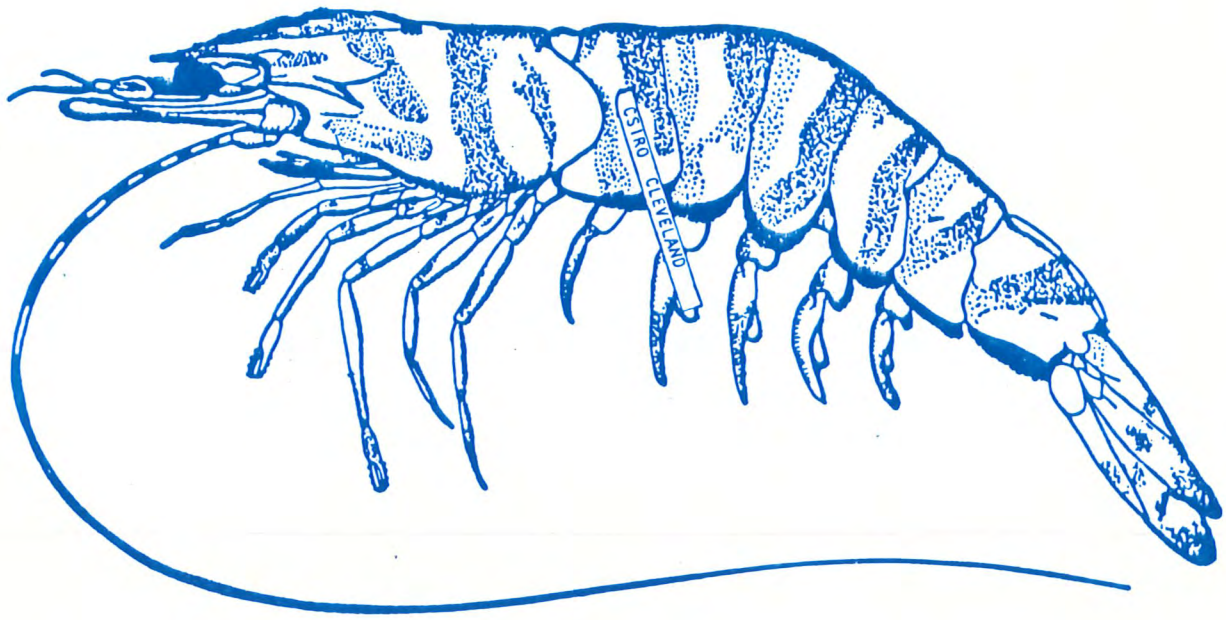
DATA AND INFORMATION SERVICE TO THE NORTHERN PRAWN FISHERY

Final Report : FIRTA Grant 82/12



CSIRO Division of Fisheries

Cleveland Marine Laboratories

FIRTA GRANT 82/12 - FINAL REPORT

DATA AND INFORMATION SERVICE TO THE NORTHERN PRAWN FISHERY

Operating funds totalling almost $110,000 have been provided by FIRTA for this service for the 6 years 1982-83 to and including 1987-88. The position of Northern Prawn Fishery liaison officer (occupied since it was created by Brian Taylor) was initially to strengthen communication between all government fisheries biological research agencies (then Department of Primary Industries (Canberra), CSIRO, Northern Territory Fisheries, and Queensland Fisheries) and both seagoing and shore-based members of the Declared Management Zone industry. The particular objectives at that time were to keep industry informed about rainfall and banana prawn catch predictions, to provide summaries of catch statistics based on fishermen's log books, and to provide general results from biological research projects.

Over the years of operation, however, the service has responded to demand. It now covers many other areas of interest as well, and caters for all prawn industry members in northern Australia including those operating in northeastern Queensland. Information including that about deepwater crustacean fisheries in the area, the South Australian prawn fishery, quality control, pelagic fish tagging, mud crabs, fishing gear, and economic surveys, has been disseminated along with data from many other topical general interest subjects. Management issues relating to the Northern Prawn Fishery have also been included.

Insofar as the original objectives go, considerably more effort has been placed on the provision of general results from biological research carried out by the various bodies involved. 'Results', in this context, include information about the projects from the planning and early stages, from progress reports, and from final reports. Projects involving biological studies of the life cycle, the ecology, and the exploitation of banana, tiger, endeavour and king prawns have been covered.

Communication has been both in writing and verbally. The *Northern Prawn Fishery Information Notes*, a regular newsletter prepared by the liaison officer, has been the primary written medium. The first of these notes prepared as part of this grant, were printed in October 1982 and 500 copies were distributed. In February 1988, issue number 12 was printed and 1200 copies were distributed. In addition to the main body of information in these notes, an extensive bibliography is included to assist readers with any further reading. Appendix A contains copies of these *Information Notes.* Articles without an author credit were written by the liaison officer and all others were prepared specifically for these notes. Other literature prepared by the liaison officer as part of these duties is also included in Appendix A.

Many other articles, reprints, reports etc. considered to be of interest have also been distributed from time to time. The physical bulk of these precludes enclosing copies and so these are simply listed in Appendix B. This list does not include reprints of scientific journal articles. The distribution of these has been somewhat limited whereas most other material has been widely distributed throughout the whole of industry.

An annual one day Preseason Prawn Workshop is arranged and promoted as part of this service and this is the main feature of verbal communication. Most of these workshops have been held in Cairns at a convenient time for most Northern, Torres Strait and Queensland northeast coast prawn fishery operators and topics have ranged from those of direct relevance to industry (e.g. impact of fuel costs on NPF operations) to those of general interest (e.g. fish predation on prawns). The popularity of the workshops can be gauged by the increase in participants from 50 in 1982 to 150 in 1988. Appendix C contains some examples of both pre and post publicity for the workshops as well as the agenda for just a few years.

Extensive travel has been a feature of the liaison work and specific liaison visits to the various ports as well as an active involvement in projects such as tiger prawn tagging, preseason and in-season banana prawn sampling, and joint CSIRO/Industry catch sampling have allowed considerable personal contact with industry members. Contact with government researchers and managers is also essential to collect information and this is often through attendance at formal meetings, seminars and workshops.

The establishment and maintenance of a distribution network required to effectively reach both sea-going and shore-based industry members has required continuous effort, and frequent personal contact has been essential. The network can also be of considerable benefit to other projects where widespread advice/cooperation of industry is required (e.g. closure notices, tagging projects). Furthermore, the distribution network includes log book collectors in the various ports and written material distributed through this channel helps promote cooperation with the log book program.

The value of this service has been recognised by the Northern Prawn Fishery Management Committee (NORMAC) who are now providing a contribution toward operating costs from a research levy imposed on operators in this fishery.

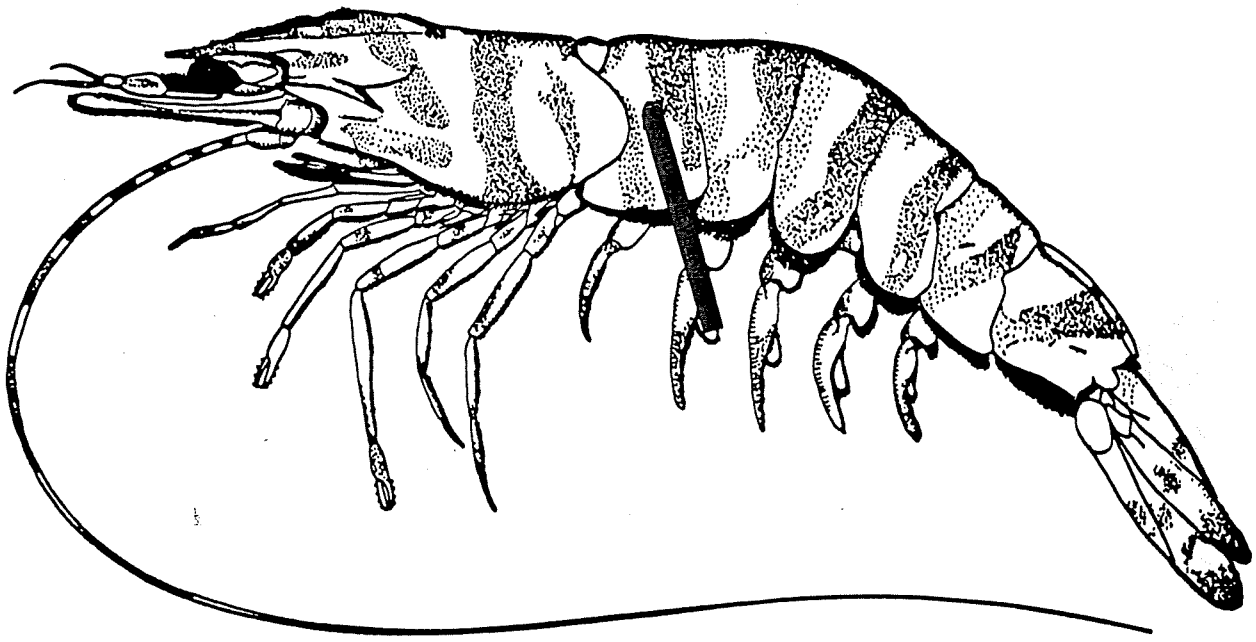
Brian Taylor.
NPF Liaison Officer.
February, 1989.

APPENDIX A.

CSIRO

DIVISION OF FISHERIES RESEARCH

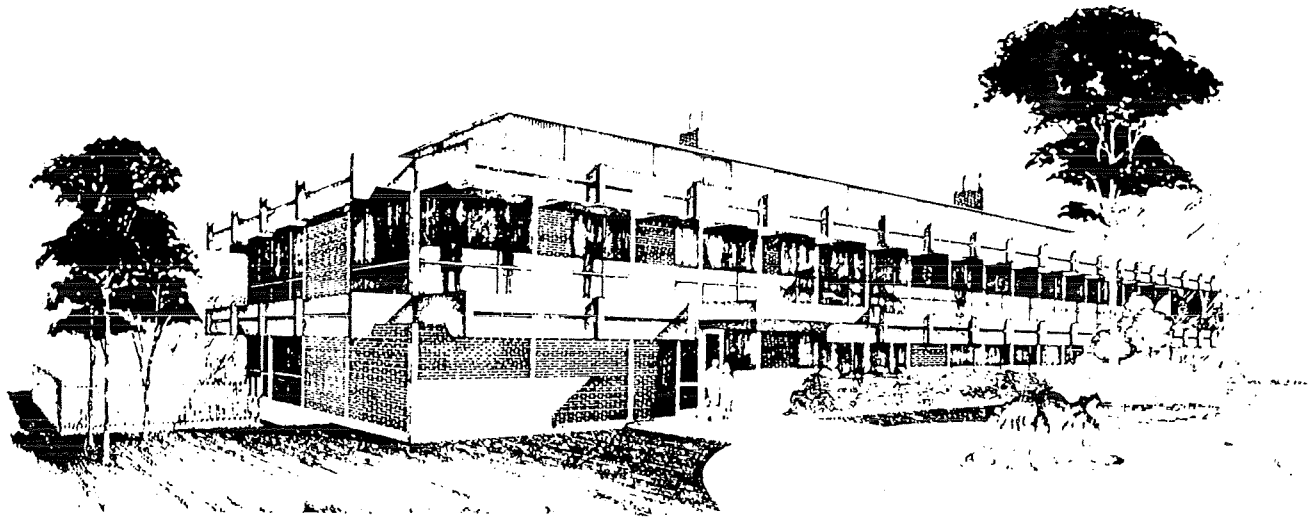
TROPICAL PRAWN PROJECT



INFORMATION NOTES

Compiled by Brian Taylor

OCTOBER 1982



CSIRO MARINE LABORATORIES

233 Middle Street

Cleveland, Qld 4163

Australia

INTRODUCTION

As mentioned in the CSIRO Tropical Prawn Project Information Notes dated February 1982, a part of Brian Taylor's duties now include liaison with members of the northern prawn fishing industry. The preparation and distribution of these Information Notes is seen as one of the ways in which we can improve the flow of information to industry. To help with the distribution of these notes and any other material which may be of interest, we have enlisted the help of the fishermen's logbook collectors in the various ports as listed below:

Darwin	Dave Kelly, Cameron Macraild, Arnold Baker.
Groote Eylandt	Norm Carrol
Cairns	Don Fennemore
Karumba	Lee Kehoe
Thursday Island	Peter Ahmat
Weipa	Ken Schafer

It is again stressed that if communication is to be effective, then it must be a two-way flow. The nature and area of your operations make it difficult for me to contact you all individually, and so any suggestions (such as the method of distribution of these notes) or enquiries can also be made through the logbook collectors as listed,

or to: Brian Taylor
CSIRO Marine Laboratories
233 Middle Street
Cleveland, Qld 4163
Phone: (07)286-2022,

or to any other CSIRO staff who may be in the northern area from time to time.

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You may have seen some material appearing in these notes before, but I ask that you bear with me as some readers may not have been in the industry for as long as you, or they may simply have missed earlier Information Notes.

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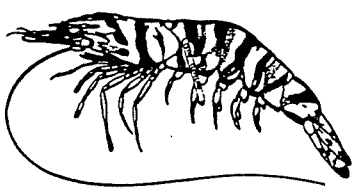

ORGANISATIONS WITHIN AND MANAGEMENT STRUCTURE OF THE NORTHERN PRAWN FISHERY

Many of the various bodies associated with the northern prawn fishery are often referred to by initials only and this can be confusing. This opportunity is taken not only to list some of these bodies, but also to outline the structure of the present management regime. The following is modified from Somers (1977).

Abbreviations

AFC	Australian Fisheries Council
AFIC	Australian Fishing Industry Council
CSIRO	Division of Fisheries Research Commonwealth Scientific and Industrial Research Organization
DMZ	declared management zone
DPI	Fisheries Division Commonwealth Department of Primary Industry
NFC	Northern Fisheries Committee
NFCA	Northern Fishing Companies Association
NFU	Northern Fisheries Unit Commonwealth Department of Primary Industry
NORPAC	Northern Prawn Advisory Committee
NPF	northern prawn fishery
NT Fisheries	Fisheries Division Northern Territory Department of Primary Production
QLD Fisheries	Division of Dairying and Fisheries Queensland Department of Primary Industries
SCF	Standing Committee on Fisheries
TWG	Technical Working Group
UPTOP	United Prawn Trawler Operators Association
WA Fisheries	Western Australia Department of Fisheries and Wildlife

* * * * *

Body	*Membership*
NORPAC	DPI N.T. Fisheries Queensland Fisheries N.T. AFIC Queensland AFIC NFCA UPTOP N.T. independent fishermen Qld independent fishermen
NFC	CSIRO DPI N.T. Fisheries Queensland Fisheries W.A. Fisheries
SCF	Departmental heads from fishery departments in all States and the Northern Territory. Commonwealth Department of Primary Industry CSIRO Commonwealth Department of Finance
AFC	Fisheries Ministers from all States and Northern Territory. Commonwealth Ministers for Primary Industry and for Science

With the exception of NORPAC, which advises only on matters relating to the prawn fishery, all committees deal with all types of fisheries.

