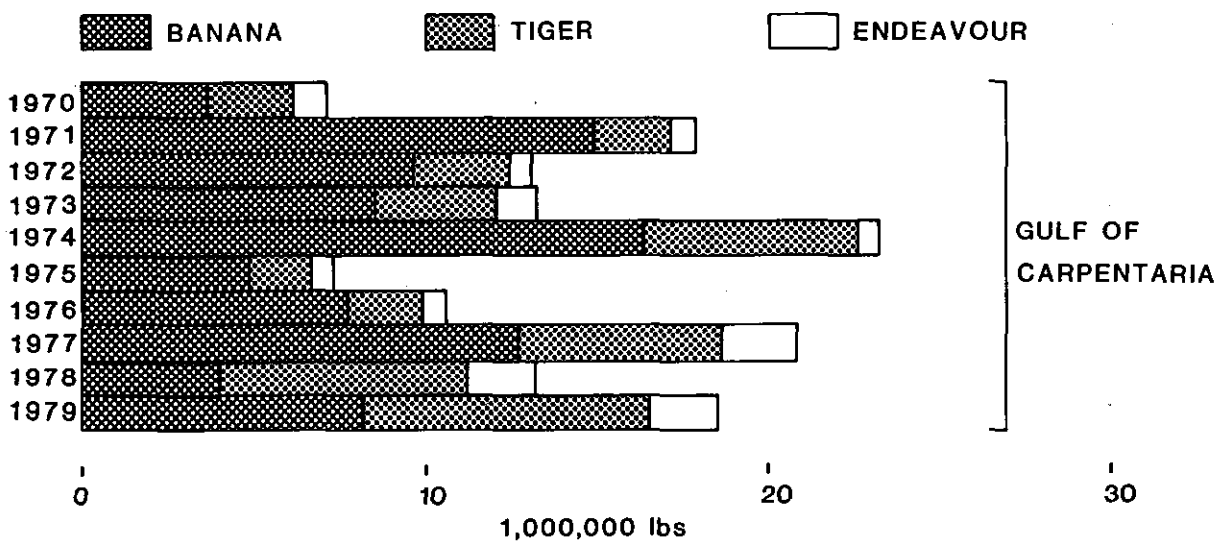
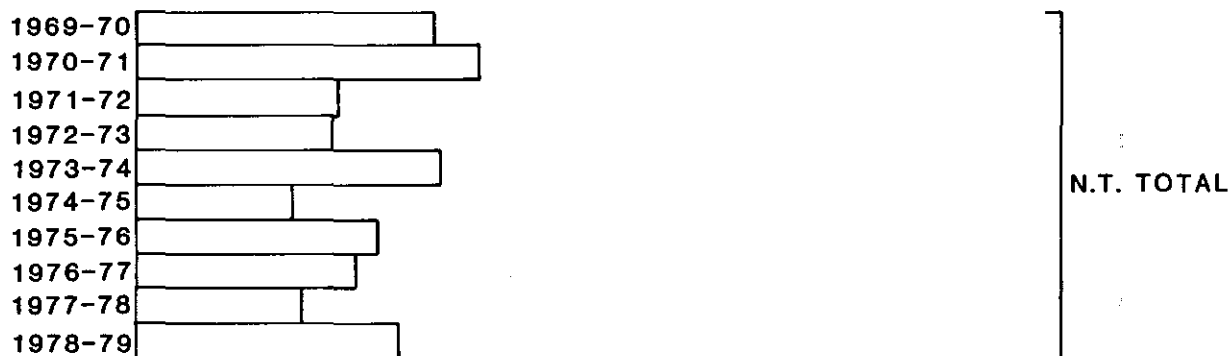
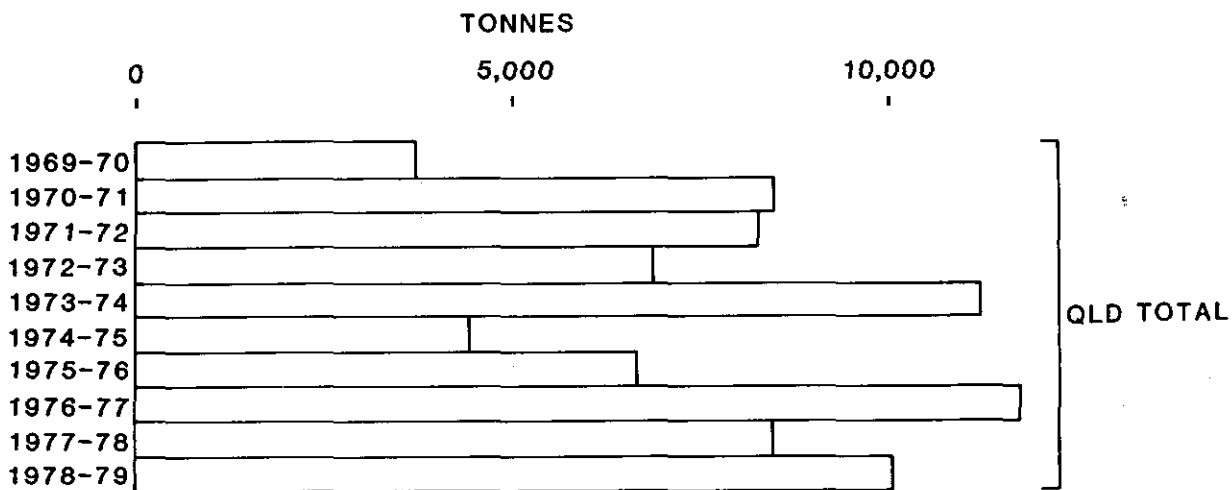