The Australian Fisheries Council (AFC) has the role of implementing broad management policies recommended to it by the Standing Committee on Fisheries (SCF). Both the AFC and the SCF have little to do with the detailed formulation of policy as concerns the NPF. It is at the level of the Northern Fisheries Committee (NFC) that management strategies are formulated and in this sense, represents the key to decision making for the northern prawn fishery.

The Northern Fisheries Committee provides a mechanism for coordinating the management of fisheries which extend over more than one of the regions which are represented. Furthermore, it provides a platform for discussion of any management problems faced by its members. The committee at times appoints special working groups of suitably qualified personnel to deal with special problems facing the fishery (for example, TWG).

In October 1976, the AFC announced the establishment of the Gulf of Carpentaria Prawn Advisory Committee (GOCPAC) in order to have direct consultation with the industry on matters of broad management policy. This committee has since changed its name to that of the Northern Prawn Advisory Committee (NORPAC) and its membership consists mainly of industry representatives.

* * * * *

PUBLICATIONS

The document prepared by the Technical Working Group of the Northern Fisheries Committee, *Development and Management of the Northern Prawn Fishery* has been published and is now being distributed. As mentioned in the last Information Notes this is a comprehensive document and includes such topics as management, statistics, stock assessment and economics.

* * * * *

A statistical summary covering the northern prawn fishery for the calendar year 1981 has recently been published by Commonwealth Department of Primary Industry and copies of this are also being distributed.

* * * * *

The April 1982 edition of *Australian Fisheries* contained three articles of particular interest:

(1) *Northern Prawn Fishery - boats, gear and methods*

(2) *Studies identify Indian banana prawn in northern catches*

(3) *World prawn markets - likely continued growth in the 1980's.*

The July 1982 edition carried an article entitled *Early results reveal value of tiger prawn tagging in Gulf of Carpentaria.*

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In response to an industry request, the bibliography at the end of these notes has been expanded to include other references which may be of interest.

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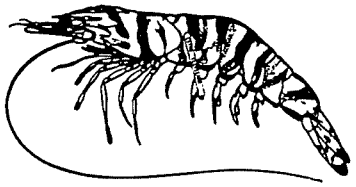


STATISTICS

Comprehensive statistical data may be found in -

(1) annual statistical summaries prepared and published by Commonwealth Department of Primary Industry;

(2) log book data summaries prepared by Northern Territory Fisheries;

(3) CSIRO Marine Laboratories Report 138 "Fishery Statistics Relating to the Declared Management Zone 1968-1979";

(4) TWG report "Development and Management of the Northern Prawn Fishery";

(5) Australian Bureau of Statistics "Fisheries Australia" - financial year summaries.

Some published data covers the entire northern prawn fishery (Bowen to Broome) and some covers only the declared management zone, and care should be taken to note these differences.

Much of the statistical data given in these Information Notes has been published previously and is included here in a format which allows comparisons to be more readily made. Your comments as to the most appropriate statistical information which should be presented in these notes would be very much appreciated.

* * * * *

TABLE 1. DMZ VESSEL NUMBERS

1977	1978	1979	1980	1981
193	237	240	277	280

These numbers include vessels operating as interim replacements.

* * * * *

Total recorded landings for the entire northern prawn fishery in 1981 were at a record high of 14,093 tonnes. Landings for the DMZ were 12,067 tonnes which is below the record catch of 13,864 tonnes estimated for this area for 1974.

Banana prawn landings for 1981 were almost double the 1980 landings so continuing the trend of large fluctuations in total catch. The catch per unit of effort (0.522 tonnes per day) was also up on 1980 but well below the 1.777 tonnes per day estimated for 1974. Trawl fishery (tiger, endeavour, king) landings continued to rise. Effort also continued to increase, however, and although the catch per day was about the same as that for 1980, both years were down on previous years. If the increased efficiency of vessels and gear is considered then this decline may be even more significant.

TABLE 2. DMZ CATCH AND EFFORT

		Total[1] Banana	*Banana[2] only*	*Other[3]*
1977	Catch*	6216	5956	4071
	Effort**	-	6535	11637
	Catch/Day	-	0.911	0.350
1978	Catch*	2535	2263	4937
	Effort**	-	4977	18746
	Catch/Day	-	0.455	0.263
1979	Catch*	4775	4335	5576
	Effort**	-	6549	18618
	Catch/Day	-	0.662	0.299
1980	Catch*	2681	2150	6543
	Effort**	-	6627	28795
	Catch/Day	-	0.324	0.227
1981	Catch*	5034	4462	7033
	Effort**	-	8554	30795
	Catch/Day	-	0.522	0.228

[1] includes banana prawns which were caught with other species

[2] Where only banana prawns were caught

[3] Tiger, endeavour, kings, mixed

* Tonnes

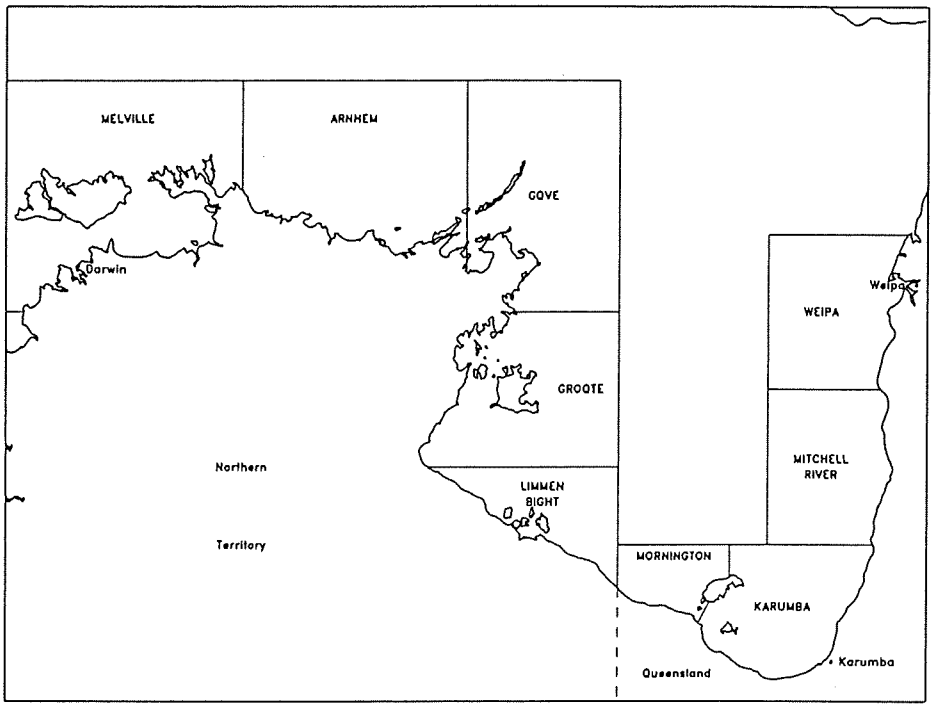
** Boat days

TABLE 3. ESTIMATED BANANA PRAWN CATCH (TONNES) BY REGION

	1977	1978	1979	1980	1981*
Weipa	641	1045	444	485	607
Mitchell River	864	169	505	171	619
Karumba	2701	387	1328	570	1438
Mornington Island	796	83	713	99	241
Limmen Bight	520	1	516	149	193
Groote Eylandt	124	70	143	105	133
Gove	70	27	63	40	112
Arnhem	68	69	106	59	304
Melville	432	684	954	1003	1330
TOTAL DMZ	6216	2535	4775#	2681	5034#

* Preliminary figures

\# Includes prawns from unspecified area



Map of northern Australia showing the statistical partitioning used in collating regional catches

TABLE 4. ESTIMATED TIGER PRAWN CATCH (TONNES) BY REGION

	1977	1978	1979	1980	1981*
Weipa	114	363	79	85	191
Mitchell River	0	0	1	0	11
Karumba	460	468	503	691	533
Mornington Island	301	82	411	82	389
Limmen Bight	143	96	1035	788	932
Groote Eylandt	1581	1987	1596	2210	1993
Gove	166	264	213	392	296
Arnhem	1	3	0	57	20
Melville	134	336	346	400	696
TOTAL DMZ	2900	3599	4218#	4727#	5118#

* Preliminary figures

\# Includes prawns from unspecified area

TABLE 5. ESTIMATED ENDEAVOUR PRAWN CATCH (TONNES) BY REGION

	1977	1978	1979	1980	1981*
Weipa	166	95	88	59	179
Mitchell River	0	0	0	0	0
Karumba	115	212	151	240	146
Mornington Island	43	29	89	26	102
Limmen Bight	28	7	161	107	143
Groote Eylandt	490	496	369	714	457
Gove	86	61	56	87	60
Arnhem	1	1	0	6	4
Melville	196	339	289	423	646
TOTAL DMZ	1125	1240	1213#	1667#	1760#

* Preliminary figures

\# Includes prawns from unspecified area

TIGER PRAWN TAGGING

As some readers would be aware, a tiger tagging experiment was conducted in the Sweers-Bountiful Islands area in June 1978 when almost 8,000 prawns were tagged. All of these prawns were the brown tiger (*Penaeus esculentus*), the species which comprises almost the entire tiger prawn population of this area. The experiment was designed to compare the effectiveness of the then new streamer tag with the older pin type disc tag as well as to gain information regarding migrations and fishing mortality rates. Approximately equal numbers of each tag were used. Reported recoveries totalled about 14% of those released and of these about 70% were streamer tags and about 30% disc tags. The streamer tag was thus considered to be more effective. Of the 14% recovered, however, only about 30% were recovered on-board, with the balance being returned via shore based processing establishments. As the date and area of recapture with factory recoveries is usually unknown and as the proportion of these recoveries was very high in this experiment, we were unable to calculate any firm fishing mortality rates. Where the date and position were available it was observed that there was a gradual, but very slight (up to a maximum of 12 miles in six months) dispersal around the release points.

* * * * *

It was thought that one of the reasons for the lower than expected on-board recoveries may have been the colour of the tags used, and during the 1981 tiger tagging work carried out around Groote Eylandt, streamer tags of a different colour were used. In contrast to the 1978 releases when only 30% of all recoveries were made on-board, about 90% of all recoveries have been recorded as on-board for the 1981 release. This higher rate might partially be because of the changed tag colour but on-board handling and grading has undoubtedly contributed. Whatever the reasons, we have had far more success with recovery data for the 1981 experiment.

Recoveries have been reported from a total of 132 vessels with numbers of returns ranging up to 189. If you have tags on board or if you recover tagged prawns, please contact either CSIRO, Queensland or Northern Territory Fisheries, or your log collector.

Many of the prawns tagged and released to the south of Groote Eylandt in June 1981 were the brown tiger, and like those tagged in the Sweers-Bountiful Islands area during the same month but in 1978, these showed only a gradual dispersal from the release point. Those released to the north in June showed a little more movement. It should be noted, however, that quite considerable movement was shown by the brown tigers which were released north of Groote Eylandt in February.

More detailed but preliminary results from this 1981 experiment have been published in the July 1982 issue of *Australian Fisheries* and reprints will be available.

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In conjunction with the field tagging work we are carrying out laboratory trials to observe the effect of the streamer tags on some aspects of prawn behaviour. Results to date confirm that there is little mortality which can be directly attributed to the effects of the tag or the actual tagging operation. It is doubtful that predation (there is none in the laboratory, of course) operates selectively on tagged prawns as observations have shown that when tagged prawns are buried the tag is either completely covered or is only partially visible.

The effect on growth is most interesting but it must be stressed that these are preliminary observations only. No difference in size increments at moulting has been observed between tagged and untagged control prawns, but the time between moults seems to be slightly less for the tagged prawns. The net effect after several months is that the tagged prawns increase in length at a marginally faster rate than the untagged. Any volunteers to help tag the entire population?

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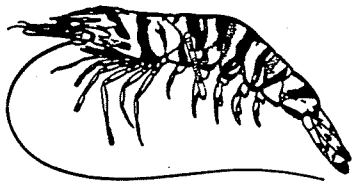

During March 1982, the oceanographic research vessel, "R.V. Sprightly", was in the Gulf of Carpentaria as part of a research cruise which was to take it right around the Australian continent. The Weipa to Darwin leg of this cruise afforded us the opportunity to carry out some work on the ecology of adult tiger prawns. Sediment samples were taken with the aim of studying the distribution of the two species of tiger prawns (brown and grooved tiger prawns) in relation to bottom types. Prawn samples were also taken to provide material for reproductive studies. Although the work was concentrated in the area to the north of Groote Eylandt, samples were taken right across the Gulf and up into the Arafura Sea. The samples taken during the cruise are currently being analysed.

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NORTHERN TERRITORY FISHERIES DIVISION

The following notes have been provided by Northern Territory Fisheries in Darwin.

* * * * *

Commonwealth FIRTA have recently made available funds enabling us to undertake a study of the closures in the western Gulf of Carpentaria insofar as tiger and endeavour prawns are concerned. The study will investigate the size and species composition within and adjacent to the closure areas as declared in 1982. A commercial trawler will be chartered to sample prawn stocks in the area from October 1982 to March 1983. The information obtained will enable government and industry to assess the effectiveness of the closure in regard to both geographic boundaries and timing.

* * * * *

In studies undertaken as its contribution to research in the northern prawn fishery, the Northern Territory Fisheries Division is examining trends in the western gulf tiger and endeavour fisheries. Initial sampling at Groote Eylandt was undertaken by Norm Carroll from 1979. This research program was expanded in January 1982 when funds were made available through the Northern Territory Fishing Industry Research and Development Trust Fund, and Ric Buckworth was appointed and based at Groote Eylandt. The main thrust of this program is directed at the exploited phase of the prawn stocks and includes an assessment of trends in catch and effort in the fishery integrated with biological data on species and size composition. Samples taken on commercial vessels either by scientific staff or members of the fishing fleet are of crucial importance in this work. The data they provide is being used in association with the log book data to define geographical and seasonal variation in species and size composition of the catch. Sampling also provides information on growth, mortality, spawning times and areas, recruitment and the incidence of parasitism. This programme, in association with the 1982/83 closure study, will provide valuable information for the assessment of the status of this important sector of the northern prawn fishery.

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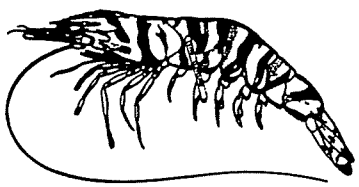

QUEENSLAND FISHERIES

These notes have been provided by staff at the Northern Research Laboratory at Cairns.