Fig. 2 Prawn production from the Gulf of Carpentaria sector of the Declared Management Zone for the years 1969 to 1979 compared with total production (all species) for Queensland and Northern Territory. Landings for the Gulf of Carpentaria are broken down into the three major component species. Statistical data for Queensland and Northern Territory are from *Fisheries Newsletter* (1949-81) and Gulf landings from CSIRO (Somers and Taylor 1981).

requests scientific investigations. A rather unusual circumstance is that the environmental and biological researches carried out in the southern Gulf in 1963-65 relate to an area in virgin condition and to stocks of animals hitherto unaffected by fishing pressures and urban development. These data are thus especially valuable because they provide a base line for comparison in future studies of the status of stocks and environment as may be required for management purposes from time to time.

1.2 PLANNING AND OPERATIONS

1.2.1 ORIGIN AND PURPOSE OF THE PROJECT

Because of its geographical remoteness, restricted communications, and limited demand for fresh sea foods by the sparse populations of a few towns and scattered settlements, the fishery resources of the Gulf of Carpentaria remained unexplored. After World War II small scale commercial fisheries began operations in the southern part of the Gulf using Karumba as base (see Bibliography). One of these operations involved catching barramundi or giant perch (*Lates calcarifer*) and so-called "salmon" or threadfin (*Polydactylus*) by set nets in the saline lower reaches of rivers. The other was trolling for Spanish mackerel (*Scomberomorus commersoni*) and handlining for reef fishes around the Wellesley Islands.

For many years the Queensland Government held that exploratory work should be carried out in the Gulf to ascertain if fisheries resources were present and to obtain some measure of their magnitude. This belief was strengthened in early 1960 by reports of large schools of prawns in inshore waters. Zoologists who had studied the systematics of penaeid prawns had already established the presence in the Gulf of several species

including some commercially desirable kinds.

By 1962 fishing intensity on east coast prawning grounds had reached a point where the numbers of operators and vessels were increasing but the catch per unit effort was declining. Need for extension of operations into new areas was becoming urgent. The Gulf of Carpentaria, being a large shallow muddy basin of tropical water receiving drainage from numerous rivers and bounded on three sides by lowland country with a small annual rainfall, appeared to have much in common with some major prawn producing areas elsewhere in the world. The Queensland Government considered the time opportune to test prospects of developing fisheries in the Gulf.

As a first move the Queensland Government sought assistance from the Commonwealth Government to plan and conduct operations to prospect for prawns in the Gulf of Carpentaria. By early 1963 a framework was formulated on which a survey could be operated. This coincided with the firm of Craig, Mostyn and Co. Pty Ltd taking steps to set up a shore processing plant and other facilities at the port of Karumba, and arranging to bring a small fleet of prawn trawlers and a refrigerated mother ship to the southern part of the Gulf. The Queensland and Commonwealth Governments agreed to finance a survey of two years duration.

1.2.2 OBJECTIVES OF THE SURVEY

In setting out a plan of survey operations and establishing a guiding committee with terms of reference, an interdepartmental conference held in Brisbane on 7-9 May 1963, laid down the objectives of the proposed survey (Harrison 1965). Although items included provision of a basis for predicting effects that fishing might have on stocks, management measures, and recommendations for extension of

survey, etc., all such might be regarded as supplementary to what was likely to be achieved in practice during field operations of limited duration. As far as the conduct of field operations in a selected area was concerned, these objectives were reduced to the following:

- (a) To establish the magnitude of the prawn stocks and the sustainable yield.
- (b) To determine the distribution of prawns and variation with time of the characteristics of distribution and abundance.
- (c) To define the physicochemical environment.
- (d) To define the types of biota associated with prawns.