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SURVEY OF JUVENILE PRAWN NURSERY AREAS WITHIN TRINITY BAY AND TRINITY INLET, CAIRNS

Introduction

Sampling sites were chosen during a preliminary daylight survey in July 1980. Three sites in Trinity Bay proper were located over shallow, central and deep zones of dense seagrass beds that lie to the east of the mouth of the Inlet. Of the other three sites, two were located over the central zones of seagrass beds at opposite ends of the Inlet, i.e. at the mouth and 8 km upstream. The remaining much deeper Inlet site was located over a compacted shell grit bottom approximately 2 km upstream of the mouth.

All samplings were completed in a single night within two days of successive full moons over the period August 1980 to April 1982. Duplicate trawls of approximately 5 minutes duration over 150 m of bottom were made within 2 hours of full tide with a 1.5 m beam trawl fitted with a 12 mm mesh net. A 4 m aluminium dinghy powered by a 15 kw outboard motor was used to tow the trawl at an across the bottom speed of 0.5 ± 0.1 m/second, i.e. 1 knot. Salinity and temperature were recorded at each site.

Results

General

A total of 6017 penaeid prawns, including members of more than 20 species and 6 genera, were captured over the 21 samplings conducted. More than 95% of this total was however made up of only 6 species: the brown and grooved tiger prawns (*Penaeus esculentus* and *Penaeus semisulcatus* respectively); the true or blue tail and false or red tail endeavour prawns (*Metapenaeus endeavouri* and *Metapenaeus ensis* respectively); the york prawn (*Metapenaeus eboracensis*) and the common northern hardback prawn (*Trachypenaeus fulvus*). The two tiger and endeavour prawn species are the most important commercial species to the region.

Tiger prawns

Large numbers of juvenile grooved tiger prawns were taken on all seagrass sites, especially middle zone sites, both in the Bay and Inlet. Only a small number of this species was however captured at the deeper hard bottom Inlet site. The distribution of the brown tiger prawns was generally similar except that very few were caught at the upper Inlet seagrass site, indicating that postlarvae and juveniles of this species probably have poorer estuarine penetration than those of grooved tiger prawns.

In the case of both brown and grooved tiger prawns, mean size, size range and seasonal variations in abundance varied only marginally between seagrass sites at different locations and depths. The timing and duration of peak juvenile recruitment to these seagrass nursery areas however varied considerably between the two species, being earlier and briefer (October to December) in brown tiger prawns than in grooved tiger prawns (December to March). These peak juvenile recruitment dates in turn indicate peak effective spawning seasons of July to September for brown tiger prawns and from September to December for grooved tiger prawns.

Endeavour prawns

Catches of juvenile true and false endeavour prawns contrasted markedly. A consistently high total number of true endeavour prawns were caught at all seagrass sites regardless of depth or location. The sizes of true endeavours taken at the upper and lower Inlet seagrass sites were considerably smaller on average to those taken on the three Bay seagrass sites. This probably indicates that true endeavour prawns vacate estuary seagrass sites at a smaller mean size than they vacate the more seaward Bay seagrass areas.

Catches of false endeavour prawns contrasted markedly with the above. Catches taken at all Inlet sites were larger than those taken at any of the Bay sites and increased with distance upstream from the mouth. Of false endeavour prawns taken within the Bay, those taken at the shallow site were on average considerably smaller, indicating a possible net movement to deeper zones with progressive growth. The two endeavour prawn species also contrasted markedly in relation to seasonal patterns of recruitment of juveniles to nursery areas. Numbers of true endeavours rose and fell rapidly but asynchronously across the various sampling sites. This probably means that effective breeding of the species occurs to some degree through most months of the year. Not so in false endeavour prawns however. False endeavour catches in fact followed a very pronounced seasonal pattern in which a large pulse of juvenile prawns appeared at all sites between January and April in 1981. A second annual pulse of false endeavours was also well developed by the time the study was terminated in April 1982.

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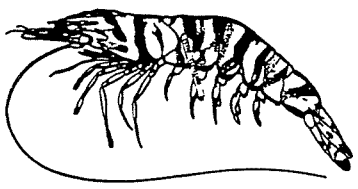

PUBLICATION LIST

CSIRO Scientific Publications

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Barclay, M.C., W.Dall, and D.M. Smith. 1982. Changes in lipid and protein levels of the tiger prawn, *Penaeus esculentus* Haswell during starvation and the moulting cycle. *Journal of Experimental Marine Biology and Ecology* (Submitted).

Church, J.A. and A.M.G. Forbes. 1981. Non-linear model of the tides in the Gulf of Carpentaria. *Australian Journal of Marine and Freshwater Research 32*, 685-698.

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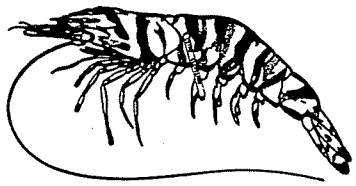

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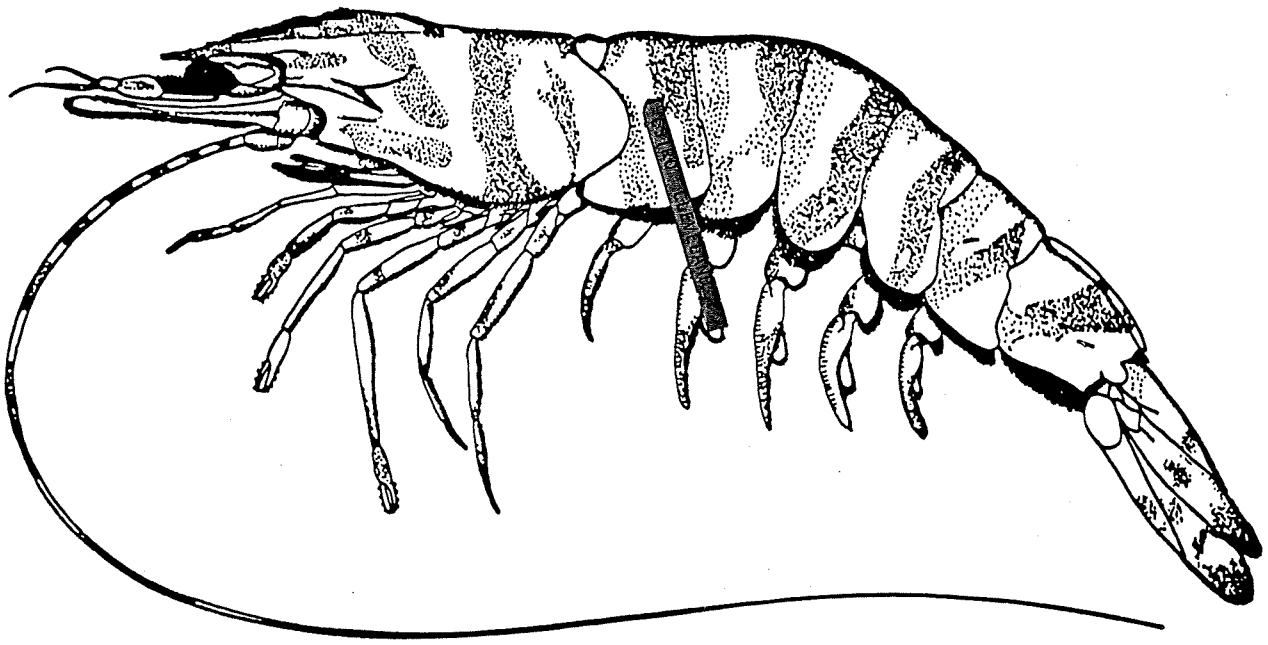
NORTHERN PRAWN FISHERY

INFORMATION NOTES

FEBRUARY 1983



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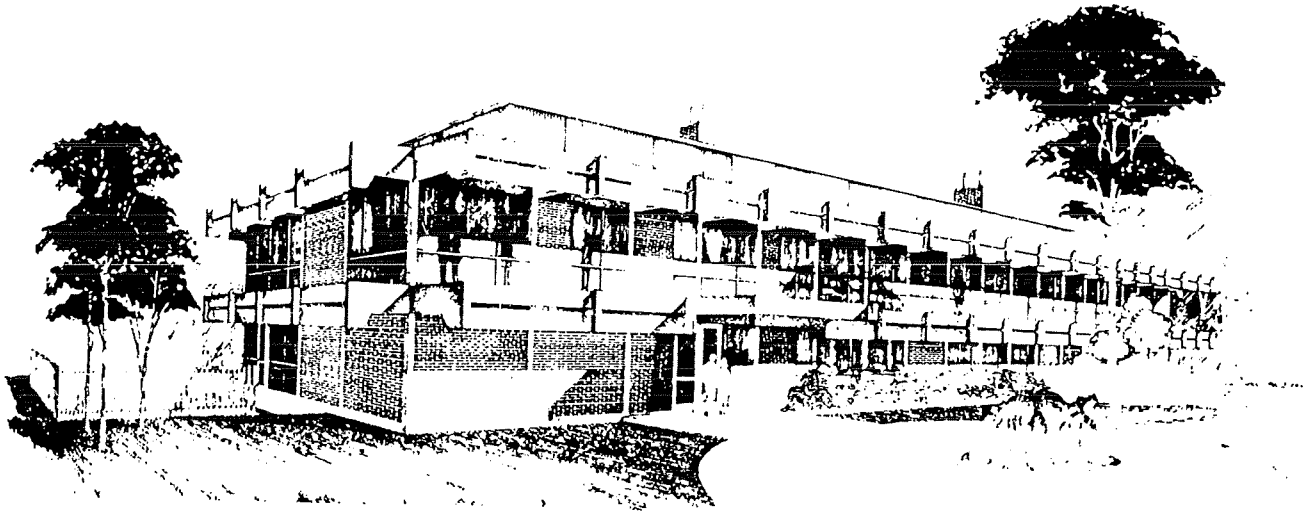
CSIRO Division of Fisheries Research



CSIRO MARINE LABORATORIES

233 Middle Street

Cleveland, Qld 4163

Australia

INTRODUCTION

During the years 1976-1979 when some staff from the CSIRO Tropical Prawn Project were directly involved in the collection of data from industry, we were able to prepare and distribute information notes concerning both this statistical data and biological data from other CSIRO studies in the northern prawn fishery. When field work terminated later in 1979, however, these notes were no longer issued although results from some biological studies were given in *Australian Fisheries*.

At the pre-season workshop organized by N.F.C.A. and held at Karumba in February 1982 it was announced that CSIRO had provided funds in 1981-82 for the position of part-time liaison officer in the northern prawn fishery. Brian Taylor assumed the responsibilities of this position in late 1981 and in this capacity attended the workshop and outlined some ideas concerning this new position.

The first objective was to briefly present to you results of CSIRO work since the time field work had ceased and to bring to your attention a list of publications describing these results in more detail. This was done essentially through the preparation and distribution of the CSIRO Tropical Prawn Project Information Notes and through the distribution of various technical reports. Reprints of relevant articles from Australian Fisheries were also made available. State fisheries staff and log book agents have provided invaluable help in the distribution of this material.

The second and current objective is to describe research work presently being carried out in the northern prawn fishery and to keep you aware of results and developments in these programs. At the same time we would hope, through personal contact, to keep abreast of new developments in the fishery. FIRTA is funding this position for 1982-83 and hence the change of title and scope of these information notes which now cover all relevant research programmes. It is intended, however, that information will generally be disseminated in much the same way and we would be pleased to hear any criticisms or suggestions you may care to make. It should be noted that considerable information is also available through the expanded NORPAC membership and through the pre-season workshops which have been held in the last two years. Some of the material appearing in these notes has, in fact, covered presentations made at the 1983 Cairns workshop.

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One again the publications list at the end of these notes has been expanded and updated and includes many recent articles and reports which may be of interest.

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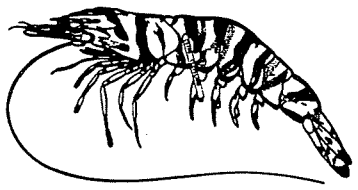
In the October 1982 Information Notes the log book collectors operating in the various ports were listed. Since that time Norm Carrol has moved from Groote Eylandt to Darwin and Dave Kelly is now operating from Groote Eylandt.



PROPOSED CSIRO TIGER PRAWN RESEARCH

It was announced in the August 1982 *Australian Fisheries* that FIRTA is to fund a detailed tiger prawn research project to be carried out by CSIRO in the Gulf of Carpentaria. Although the work will be aimed at the two principle tiger prawn species (brown and green or grooved tiger) data will, of course, be collected on other species. Considerable planning has been necessary and some preliminary field work has already been done (as reported later in these notes). This project, and those being undertaken by both Northern Territory and Queensland Fisheries, will be coordinated through the Technical Working Group of the Northern Fisheries Committee.

Since 1976, fishing effort (measured as boat days) in the tiger prawn fishery of the DMZ has increased four to five-fold from an estimate of about 7000 days to about 31000 days in 1981. The catch has risen from about 20% to about 50% of the total DMZ landings of all prawn species. The two tiger prawn species (and the two endeavour species) are recorded only as tiger (and endeavour) in commercial landing and fishermen's log book records and detailed statistical information regarding the individual species is not available and, due to a lack of previous research, little is known about the biology and ecology of the species found in this increasingly valuable resource.

The Groote Eylandt area supports the largest tiger prawn fishery in the DMZ and as both species of tigers and endeavours are taken here, the study will commence in this area. A field station is to be set up and sampling, initially to the north of Groote and in Blue Mud Bay, will be carried out from the 16.0m RV *Karin* (formerly based in Sydney) and from a 5.7m Sharkcat. Field sampling is expected to start in the latter half of 1983.

The overall objectives of this project are to collect data allowing us to calculate exploitation levels and make stock assessments, and to determine and explain critical factors affecting the annual abundance of prawns. This will involve a detailed ecological study of

the entire life cycle of each species in addition to the processing of data collected from commercial operations.

* * * * *

Adult Studies (Geoff Kirkwood, Ian Somers, Brian Taylor)

The work of this group will be concerned primarily with the commercially exploited resource. Intensive sampling will show changes in population structure and abundance over time and area. Further tagging work is envisaged to assist in studies of growth, migration, natural mortality and fishing mortality.

Concurrent with these studies concerning population dynamics we will also be collecting environmental data and in particular, substrate samples will be taken and analysed in an effort to determine habitat preferences of the adults of the different species (some substrate samples have already been taken from the RV *Sprightly*).

All sampling will take place in and around the fishing grounds to the north of Groote Eylandt including N.W. Bay.

* * * * *

Juvenile Studies (Derek Staples, Dave Vance, Don Heales, Rob Kenyan)

From our preliminary work in the Weipa area (reported later), we now know that the very young stages of both species of tiger prawns and one species of endeavour prawn will not live in an inshore area unless vegetation, such as seagrass, is present. After spending 2-3 months in these seagrass areas, the prawns (now called sub-adults or adolescents) migrate offshore to recruit into the commercial fishery. The seagrass areas around Groote Eylandt and on the adjacent mainland are therefore extremely important to the tiger and endeavour fishery in this region.