1.2.3 OPERATIONAL ARRANGEMENTS

(a) Management and Finance

The Queensland Government, through its Department of Harbours and Marine (which at that time administered fisheries), and the Commonwealth Government, through its Department of Primary Industry, agreed to finance a survey of two years duration. The Commonwealth contribution was to be met from the Fisheries Development Trust Account. These departments asked CSIRO Division of Fisheries and Oceanography to assist in planning, and to undertake the direction of survey operations, and to conduct scientific investigations. A guiding committee with representatives from these three departments was made responsible for the general co-ordination of the project. The detailed planning of operations including experimental trawling, collection of scientific data, and supervision of personnel was vested in a project leader appointed by CSIRO.

(b) Basic planning

It was envisaged that some data on the resource potential would be derived from prospecting operations of private enterprise. However the main body of information would be drawn from a properly planned survey employing a government survey vessel. This vessel was to obtain evidence in respect to the whole nominated area by systematic sampling, satisfying, as nearly as possible, requirements of statistical analysis. Such a plan was appropriate to the condition of almost total ignorance of the area. As far as practical the survey operations were to be associated with the operations of private enterprise.

Whilst the survey vessel was to use standard commercial gear and to follow commercial practices, the survey operations were to be planned and conducted along scientific lines. Much time and effort were to be devoted to scientific study of prawns, the associated benthic organisms, and the prevailing physical and chemical conditions of the survey area.

(c) Area of operations

Because the total area of the Gulf of Carpentaria exceeded 250 000 km² it would have been impractical for a single survey vessel to sample usefully within such an area in only two years, and a decision was made to confine operations to about one tenth of this area. The information that a commercial operation with about a dozen trawlers and supporting facilities would be based at Karumba greatly influenced the decision in selecting a particular area.

The area chosen was the south-east corner of the Gulf as defined below. In addition to the facilities and support that commercial operations would supply, the selected area was chosen also partly because

of its convenient size and particular topography, and partly because of its relative accessibility by road and air transport.

The survey area had an area of about 25 000 km². It was defined as being that part of the south-eastern corner of the Gulf bounded on the north by a line due east from the north-east tip of Mornington Island, on the west by a line due south from the south-west tip of Mornington Island, and on the east and south by the mainland coast. This represented all waters of the south-east part of the Gulf south of 16°24'S and east of 139°06'E.

In practice, the survey vessel also carried out some operations outside this defined area but within boundaries north to 15°48'S and west to 138°54'E. Other data were contributed by commercial vessels which sampled in areas off Weipa and Groote Eylandt.

(d) General arrangements

General administrative management of the project including arrangements for vessel charter was undertaken by the Department of Harbours and Marine. Technical direction and conduct of the survey was carried out by CSIRO. This organization also arranged for the purchase and shipment of most equipment and stores, leasing of accommodation from Ansett Hotels' Karumba Lodge, and the hiring of a vehicle. Examination of technological and economic aspects were the responsibility of the Fisheries Division, Commonwealth Department of Primary Industry. Data processing and preparation of reports was carried out principally by officers of CSIRO Division of Fisheries and Oceanography. Officers of CSIRO Division of Mathematical Statistics also participated in the earlier stages of data processing. Computing facilities were made available by CSIRO.

(e) Arrangements for identification of biota

Advice was sought from curators at the Australian Museum regarding identification of fauna, particularly invertebrate groups comprising the benthos or "trash" component of trawl catches. Initially it was arranged that samples would be sent to the museum in Sydney for sorting and distribution to specialists for identification. Although some material was sent to the Australian Museum, the arrangement was not followed. Team members through their own expertise coupled with guidance from visiting curators became capable of identification of the more important groups including prawns, fish, stomatopods and swimming crabs. A reference collection was assembled on site, and at the termination of the survey this collection was transferred to the Australian Museum.

1.2.4 FACILITIES AND PERSONNEL

(a) Port of Normanton and settlement at Karumba

The first town in settlement of the Gulf district was Burketown, founded on the Albert River in 1865. Fever wiped out much of the population and the settlement was transferred to higher ground as far up the Norman River as was navigable to ships of that time. Thus in 1867 Normanton became the sole port for North West Queensland servicing the pastoral and mining interests as far south as Cloncurry and Richmond. Karumba on the eastern bank at the river mouth came into being as a signal station. Normanton is on the western side of the river about 80 km upstream and an approximately equal distance from Karumba by road.