The first objective of the juvenile studies will be to locate and describe the main inshore seagrass and vegetative areas. By following the fate of juvenile prawns in these areas, it should then be possible to determine what makes a good (or bad) nursery area for each species concerned and to identify the factors influencing the numbers of prawns surviving to recruit into the fishery each year. By tagging juvenile prawns in selected inshore areas, the offshore migration of sub-adults will be followed. In cooperation with the Northern Territory Fisheries program of sampling sub-adults in and around the closed areas, a better definition of areas and/or seasons requiring protection from fishing activity will be established.

Supporting laboratory work will include observations on the effect of temperature, salinity and food availability on survival and growth.

* * * * *

Larval Studies (Peter Rothlisberg, Chris Jackson, Bob Pendrey)

The larval ecology group has already obtained a series of plankton samples which contain larvae of all species of prawns from the Gulf of Carpentaria, including the Groote Eylandt area. For the past several years a great deal of time has been spent spawning prawns, raising larvae (see *Australian Fisheries*, July 1978) and developing techniques so we could identify to species, the larvae from the Gulf samples (refer February 1982 Information Notes). That work is nearing completion with a Marine Sciences and Technology grant this year to identify the endeavour larvae. Fortunately, because larvae of all species are caught simultaneously, the samples will be very useful in helping to define spawning times and locations.

Further field studies will be carried out on factors affecting larval drift. Studies of this type with banana prawns (February 1982 Information Notes and CSIRO Marine Research Report 1979-1981) were very useful in helping to understand the relationship between times and locations of spawning and postlarval recruitment patterns. Future studies will focus more intensively on larval behaviour; how it differs between species and how it changes with larval and postlarval development.

This group will continue larval rearing experiments in the laboratory. This time the studies will be on the effects of temperature, salinity, and concentration of different food types on larval growth rates and survival.

* * * * *

Reproductive Studies (Peter Crocos)

The reproductive biology of individuals of each species will be investigated and this will include studies of features such as size at maturity and first mating, insemination of females, rate of ovarian development, fecundity and variation with size, and the frequency of spawning. These parameters will also be studied at the population level, as will the abundance of spawning females over time and space hence allowing population fecundity to be estimated. In conjunction with results from the larval group, spawning areas and times will also be defined.

Considerable laboratory work is required for this segment and this will include experiments with prawns held in controlled laboratory conditions.

* * * * *

Experimental laboratory studies

Some of this work has already been mentioned and the following is a brief description of other laboratory studies which will also support this project.

Behaviour (Burke Hill, Ted Wassenberg)

As previously reported, the effect of tags on the general activity pattern and on moulting, growth, and mortality of tiger prawns is being investigated using infra-red closed circuit television and time lapse video recorders. This work is continuing. The reactions of prawns to varying water temperatures is also being observed in order to estimate changes in catchability. Tiger prawns appear to spend more time buried when temperatures are low.

* * * * *

Physiology and Nutrition (Bill Dall, David Smith)

These studies are also being continued. Currently, tiger prawn energy requirements and utilization of sources of stored energy are being investigated. Prawns appear to use protein preferentially as an energy source, in contrast to other animals where fats are the primary stored energy source. It is now possible to determine the energy budget of prawns so that this can be related to the basic production of the environment. Such data also have relevance to aquaculture. Future research will examine the uptake and utilization of food substances by prawns.

* * * * *

Food Chains (David Moriarty, Peter Pollard)

As reported in earlier information notes the role of bacteria in food chains and especially those associated with seagrass and mangrove areas is being investigated and this work is continuing. Most fish and crustaceans can digest only a very small proportion of plant material and bacteria play a major role in converting this material to forms which can be more fully utilized by prawns and other organisms.

Techniques have been developed to measure bacterial biomass and productivity and we are progressing toward a much better understanding of energy and nutrient flow in these systems.

* * * * *

Although the proposed tiger prawn project has, for convenience, been described in terms of studies to be carried out by various groups, it will be a closely integrated project. As you may have observed there is some overlap, particularly in the field studies, and much of the sampling will, in fact, be carried out on the same cruises.

PRELIMINARY TIGER PRAWN STUDIES

As mentioned earlier in these notes and as outlined in the February 1982 Information Notes, some preliminary work on tiger prawns has already been carried out. This work has included the tagging of adult prawns in the Groote Eylandt area and a study of the nursery grounds in the Weipa area.

Tagging

A tagging program to be carried out by CSIRO was described in the March 1981 *Australian Fisheries* ("Tiger prawn tagging program in the Gulf of Carpentaria") and about 20,000 tiger prawns were subsequently tagged and released in this experiment. By the end of 1982, a total of 2062 tags (15%) from the 13,180 brown tiger prawns released had been returned, and 570 (8%) of the 6812 green or grooved tigers had also been returned. A further 295 tags in which the species was not given were also returned, thus giving about a 15% return overall. The maximum times at liberty were 15 months for the brown tiger and 10 months for the green or grooved tiger. The article "Early results reveal value of tiger prawn tagging in Gulf of Carpentaria", appearing in the July 1982 *Australian Fisheries* detailed migration and growth rate information obtained from this work. Reprints of both articles have been widely distributed throughout industry and some general results were also discussed in the October 1982 Information Notes.

* * * * *

Nursery Ground Study

As you may have read in the February 1982 Information Notes the objectives of this preliminary study in the Weipa area (mainly in the Embley River) were

(1) to locate and characterize the nursery grounds of the two principle tiger prawn species (brown and grooved);

(2) to develop efficient sampling techniques and strategies;

(3) to observe seasonal changes in the postlarval and juvenile populations.

Results from this work are summarized and discussed below, but it should be noted that this data was collected over one year only from September 1981 to September 1982.

Both tiger species were found to be quite selective as regards habitat preference. Most, (90%), were found over seagrass substrates and the remaining 10% were found in areas where algae was growing. None were found in areas devoid of vegetation.

Immigration of postlarvae of both species into the estuary nursery grounds peaked twice during the sampling period. Approximately equal numbers of each

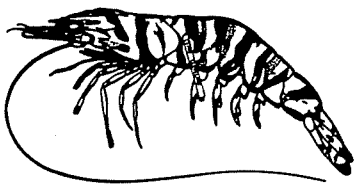
species were found during these pulses which occurred in September-October just before the wet season and in March-April just after the wet season. These immigration patterns do not reflect the spawning activity of adults in Albatross Bay as found by Jim Redfield in earlier *Judy B* cruises, and so it would seem, as Rothlisberg reported for banana prawns, that environmental factors including tidal and current regimes may well determine the ultimate fate of eggs and larvae.

Redfield also found that recruitment of adolescent tigers into the offshore areas in Albatross Bay occurred mainly in January with a second, but smaller, recruitment occurring during winter. These can be related to the peaks of postlarvae and juveniles found in the nursery areas in early spring and early autumn respectively.

It is interesting to note that preliminary work in the Groote Eylandt area shows that postlarvae and juveniles of both species immigrate into inshore nursery areas only during September-October (spring).

As reported in the October 1982 Information Notes the Queensland Fisheries study in the Cairns area showed even further variation. Once again it seems that we are confronted with a complex pattern which varies both geographically and in time. It is hoped that the combined results of work by CSIRO, Northern Territory Fisheries and Queensland Fisheries will provide a clear understanding of this pattern over time and space.

Incidental to the main objectives of providing data concerning tiger prawns, the sampling also provided information about other species. Juveniles of the blue tailed or true endeavour were found only on seagrass beds, whereas the red tailed or false endeavour ranged over all habitats sampled. As expected from earlier work, banana prawns were found essentially only in the mud-mangrove areas. Immigration peaks of postlarvae and juveniles of blue tailed and red tailed endeavours were found in December and February respectively and again this varies from that found by Queensland Fisheries in the Cairns area.



BANANA PRAWN CLOSURES IN THE GULF OF CARPENTARIA

This section discusses the validity of various opening dates for optimizing the banana prawn fishery given the high levels of fishing intensity which now operate. Firstly, however, some background information which has essentially been reproduced from the March 1979 Information Notes is given.

Background

In an unfished population of banana prawns, the total weight in the population at any point in time during its approximate 12 month life span will depend on three factors:

(a) the number initially in the population;

(b) the rate at which individual prawns grow;

(c) the rate at which prawns are suffering natural mortality (predation, etc.).

Natural mortality has been estimated to be about 5% of the remaining population per week and growth rates are known with banana prawns attaining a size of 8-10 count per lb in 12 months. Because this data can be analysed on a per prawn basis, graphs and curves which are independent of the number of prawns initially in the population can be constructed to show the relative resultant biomass (weight) at any time.

If the aim of management was to take the maximum weight of prawns possible in any one year and there was an unlimited number of vessels available, then a closure would be set with an opening date which coincides with the maximum weight in the unfished population. There are three factors which would make such an aim unrealistic however.

(i) The long term viability of the stocks is an important consideration which is not necessarily consistent with the above objective;

(ii) An unlimited number of vessels does not exist which means that the catch must be taken over a period rather than at the instant the population is at maximum weight. The effectiveness of the fleet in recent years, as evidenced by the extremely short seasons, does mean, however, that the fleet's fishing power, although finite, is extremely high. It has been shown, in fact, that any increase in fishing effort (through increased numbers of vessels) is not going to lead to any increase in total catch, but rather will result in a decrease in the average catch per boat and possibly in further shortening of the season. Furthermore, although possibly of academic interest only, quite substantial decreases in fishing effort (reduced number of vessels) would not necessarily result in significant decreases in total catch but rather in a lengthening of the time taken to produce that same catch and an increase in the average catch per vessel;

(iii) Because the bulk of the catch is exported, its value rather than its weight is the more important parameter in terms of optimal opening dates for the banana prawn season. The value of larger prawns is higher than that of smaller prawns on a per kg. basis, and as such, the optimal size at which fishing should commence will differ from that determined by weight alone. The average size of prawns in the catch has been influenced over the years by two major factors: the increasing fishing power of the fleet, and the effect of various pre-season closures. A pre-season closure is theoretically designed to allow prawns to reach an optimal size before being fished and thus, in effect, sets a minimum size of capture. Increased fishing power on the other hand means a lower probability of a prawn reaching a ripe old age and thus has the effect of reducing the average size.

As it has been shown that the majority of banana prawns reach maturity at a size of about 22-23 count per lb., non-exploitation of smaller prawns would also be consistent with biological aims of stock viability. Thus there can be no debate as to whether closures are a good thing or not, but rather what is the best and most equitable form that a closure should take.

* * * * *

The Validity of Closure Dates

Although many factors may ultimately contribute to the optimization of this fishery, three factors are considered here:

(1) Weight of catch;

(2) Gross export value;

(3) Profit to the processing sector.

In order to establish the relationship between these variable factors and the opening date, the following procedure was adopted.

(a) The known growth rate of banana prawns was used to standardize to March 1st each year the size composition of commercial catch samples from the Karumba and Weipa regions. All such data for a particular region was then combined to provide an estimate of the size composition of the entire population for that region and that year as at March 1st.

(b) Logbook data provided by fishermen in 1981 was used as a measure of current fishing intensity.

(c) By using data from (a)-size composition-, and (b)-1981 fishing levels-, and by including known growth and mortality rates, we constructed for each area and each year, graphs showing the relative estimated catch weight corresponding to various opening dates.

(d) This relationship was then extended to account for the increased value per kg. of larger prawns, thus obtaining a relationship between annual export value and opening date.

(e) An attempt was also made to incorporate the variable processing cost per kg. associated with prawns of different sizes thereby having some measure of profit (at least to processors) associated with various opening dates.

The graphs which show the relative catch weight, gross export value, and net export value (indicating profit to processors) which would have been obtained at various opening dates had the current level of fishing intensity been operating, are shown for the Karumba region in 1979 (Figure 1). A maximum catch weight would have been obtained with an opening date of March 23rd. A maximum in gross export value would have been obtained with an opening date some three weeks later (April 17th), whilst a maximum net value (indicating profit to processors) would have resulted from an even later opening on May 5th.

The fact that the catch from this fishery is primarily exported indicates that the gross export value may be a more important consideration than weight landed when choosing an appropriate opening date. Although maximizing net value (profit) is more consistent with economic efficiency, there was considerable difficulty in obtaining a precise relationship between prawn size and processing costs. For this reason, coupled with the added complexity of bulk export packs, the remainder of this discussion will be associated with maximizing gross export value.

It is useful to appreciate the sensitivity of changes in export value to changes in opening dates and the range of dates which would still result in export value

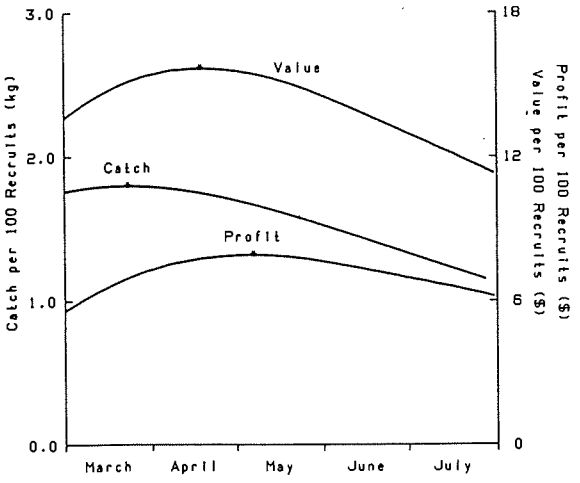


Figure 1. Relationship between catch weight, value, profit to processors and opening date based on the Karumba region 1979 (given 1981 fishing intensity levels).

within 95% of the maximum (given current fishing intensity) has been calculated along with the date corresponding to the maximum. This analysis has been carried out for the Karumba and Weipa regions for several years and the results are given in both Table 1 and Figure 2.

In summary:

- there is marked variability in the optimal opening dates
- because of the variation in size compositions between areas, any pre-season sampling strategy aimed at fine-tuning the opening date for any particular year must encompass all major fishing areas as well as assessing the relative recruitment strength to each area.
- despite the variability in opening dates, it would appear that under current levels of fishing intensity, maximum gross export value would be obtained with an opening date somewhat later than mid-March, possibly as late as mid-April.

TABLE 1. Opening date and gross export value relationships.

Area and Year	Date for maximum value	Range for 95% of maximum value
Karumba		
1974	17 April	17 March-18 May
1975	26 April	29 March-29 May
1976	26 April	28 March-30 May
1977	8 April	11 March-13 May
1978	17 April	21 March-25 May
1979	17 April	19 March-21 May
Weipa		
1974	12 March	* -15 April
1975	26 March	* -30 April
1976	7 April	7 March-9 May
1977	7 April	8 March-10 May
1978	8 April	12 March-17 May

* Before 1 March

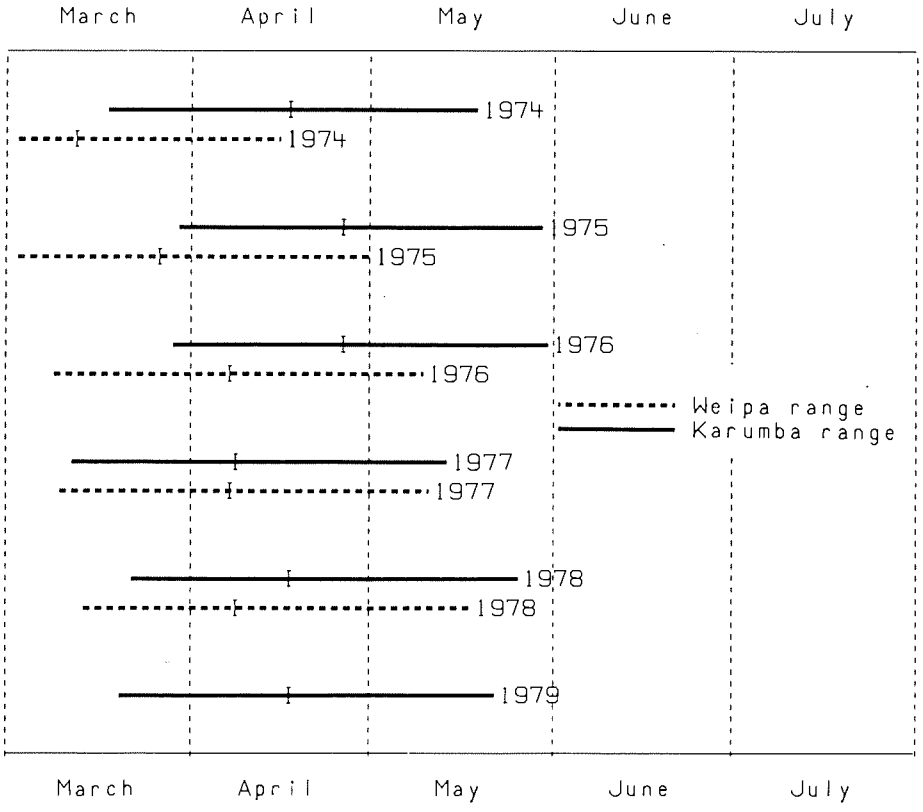


Figure 2. Opening date corresponding to maximum export value and range of opening dates resulting in export value within 95% of maximum (given 1981 fishing intensity levels).

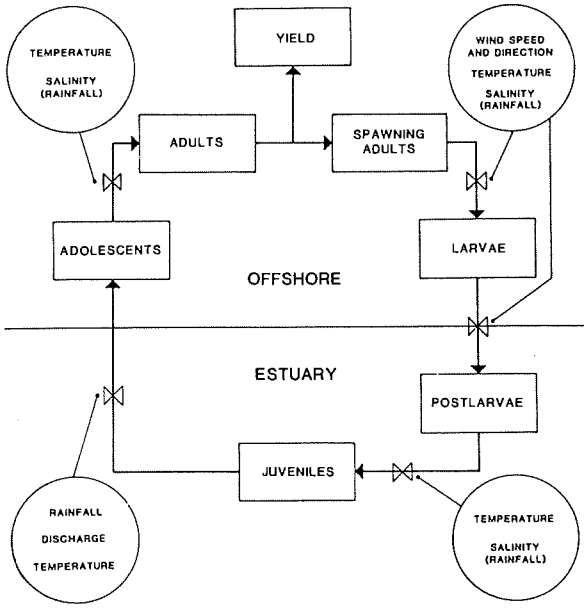


Figure 3. Life history stages of the banana prawn showing the main factors which can affect abundance at each stage.

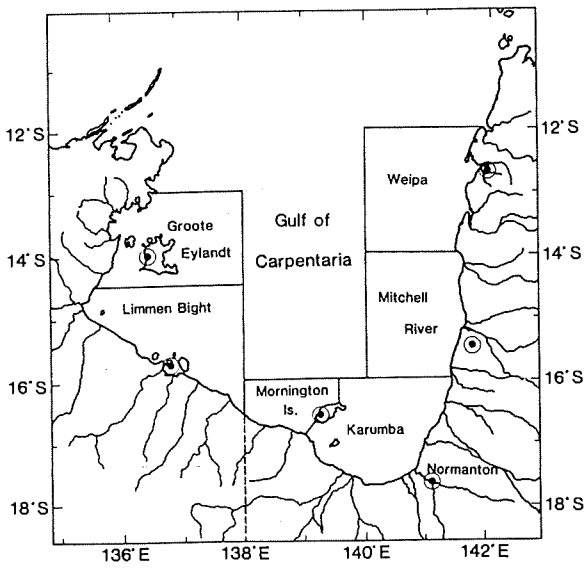


Figure 4. Regions used to calculate catch and rainfall statistics in the Gulf of Carpentaria.

TRENDS AND PREDICTIONS OF BANANA PRAWN CATCHES IN THE GULF OF CARPENTARIA

(This paper was prepared by D.J. Staples and summarizes a presentation made at the 1983 Cairns pre-season prawn workshop.)

It is now well accepted that rainfall affects banana prawn catches. The purpose of this paper is to examine:

(i) the extent to which rainfall influences banana prawn catches in the different regions of the Gulf of Carpentaria ;

(ii) how rainfall differences can be used to explain trends in the Gulf banana prawn fishery over the last decade; and

(iii) if banana prawn catches can be predicted before the opening of the fishing season.

Banana Prawn Biology

Banana prawns undertake two quite extensive migrations during their life. The first migration takes place when the larvae, which are hatched from eggs shed at sea, move inshore into the estuaries which function as nursery areas for the juvenile prawns. The second migration takes place after several months of residence in the estuaries. Given the required set of stimuli, juvenile prawns move back into offshore waters where they become available to the commercial fishery. The survivors of the fishery spawn and thus complete the cycle. During their life banana prawns occupy diverse habitats and consequently a wide range of factors, any of which can act at different stages of the life cycle, may affect the abundance of prawns available to the fishery. Some of these factors are shown in Figure 3.

Effect of Rainfall

It can be seen from Figure 3 that rainfall can affect banana prawns at several points in their life cycle. Because of the seasonal nature of rainfall, the timing of different life history stages in relation to the wet monsoon period is also important. In the Karumba region of the Gulf (Figure 4) the most important period of immigration of larvae into the estuary takes place in the pre-wet season months of October and November. These larvae live in the estuary for several months and then migrate offshore during the monsoon months. Here we have found that the number of prawns migrating each year depends to a large degree on the amount and timing of rainfall although the number of juvenile prawns present in the river at the time of rainfall is obviously also important. There is a good agreement between the amount of rainfall in any year and the subsequent banana prawn catch in this region (Figure 5). In the northern regions of the Gulf, however, the effect of rainfall is not as direct and the relationship between rainfall and catch is not so clear (Figure 6). Rainfall relates well to catches in the Mornington Island

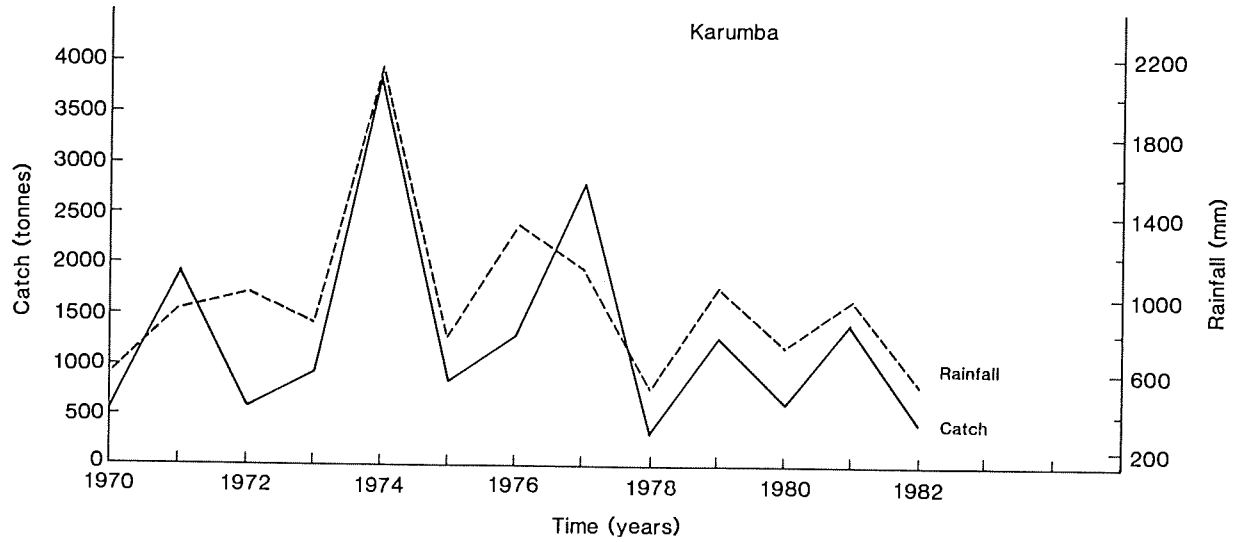


Figure 5. Annual banana prawn catches and annual rainfall in the Karumba region of the Gulf of Carpentaria, 1970 to 1982.

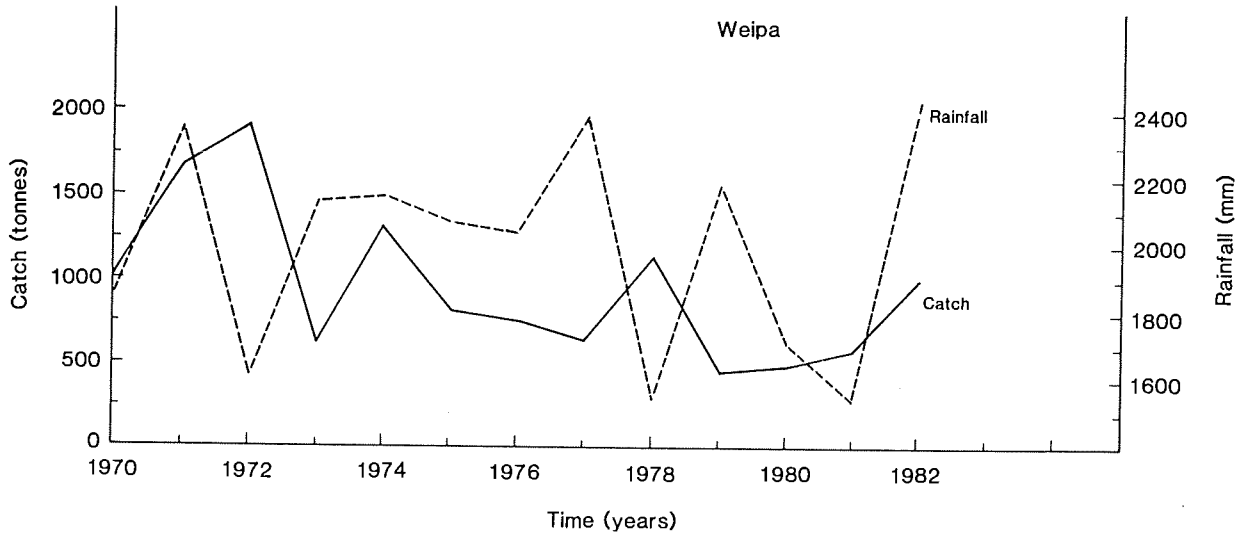


Figure 6. Annual banana prawn catches and annual rainfall in the Weipa region of the Gulf of Carpentaria, 1970 to 1982.

and Limmen Bight regions as in the Karumba region, and because catches from these three regions contribute a major part of the total Gulf catch, a reasonable agreement between total Gulf rainfall and total Gulf catches exists (Figure 7).

Trends over the Last Decade

Using the Karumba region as an example, a plot of banana prawn catches since 1970 shows that catches have generally declined since the large catch of 1974 (Figure 8a). A plot of rainfall over the same period, however, also shows a similar decline (Figure 8b). The amount of each year's catch which cannot be explained by rainfall has been calculated and is known as the residual. After removing the effects of rainfall no downward or upward trends can be seen (Figure 8c).

Predictions

In the Karumba, Mornington Island and Limmen Bight regions, rainfall data collected before the opening of the banana prawn season can be used to predict catches. Based on data collected up to the end of January each year, a graph can be constructed and used to predict catches (solid line in Figure 9). The grey shaded area around the line represents the confidence with which a prediction can be made on the basis of the twelve years' data now available and it shows the range within which a prediction calculated from a given rainfall figure will fall 95 times out of 100. For example, in the Karumba region, based on a rainfall figure of 600mm, the predicted catch is 1,476 tonnes. There is a 95% chance that the catch will be between 995 and 1,960 tonnes. As future year's data are added to our equations, the

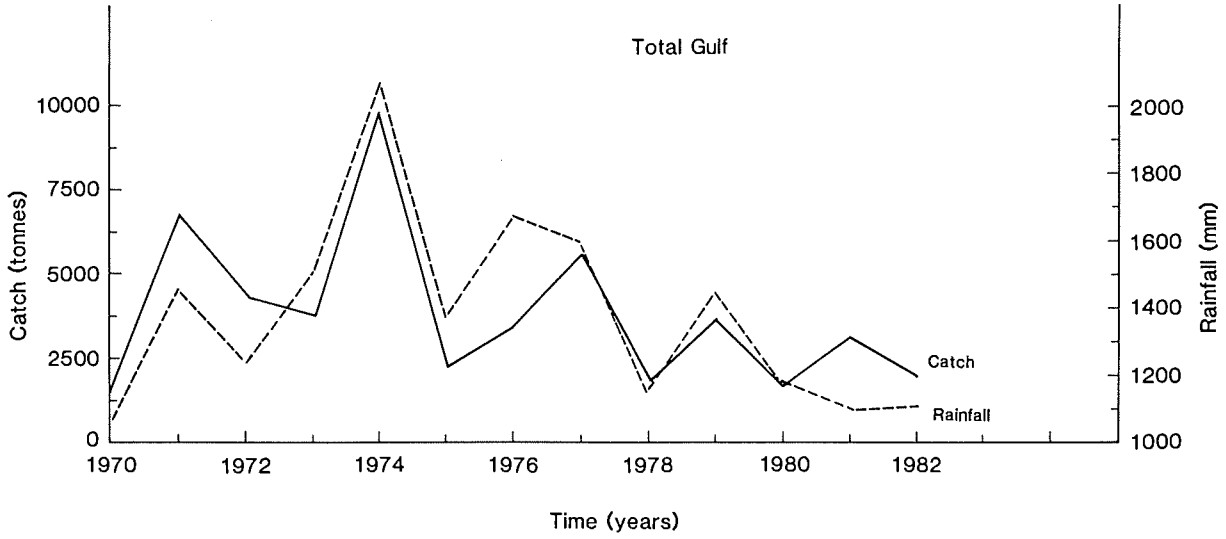


Figure 7. Annual banana prawn catches and mean annual rainfall for the total Gulf of Carpentaria, 1970 to 1982.