Discovery of gold at Cloncurry in 1867 and at Croydon in 1885 influenced the early development and subsequent decline of Normanton. Survey on a rail link between Normanton and Cloncurry began in

1885 but soon after construction work commenced in 1887, the connection was diverted to the Croydon gold fields and completed in 1891. Gold output from Croydon began to decline in 1894, and in 1910 a rail link between Townsville and Cloncurry diverted much of the trade with the southern parts of the hinterland from Normanton.

The original settlement of Karumba was at the site of the signal station known locally as "The Point". In 1963 the port authorities were maintaining two government cottages and a boatshed on the same site. The main centre of settlement was several kilometres upstream in the area formerly named Kimberley. Here several sets of buildings and other structures remained. The site had seen use as a Department of Civil Aviation staging and fuelling base for an overseas flying boat route, a staging and signal station for RAAF wartime operations, and then as a fishing and hunting lodge. At the time of the survey it was operated by Ansett Hotels as Karumba Lodge, and the owners had developed an airstrip and freshwater supply at "The Point". A cattle yard with loading ramps slightly further upstream was used irregularly to embark livestock shipments to transport ships of shallow draft. An abattoir had operated on land adjacent to Karumba Lodge, and its site was taken over by Craig, Mostyn and Co. Pty Ltd for construction of a prawn processing plant, wharf and fuelling facilities.

At the time of arrival of personnel connected with the processing plant, survey team and fishing vessels, the local population comprised 10 residents and about 13 hotel staff.

(b) Communications and services

Karumba was connected to Normanton by road but this was unsealed and crossed soft-soil plainland and salt-pan, crossing Walker's Creek by

wier and Norman River at Normanton by punt. It was subject to severe flooding and wash-aways during the wet season and consequently was not trafficable for three months or more each summer. Ansett Airways operated an air service from Cairns to Normanton on Wednesday and included Normanton and Karumba stops on their Friday "Station Run" service for Cape York Peninsula. TAA operated another service from Cloncurry through Normanton for the western Gulf district once weekly. A small coastal steamer from Thursday Island handled freight to Karumba and other Gulf ports several times each year.

Karumba Lodge had a party-line type telephone link by landline to Normanton and a Flying Doctor service radio link with Cairns. Remoteness of Karumba then was implicit in the telecommunications address "Karumba, Cairns Outpost". Mail was carried by the commercial air services as "private bag" contract.

(c) Operational headquarters and field laboratory

The survey party set up a shore base close to the processing factory and wharf then under construction. This base served as operational headquarters, laboratory and living quarters for scientific staff. Accommodation consisted of a very small cottage building within the grounds of Karumba Lodge. The living area, comprising one large and one small room, kitchen, bathroom and laundry, was used as staff living quarters and office. The space below the floor was provided with concrete paving and fly-wire walls, and thus converted into a makeshift field laboratory for the handling of biological, hydrological and sediment samples, and for the storage and display of reference collections of fauna (Munro 1972). Preliminary data processing was handled at the centre. A two way radio station was set up to coordinate operations with the survey

vessel and to communicate with commercial fishing vessels in the area.

The survey party became more self dependent with the acquisition of a heavy duty motor vehicle utility, and an aluminium outboard motor powered boat for river work.

(d) Personnel

The vanguard of the survey team arrived at Karumba on 24 July 1963 fairly soon after the commencement of construction of the processing plant and associated facilities for Craig, Mostyn and Co. Pty Ltd. The chartered survey vessel *Rama* arrived three days later. A preliminary familiarization cruise was undertaken on 29 July. The last cruise terminated on 27 July 1965, and survey personnel were withdrawn from the area as soon as possible afterwards.

The chartered survey vessel was crewed throughout the survey by a fishing master (skipper/engineer) and one deck hand. There was one change in fishing master and four changes in deck hands. The crew were employed by the owners and the ownership changed during the course of the survey operations. One (or occasionally two) members of the scientific team accompanied each cruise.

Scientific staff were employees of the Department of Harbours and Marine and CSIRO Division of Fisheries and Oceanography. Many of the team members were recruited especially for the project and had to be trained on site. As employees of the Queensland State Government and the Commonwealth Government, they served on different awards under different terms and conditions of employment. Staff were rostered on the basis of three months continuous duty in the area alternating with about three weeks either in Brisbane or Sydney.