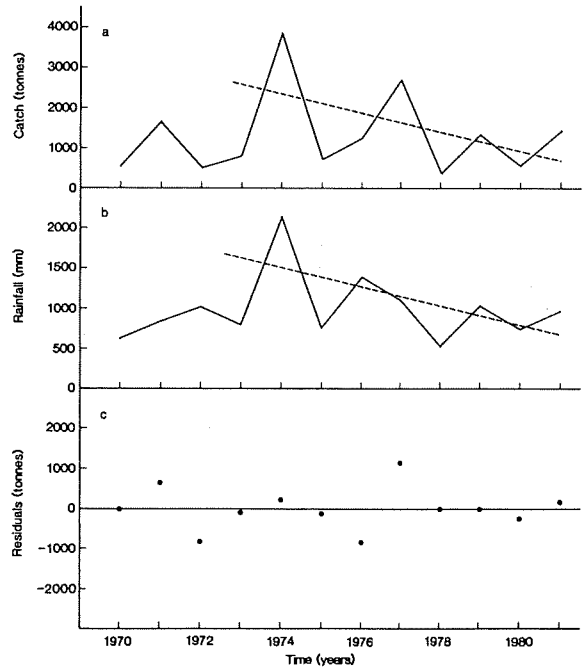


Figure 8. (a) Catch of banana prawns for Karumba region, 1970 to 1981.
(b) Annual rainfall for Karumba region, 1970 to 1981.
(c) Relative catch of banana prawns calculated as the difference between observed catches and expected catches based on rainfall figures (Karumba region, 1970 to 1981).

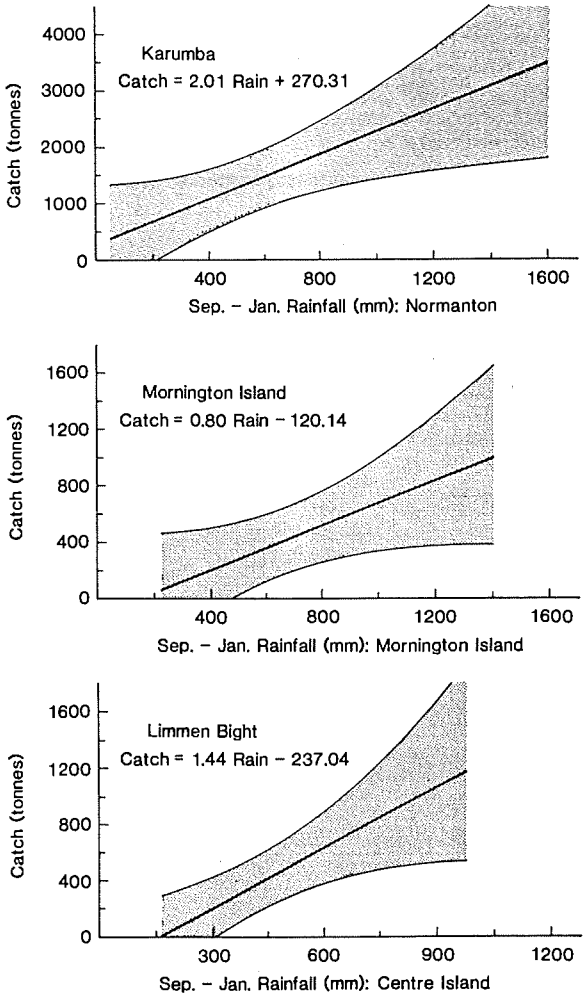


Figure 9. Predicted catches of banana prawns (solid line) for three regions of the Gulf based on rainfall from September to January inclusive each season. Shaded area gives 95% confidence limits to the predicted catches.

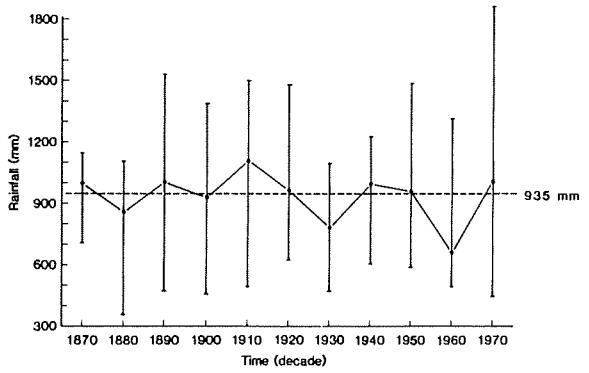


Figure 10. Ten year averages and range of rainfall at Normanton, 1870 to 1970.

confidence of predictions will improve. The accuracy of predictions also improves the closer one moves towards the opening of the season - thus by the end of February a narrower range of prediction is possible. Based on rainfall figures up to the end of January, catch prediction figures for the Karumba, Mornington Island and Limmen Bight regions for 1982 were 773, 0, and 285 tonnes respectively. The actual catches have been estimated to be 453, 43 and 255 tonnes, respectively. The Karumba catch was down from that predicted, but still lay well within the confidence limits of predictions. For 1983, rainfall figures to the end of January are 90mm, 54mm, and 72mm respectively, giving predicted catch figures of 452, 0, and 0 tonnes for the three regions. Because these rainfall figures fall outside the range recorded during the history of the banana prawn fishery in the Gulf, predictions cannot be very exact (refer Figure 9). Limits of the predictions are 0-1300 tonnes for Karumba, 0-500 tonnes for Mornington and 0-280 tonnes for Limmen Bight. Because catches in Weipa, Groote Eylandt and Mitchell River regions have not followed rainfall patterns, predictions are more difficult. The best prediction is probably average catches over the past few years which are 746, 210, and 589 tonnes respectively. These regional predictions add up to 1,995 tonnes for the total Gulf.

Long-term Forecast

Over 100 years of rainfall figures are available for Normanton (Figure 10). Rainfall at this station has ranged from a minimum of 354mm in 1884 to 1851mm in 1974. Ten year averages show that the rainfall in the last decade has been more variable than in earlier decades, but the overall rainfall in the 1970's was above average. (The average annual rainfall over this period was 1,009mm and the average annual banana prawn catch was 1,380 tonnes.) The high rainfall of 1974 was well above that ever experienced in the past 110 years, and chances of another 1974 are remote. Our expectation of catches based on these 1970 figures, therefore, are too high, and on average we can expect catches to be lower in the future.

STATISTICS

As pointed out in the October 1982 Information Notes, various statistical data may be found in several publications. Although much of this data is of historic nature, it is of interest as it allows comparisons to be made and indicates developments and trends in the fishery. Recent statistics are published by Fisheries Division, Commonwealth Department of Primary Industry both as a calendar year annual report and, more recently, as a progressive monthly report. Enquiries about these latter reports should be directed to Commonwealth fisheries field officers or to Paul Ryan in Canberra.

The following contents page from the 1981 annual statistical report has been reproduced to show the forms in which data is available. If you feel that any such data should also appear in future issues of these Information Notes, you are again asked to contact either CSIRO or any other fisheries field staff and to specify the exact information you would like to see reproduced.

Contents page of 1981 D.P.I. Annual Statistical Report

Table 2 has been compiled essentially from data provided through the fishermen's log book program.

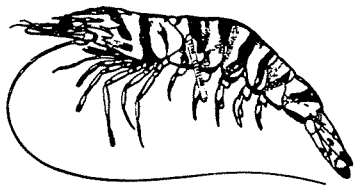
TABLE 2. D.M.Z. Banana Prawns

N.B.: The figures in brackets under the various headings are the respective catches per day fished and are given in kilograms. All other figures are given in tonnes.

	1978	1979	1980	1981	1982[A]
Total landings	2535	4775[B]	2681	5034[B]	2900[B]
Catch/ day fished	0.455	0.662	0.325	0.515	0.427
Catch by Region					
Weipa	1045 (807)	444 (435)	481 (397)	577 (551)	1001 (601)
Mitchell River	169 (336)	505 (507)	171 (206)	599 (401)	50 (190)
Karumba	387 (453)	1328 (876)	570 (416)	1444 (703)	453 (549)
Mornington Island	83 (315)	713 (1013)	99 (224)	237 (368)	43 (137)
Limmen Bight	1 (5)	516 (876)	147 (300)	190 (405)	255 (507)
Groote Eylandt	70 (91)	143 (336)	105 (243)	129 (395)	155 (361)
Gove	27 (105)	63 (680)	41 (222)	108 (375)	41 (240)
Arnhem	69 (308)	106 (488)	60 (203)	315 (574)	102 (195)
Melville	684 (321)	954 (505)	1007 (335)	1381 (490)	791 (368)

[A] Preliminary data
[B] Includes product from unspecified areas.

Note: Although total landings and catch by region estimates are given for the whole year and therefore include banana catches made incidental to "tiger trawling", the catch/day fished figure refers to data where only banana prawns were caught (or searched for and not caught).



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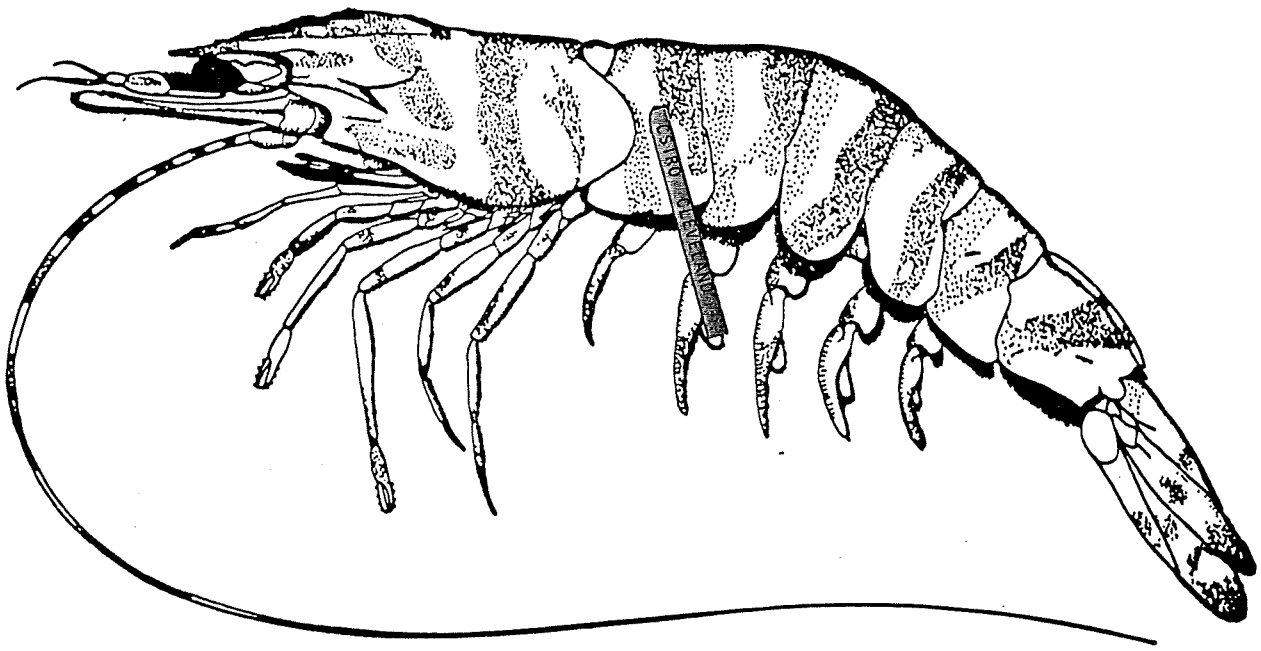
NORTHERN PRAWN FISHERY

INFORMATION NOTES

NUMBER 4 SEPTEMBER 1983



Compiled by Brian Taylor

Industry Liaison Officer

CSIRO Division of Fisheries Research

BIOLOGY OF THE BANANA PRAWN (*Penaeus merguiensis*) IN THE GULF OF CARPENTARIA - AN OVERVIEW

(This paper was prepared by Drs P.C. Rothlisberg and D.J. Staples (CSIRO) and presented at the 1983 Cairns Preseason Prawn Workshop)

INTRODUCTION

The banana prawn (*Penaeus merguiensis*) is widespread throughout the Indo-West Pacific region and is commercially important in the Persian Gulf, Pakistan, Malaysia, Thailand, Hong Kong, Indonesia, Papua New Guinea, Philippines and New Caledonia. In Australia the species occurs across the northern part of the country and down the east and west coasts to about latitude 29°S. Throughout much of this range a similar prawn, the Indian banana prawn *P. indicus*, is also caught and this species has recently been found in commercial quantities in Australian waters off Port Essington and Joseph Bonaparte Gulf. To date, however, it has not been reported from the Gulf of Carpentaria which is the centre of the Australian banana prawn fishery.

The Gulf of Carpentaria fishery dates from the mid 1960's after an initial survey in 1963 by CSIRO, Commonwealth Department of Primary Industry, the then Queensland Department of Harbours and Marine, and Craig Mostyn Pty Ltd located banana prawns in commercial quantities. In the early years the fishing season extended for about nine months of the year. Because banana prawns form dense schools and are more readily caught than other prawns and as fishing effort has increased so the season has become much shorter. The bulk of the catch at present is taken in a matter of weeks.

From the early survey it was felt that *P. merguiensis* had both a one-year life span and a one-year generation time (the time taken to complete the cycle from egg to egg). It was suggested that the prawns mated in March-April (autumn) but did not spawn until the following spring. It was also found that although schooling occurred in autumn the prawns did not necessarily have to school to mate.

With the shortening of the season there were fears expressed that the fishery would collapse because there would not be adequate opportunity for reproduction.

In this paper we will describe the results of recent research on the breeding biology and prawn migrations that can explain the seasonal patterns of prawn abundance seen in the eastern Gulf of Carpentaria. We will also compare the patterns seen in the Gulf with those found elsewhere in the extensive range of the species. Finally, we will show the relevance of this information to the exploitation and management of this valuable resource.

LIFE CYCLE - GENERAL

The banana prawn lives for about one year, but can reach sexual maturity within six months of birth. The adults mate offshore when the female is soft-shelled and she then spawns approximately one month later. This mating-spawning cycle goes on throughout the year but reaches a peak twice a year - in autumn (March-April) and in spring (September-October). The number of eggs spawned depends on the size of the female, about 100,000 eggs when she first reaches maturity to over 500,000 eggs from a very large female. The eggs are not carried externally by the female as they are in crabs, lobsters, and some other (carid) shrimps but are shed into the sea. The eggs hatch in 2-3 days and the small stage that emerges from the egg, called the larva, goes through about 12 changes in body form (moults) while it swims about offshore, feeding on microscopic plants and animals (phyto- and zooplankton). During this phase (the planktonic phase), which lasts only 2-3 weeks, very few larvae manage to survive, as they too are eaten by other members of the planktonic community. Also during this phase the larvae must be transported by tidal and wind driven currents from the offshore spawning grounds to the estuarine nursery grounds. In the estuary, the young prawns abandon their swimming mode of life and settle on the banks of the mangrove lined estuaries. Here they live for the next two to three months where they grow rapidly. As a result of increased rainfall during the wet season, juvenile prawns of all sizes ranging from 12 to 100mm migrate out of the estuaries. As they move offshore, they continue to grow, mature and ultimately spawn to complete the cycle. These periods of spawning and recruitment are very seasonal due to environmental factors. The timing of these events, the factors that control them and the reasons why they differ in different parts of the eastern Gulf determine the size and distribution of the adult populations which make up the commercial catch.

LIFE CYCLE - SOUTH-EASTERN GULF

In Figure 1 we summarize, for a 12 month period, the relative abundance of eggs in the plankton, juveniles in the estuaries, and adults offshore. The number of eggs spawned is related both to the number of spawning females and to their size. A small number of large prawns will produce as many eggs as a large number of small prawns. In the south-eastern Gulf there are two peaks of egg production, one in September-October involving a relatively small number of females and the other much larger peak during the commercial fishing season in March-April. Paradoxically, the relatively small peak of egg production leads to the larger peak of juveniles in the adjacent estuarine nursery areas; the very large autumn spawning rarely gives rise to juveniles and only in relatively small numbers (dashed curve, Fig. 1). The spring peak of juveniles leaves the rivers during the wet season and gives rise to the commercially fished stocks that peak in March. This large single peak of adult abundance may be augmented in some years by juveniles that over-wintered in the estuaries through the

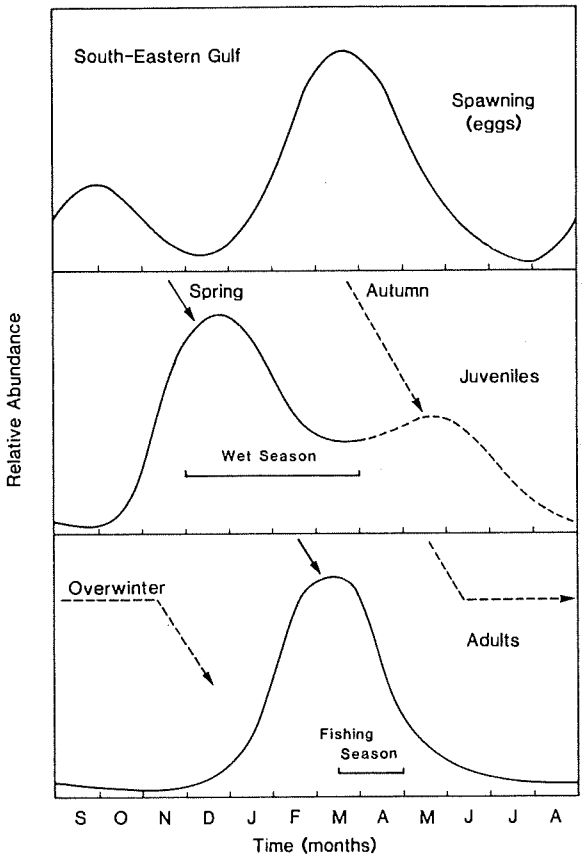


Figure 1. Seasonal cycles in the relative abundance of eggs (offshore), juveniles (estuary nursery areas), and adults (offshore) in the south-eastern Gulf of Carpentaria.

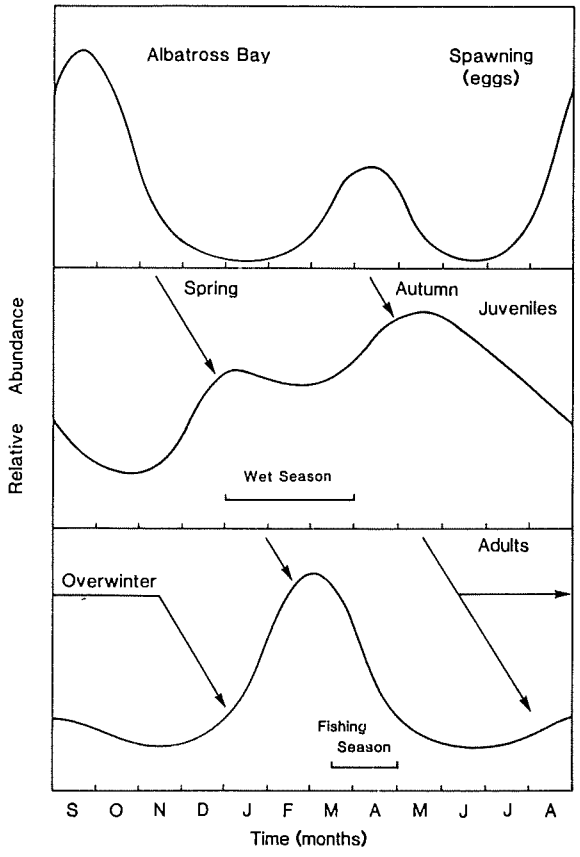


Figure 2. Seasonal cycles in the relative abundance of eggs (offshore), juveniles (estuary nursery areas), and adults (offshore) in Albatross Bay.

dry season (dashed line, Fig. 1). Survivors from the fishery appear to be the only significant source of spawning females to supply the eggs in September-October.

LIFE CYCLE - ALBATROSS BAY

In Albatross Bay there are also two peaks of egg production during the year (Fig. 2), but the relative magnitude is opposite that seen in the southern Gulf. Here the spring peak of spawning in September-October is much larger than the autumn peak in March-April. Here too the relative abundance of juveniles does not follow the relative abundance of spawning peaks, with the larger number of spring eggs giving rise to the smaller of the two peaks of juvenile abundance. In the rivers adjacent to Albatross Bay the autumn influx of juveniles into the estuaries after the wet season is consistent from year to year and larger than the pre-wet influx. Because of the close relationship between the onset of the wet season and the emigration of young prawns from the nursery areas, the juveniles which originated from the September-October spawning contribute the most significant proportion to the commercially abundant stocks in March. Many of the juveniles which come into the rivers after the wet season, however, will stay in the estuary over the dry season (overwinter) and contribute to the February-March stock six months later. This overwintering component in the north is a much more significant contribution to the adult stock than it is in the southern Gulf.

LIFE CYCLE - CAPE KEERWEER

In the Cape Keerweer region there are three peaks of spawning activity on top of a much higher year-round background level of reproductive activity (Fig. 3). Here the spring spawning occurs earlier than in the southern Gulf, but as in both areas, a large number of juveniles leave the estuary during the wet and give rise to the commercial stocks in March. Unlike the north, however, little overwintering of juveniles in the estuaries occurs, and the small peak of juveniles in April move offshore in winter and contribute directly to small offshore

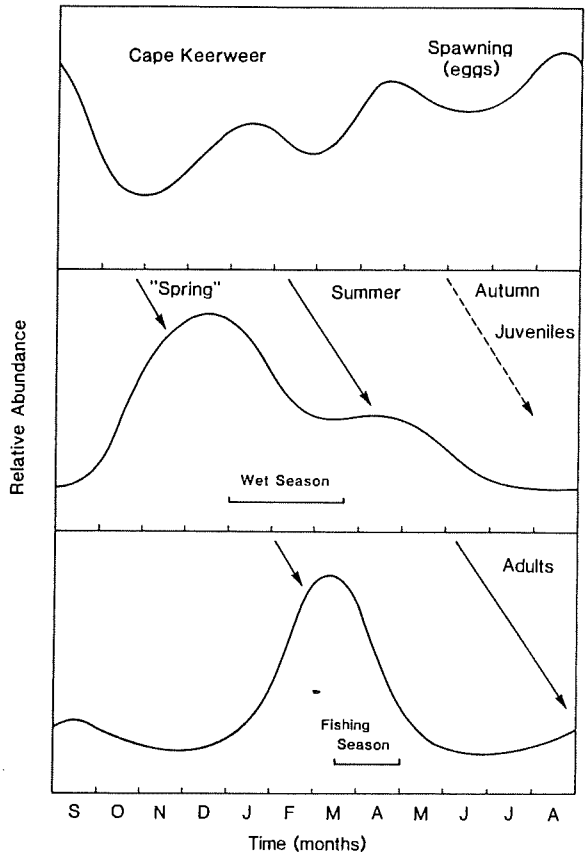


Figure 3. Seasonal cycles in the relative abundance of eggs (offshore), juveniles (estuary nursery areas), and adults (offshore) in the Cape Keerweer area.

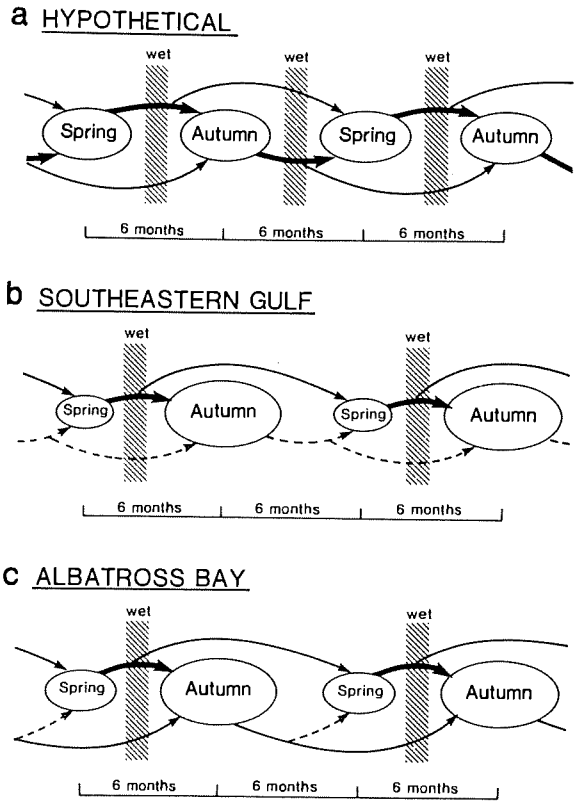


Figure 4. Relative abundance of spring and autumn stocks of adult banana prawns showing their relative input to subsequent generations.
(a) hypothetical (Indo-West Pacific);
(b) South-eastern Gulf of Carpentaria;
(c) Albatross Bay region.

stocks of adults (August-September). This lack of overwintering by juveniles in this region is probably due to increased year-round freshwater input in this region.

INDO-WEST PACIFIC PERSPECTIVE

In order to gain understanding of the complex patterns of abundance seen in the Gulf of Carpentaria it is helpful to examine patterns seen elsewhere in the animal's range. The hypothetical pattern is one in which both the spring and autumn populations are about equal in size and each contributes significantly through spawning, juveniles and offshore migration to the subsequent population six months later (thick arrows, Fig. 4a). Some survivors from each population provide a lesser contribution in 9-12 months (thin arrows, Fig. 4a). With two wet seasons each year juveniles of both populations contribute directly to the offshore fishery and overwintering of juveniles through a dry season does not play a part.

Over the range of the banana prawn throughout the world, the Gulf of Carpentaria is rather exceptional in having only one short wet season each year. The life cycle of the banana prawn in the Gulf, therefore, is quite different from the general cycle seen elsewhere. In all regions of the Gulf, even in the Cape Keerweer area where year-round fresh water modifies the picture to some degree, prawns migrate from the estuaries to the offshore area mainly during the summer wet season. The spring and autumn populations are therefore unequal in size and the autumn population is the only one large enough to support a commercial fishery.

In the south-eastern Gulf (Fig. 4b), the large autumn population contributes little and only sporadically to either the subsequent spring or autumn populations (dashed lines, Fig. 4b). The small spring population, made up mainly of survivors from the autumn fishery (thin lines, Fig. 4b), therefore, is the only significant source of the autumn fishery.

In Albatross Bay the picture differs slightly (Fig. 4c). Here too the populations are of unequal size with the autumn population forming the main

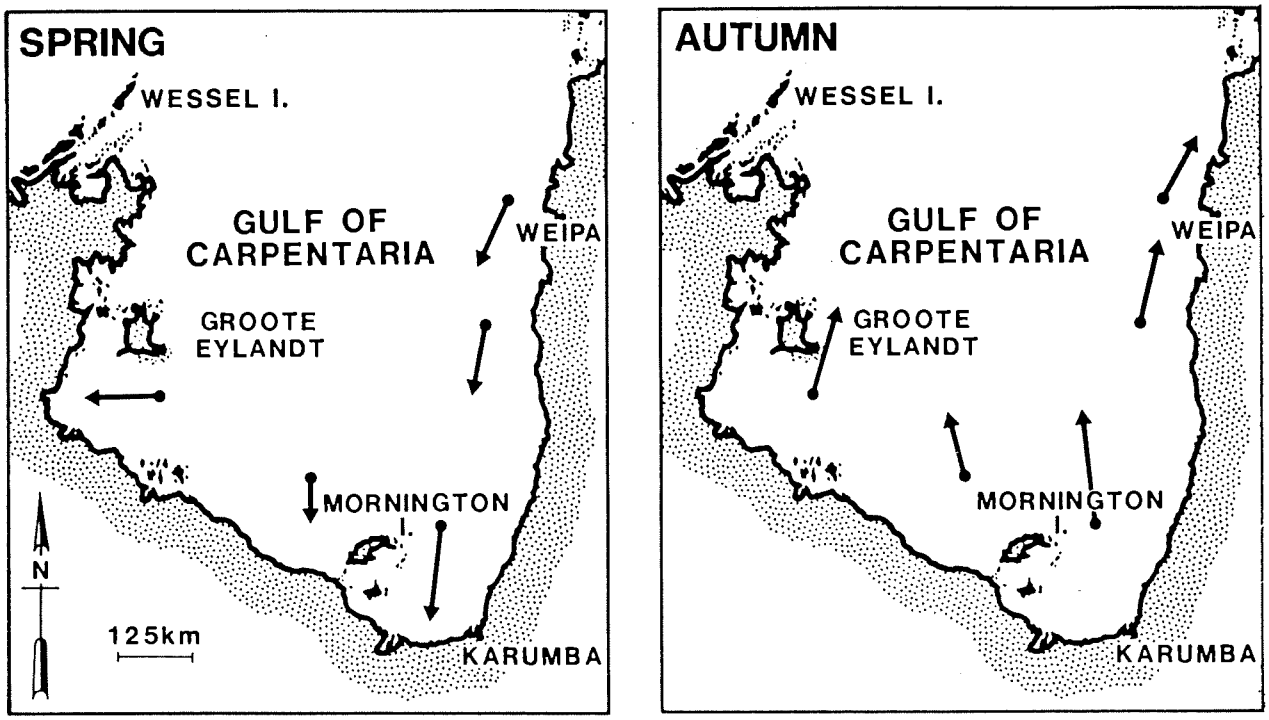


Figure 5. Changes in the direction and distance of larval drift during spring and autumn in five regions of the Gulf of Carpentaria.

commercial fishery. This population is made up mainly of prawns originating from the spring population, growing up as juveniles in the estuaries during spring and summer and migrating offshore during the summer wet season. However, in this region there is also a significant and consistent contribution of juveniles from the autumn population. These juveniles can contribute some prawns to the spring population by leaving the rivers in winter (dashed lines, Fig. 4c), but most appear to overwinter in estuaries and contribute to the autumn population 9-12 months later (small solid line, Fig. 4c).