This scientific team was made up of five graduate biologists and twelve technical assistants who participated for terms of varying duration throughout the survey period. The number of staff at Karumba, including one member aboard *Rama* when she was at sea, varied from two to eight. After elimination of days engaged in transit or on roster away from the area, a total of 3579 man-days were used during the 738 elapsed days of survey. A graduate biologist was always in charge of operations, and the project leader personally spent more than half the duration of the survey in this capacity on site at Karumba. Daily duty detail was the responsibility of a graduate laboratory steward. Inshore investigations in the Norman River began in January 1965 and one assistant was allocated to this work.

(e) Visiting specialists

Short visits were made to Karumba by three curators from the Australian Museum Sydney and another curator for the Western Australian Museum. A technical officer from the Fisheries Division, Department of Primary Industry, spent several weeks in Karumba advising on gear construction and fishing techniques.

1.2.5 STRATEGY FOR INVESTIGATIONS

The basic plan for conducting the survey is detailed under the following headings. However the plan formulated prior to commencement of operations accepted that a government survey vessel would be working side by side with a fleet of about a dozen commercial trawlers. Although half this number of trawlers arrived at Karumba to participate in the venture, none actually engaged in any trawling operations in the southern part of the Gulf. The overall approach to conduct of operations had to be modified considerably.

(a) Prospecting for prawns

The survey was conceived basically as a prospecting operation to be conducted by the government survey vessel which would carry out spot sampling according to a pattern across the whole area. Intensive fishing by commercial vessels in promising areas would follow. The two operations were to be closely integrated. Essentially the survey vessel would search for suitable prawning areas and the commercial fleet would carry out more intensive testing of stock abundance on selected sites. Initially transects were to be made to obtain basic information for dividing the survey area into zones based on physical and biological characteristics. Then each zone was to be divided by a grid so that its area could be tested systematically. Provisionally five to seven samplings in each grid were to be made annually by the survey vessel.

(b) Determination of prawn population structures

Because the survey vessel was to be equipped with standard nets and was expected to operate using commercial style fishing techniques, it could be regarded as having fishing power equivalent to that of vessels in the commercial fleet. The catch data from this and the commercial vessels were regarded as useful for analysis of structure of populations, especially when accompanied by prawn samples which would provide information on the biological characteristics of the populations. Consequently arrangements were made for the keeping of log books by the skippers of the survey and commercial vessels, and for the taking of random prawn samples from their respective catches.

(c) Studies in prawn biology and environment

In addition to the prospecting for prawns and the studies on the

distribution, structure and dynamics of their populations, the objectives of the survey required other lines of research. These included biological studies on prawns which would yield information on seasonal distribution and movements, growth rate, condition factor, feeding habits, recruitment of larvae to nursery grounds, recruitment of adolescents to fishable stocks, fecundity, gonad cycle, sex ratio, spawning place and time, and the identification of larval stages. Research lines relating to prawn habitats required hydrological observations including surface and bottom temperatures and salinities, tidal flow and other circulations, and miscellaneous oceanographical and meteorological measurements. Also in relation to habitat was the need to map depth, topography and distribution of bottom sediments, and to study the composition, distribution and general ecology of the numerous organisms associated with prawns and living on the sea floor.

It was considered that the main body of data pertaining to the lines of research on prawn biology, benthos and habitat would be collected by the survey vessel. These scientific investigations and the handling of catch data required provision of a shore base for the survey team to be set up at Karumba. This was to be used for the sorting, storage and despatch of materials to laboratories in Brisbane and Sydney, and for the initial handling of records. Arrangements were to be made with museums and universities for identification of materials.

(d) Extension of research on prawn biology

Plans also provided for a second phase in the survey where lines of research would be extended to tagging for the purpose of studying recruitment, migration, growth and population assessment. During this phase facilities were to be provided

for tagging juvenile prawns and surveying distribution of developmental stages inshore.

1.3 BIBLIOGRAPHY

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1.3.1 Articles in *Fisheries Newsletter* and its successors.

Fisheries Newsletter was first issued in 1941 by the Division of Fisheries of the Council for Scientific and Industrial Research. With the setting up of the office of the Controller of Fisheries within the Department of War Organization of Industry in 1943 it was published by that Department and the Council for Scientific and Industrial Research, an arrangement which continued until the end of World War II when a few issues were published by the Ministry for Post-War Reconstruction. Publication was continued by the permanent Commonwealth Fisheries

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