LARVAL DRIFT

One last question remains to be addressed: the paradoxical contributions of spring and autumn spawning populations to juvenile populations. In the southern Gulf we saw that the smaller (spring) of the two spawning peaks gave rise to the larger peak of juveniles and conversely in the north the smaller (autumn) of the two spawning peaks gave rise to the larger peak of juveniles. As pointed out in the life history section, after the eggs hatch there is a short planktonic period during which the larvae are at the mercy of tidal and wind driven currents to transport them from offshore spawning grounds to the estuarine nursery areas. While these larvae do not have swimming abilities large enough to counter these currents, they do have limited swimming abilities which they use to move up the water column by night and down during the day. As they move up and down they encounter currents of different speeds and directions. Depending on the time of year and the location of spawning, these currents will carry the larvae toward their nursery ground habitats or away from them. In the spring (Fig. 5) the products of the relatively small spawning in the south are directed onshore and are delivered to the adjacent nursery areas; whereas in the north the larval drift is offshore and very few of these larvae reach the necessary habitats to complete the life cycle. Because of a change during the year in the timing of currents in relation to the day-night swimming habits of the larvae, the opposite effect is seen in the autumn six months later. Now the products from the very large spawning in the south are carried offshore, while the relatively small spawning in the north is directed onshore. The fact that larval drift is alongshore off Cape Keerweer in both seasons helps explain why we see more continuous arrival of juveniles in that region.

DISCUSSION AND CONCLUSIONS

1. Individual banana prawns have a life span of up to one year, but are capable of producing eggs after six months of life. As a result, two main generations of young prawns are produced each year - one during the fishing season in March-April (autumn) and the other in September-October (spring).

2. In the southern Gulf, the eggs produced during the fishing season (March-April) are, in the main, swept offshore by the prevailing currents. The eggs produced in September-October form the basis of the following year's fishery in this region. The young prawns grow up during the summer months in the rivers and, as a result of increased rainfall during the wet, move offshore and enter the fishery from January to April.

3. In the Albatross Bay region, more of the eggs produced in March-April survive to enter the nursery areas. However, because banana prawns move out of the nursery areas as a result of increased freshwater runoff, many of these prawns overwinter in the rivers and join the summer wet season migration with the spring generation. Only one fishing season results, therefore, but the prawns in this fishery tend to be more variable in size than those in the south.

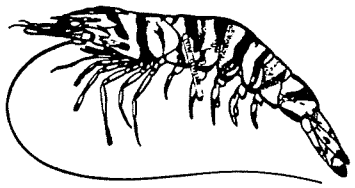
4. The Cape Keerweer region differs from both the south and the north of the Gulf in that freshwater input into the rivers occurs right throughout the year. The effect of the wet season in synchronizing the pulse of prawns that leave the estuaries and move into the offshore region is therefore less pronounced. Because of these differences in the composition of the offshore stocks, eggs are also produced more year-round with peaks in late spring, summer and autumn.

5. Because of these regional differences it is difficult to generalize for the Gulf as a whole. It can be argued that, especially in the southern Gulf, there is little need to ensure the successful spawning of the March-April stock. However, sufficient numbers of these prawns must be allowed to escape each fishing season to form the spawning stock the following September-October. Further, in the case of a total failure of spawning of the September-October prawns, the small number of prawns spawned in March-April that overwinter in the estuaries, form the only backup to prevent total collapse of the whole population.

6. Present indications are that the number of prawns surviving the fishing season is sufficient to maintain future stocks. However, because more than 80% of the stock is taken each season, the situation must be monitored closely in the future.

* * * * *

The preceding article is the last of those summarizing talks given by CSIRO staff at the 1983 Cairns pre-season prawn workshop. You are also referred to the February 1983 Information Notes as articles summarizing other CSIRO talks were featured and these two issues have now presented a considerable amount of the known biology of the banana prawn, *P. merguiensis*. It is expected that continuing laboratory work and future field studies aimed at other species will provide additional biological data.



PRESEASON SAMPLING OF BANANA PRAWNS, 1983

BACKGROUND

As a result of industry concern over a decline in the average size of banana prawns in the commercial catch from the Gulf of Carpentaria, CSIRO undertook a reassessment of the opening dates of prevailing preseason closures. A report on this study was presented to NORPAC/NFC in September 1982 and an outline was given in the February 1983 Information Notes. Notwithstanding the area to area and year to year variation in optimal opening dates, the report clearly indicated that an extension in time of the closed season would be of considerable benefit. After due consideration it was recommended by NORPAC/NFC that the opening date for the 1983 season be 1st April.

It was subsequently agreed (NORPAC meeting, February 1983) that with assistance provided by the fishing industry, CSIRO would coordinate a joint feasibility study in March 1983 to ascertain the potential for fine tuning future opening dates through preseason surveys. Preliminary discussions took place in Cleveland in late February to plan the study. At this meeting it was agreed that Ian Somers (CSIRO) would act as coordinator and David Carter (K.F.V. Fisheries) would be responsible for the logistic problems associated with the industry participation. Sampling strategies were also prepared together with arrangements for observers for each vessel participating and the reporting of survey results.

OPERATION

Vessels were provided by NFCA member companies and by the Queensland Independent Fishermen's Association. Each of the participating trawlers in the surveys had an observer from either CSIRO, DPI or Queensland Fisheries on board. Their role in the program was to ensure that each vessel completed its sampling program in accordance with the overall sampling stategy. In this respect, each vessel had to work completely independently of the other vessels in order that the final results would be scientifically comparable. It was also the duty of each observer to measure and record relevant details of all prawns caught during the survey.

The study was confined to an area in the Weipa region between the Pennefather and the Archer Rivers and was divided into two preseason surveys followed by

a survey during the first week of the fishing season. The objective of each survey was to assess the size composition of the banana prawn population at that time. The two preseason surveys were carried out in periods approximately four and two weeks prior to the opening date of 1st April. Forecasts were made on the basis of the information gained through the two preseason surveys and the results of these forecasts were checked against the size composition obtained during the first week of the season.

Survey 1 (3rd - 8th March, 1983)

This survey was carried out by three vessels over a period of six consecutive days and nights. Each vessel worked independently, spending approximately equal time in each of three sub-areas so that at the end of the survey, the results could be used to provide a measure of the variability associated with one vessel's estimation of the size composition.

Survey 2 (17th - 22nd March, 1983)

Although it was proposed to have six vessels deployed in a similar pattern to that of the three vessels during the first survey, technical problems reduced the number of fully operational vessels to five. These five vessels worked independently for one day in each of six sub-areas so that at the end of the six day survey, each had covered the whole study area in a sampling mode similar to that employed during the first survey.

Survey 3 (1st - 4th April, 1983)

Six observers were stationed on vessels during the first week of the fishing season and samples of approximately 200 prawns were measured from each school fished by those vessels. In order that the information gained during this survey be maximized, arrangements were made for observers to be placed on vessels from different organizations/companies. Where vessels with observers left the Weipa study area, samples from other fishing grounds were also analysed when the opportunity arose.

RESULTS

Size Composition

A comparison of average size of prawns (given in number of prawns per lb) from each of the surveys is given in Table 1. From this and growth rate calculations, it was possible to make predictions as to the average size of prawns in subsequent surveys. These average size forecasts are also included (in brackets) for comparison.

TABLE 1. Average size of banana prawns (measured in prawns per lb) for each survey and the forecast average size for subsequent survey(s).

Date	Survey 1	Survey 2	Survey 3
March 8, 1983	23 15		
March 22, 1983	(20.17)	21.31	
April 1, 1983	(18.52)	(19.46)	18.26

The percentage by weight of prawns (head on) in each of the commercial grades for each of the two preseason surveys is given in Table 2 together with that obtained as a result of the survey during the first week of the fishing season.

TABLE 2. Percentage of prawns (head on weight) in each of the commercial size grades - actual and forecast.

Size Grade	Survey 1		Survey 2		Survey 3
	Actual 8/3/83	Forecast (1/4/83)	Actual 22/3/83	Forecast (1/4/83)	Actual 1/4/83
U8	3.9	(3.2)	4.4	(4.0)	3.6
9/12	10.4	(10.1)	8.5	(9.1)	11.4
13/15	7.6	(13.2)	13.9	(17.8)	18.6
16/20	15.9	(35.9)	22.8	(25.0)	33.9
21/25	22.6	(19.2)	19.2	(20.4)	18.2
26/30	19.7	(9.7)	13.6	(12.5)	7.8
31/35	5.6	(3.6)	5.7	(4.0)	2.0
36/40	4.4	(2.7)	4.7	(3.3)	1.6
41+	9.9	(0.9)	7.2	(3.8)	2.8

Optimal Opening Date

The determination of an opening date for the fishing season depends on the size composition as estimated by the surveys as well as the prevailing market value of the various commercial size grades. The relationship between potential opening dates for Weipa in 1983 and the resulting total value of the catch was calculated using the size composition data from the first week of the fishing season.

The estimated opening date for Weipa which would have maximized the total gross revenue based on current market conditions was 20/4/83. The dates which were forecast by the first and second surveys for maximum gross revenue were 25/4/83 and 1/5/83 respectively. Although the opening dates forecast as a result of the preseason surveys differed from the optimal date (20/4/83) by up to 11 days, the revenue that would have resulted was still within 0.5% of the maximum possible.

The change in opening date for the 1983 Gulf banana prawn season from the 15/3 to 1/4 resulted in an improvement in revenue from the Weipa region of 6%. A further improvement of 2% would have been attained if the opening date had been 20/4.

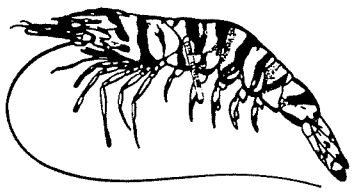
Sampling Intensity

By analysing and comparing the data collected by individual vessels against that collected by the survey as a whole, it has been possible to calculate the number of vessels required to give a particular level of precision. Thus the minimum effort required to achieve a satisfactory result in fine tuning the opening day in the Weipa area has been established.

DISCUSSION

The information and experience gained from this study has proven extremely valuable and the approach and cooperation of all participants is to be commended. Results have shown that fine tuning an opening date is feasible through pre-season sampling, at least in the Weipa region. These results can be used as an effective guide in extending the sampling techniques to other areas. The degree of success in this respect, however, is yet to be determined.

The future of pre-season sampling will ultimately be determined by the comparison between the cost of completing such a survey and the expected increase in value of the catch that would be attained as a result of the flexible opening to the season.



FISHERMEN'S LOG BOOKS

Rational management of any fishery necessitates an understanding of all biological, economic, and socio-economic aspects of that fishery. If this is not the case then much of the debate about various management options is based simply on anecdotal information and the quality of decision making must suffer accordingly. Industry participants are the primary source of information forming the data base necessary to obtain this understanding, and fishermen's log books, which provide catch and effort data, are a vital part of the information collecting system in the northern prawn fishery.

The current review of the management plan covering the D.M.Z. is based on the perceived need to contain (or even curtail) fishing effort, and it now seems an appropriate time to reiterate the importance of the log book program.

Government is sometimes criticized for the lack of ability to collate 'real time' statistics and for the subsequent lack of appreciation of 'real time' problems as they emerge. It is worth noting, however, that at the time of preparation of these notes, only about 38% of the estimated D.M.Z. prawn landings (all species) for 1982 have been recorded on processed log books. In light of the need to carefully monitor the effect of any new management plan which might be introduced as a result of the current review, along with the increased effort in tiger prawn research, it is most important that a sound data base is available. Your cooperation in the prompt submission of accurate and comprehensive log data is essential.

As a result of discussions with skippers about the advantages to the individual of keeping his or her own fishing records and to help overcome some of the seemingly unnecessary duplication in completing various log books, a 'new' book, which was described and discussed in the June 1983 Australian Fisheries, has been designed with a view to satisfying the needs of skippers, companies, scientists, and management authorities alike and it is hoped that a more comprehensive data set will result.

It has already been mentioned that management decisions may be based on log book information. Researchers also require this data however, and some specific uses in this area include :-

1. the measurement of the change in prawn abundance and the estimation of mortality rates; hence providing a relationship between yield per recruit and fishing intensity;
2. the interpretation of the pattern of tag recaptures;
3. the measurement of the relationship between annual prawn abundance and environmental factors;
4. the monitoring of the change in total fishing effort in the fishery and its effect on the average catch rate; and
5. the monitoring of changes in the total area being fished.

These and other studies allow the general 'health' of the fishery to be assessed and then monitored. Changes and trends can be detected and explained, and managers alerted where such events are undesirable.

It may well be that more immediate benefits could be realized if you were able to use the accumulated log data of the fleet to help you plan your own general fishing strategies. Some readers will remember that Northern Territory Fisheries prepared and distributed summaries of log book data covering the years 1979, 1980 and 1981, and the data contained in these

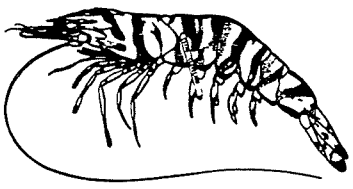
summaries is shown below. If data in this form is useful *please let us know* as summaries can be regularly distributed if your response so demands.

Data Available
(by individual species and for each calendar year).

For Whole D.M.Z.
- estimated actual landings
- recorded log catch,
- percentage log coverage
- recorded log effort
- catch per unit effort
- estimated actual total effort
- recorded log catch by week
- recorded log catch by month

Individual Statistical Regions
- estimated actual catch
- recorded log catch
- recorded log catch by month
- recorded log effort by month
- average catch per day by month
- average catch per day by week

Log data is, of course, provided in confidence and we are therefore not able to produce these summaries in finer detail as has occasionally been requested. At a recent NORPAC/NFC meeting (August 1983) it was in fact agreed that in order to preserve confidentiality, summarized data collated to a weekly and regional basis (as in the summaries) could only be made available after one year and only where ten or more vessels were involved. It was further agreed that data collated on a daily and smaller area basis should be made available only after two years, again only where ten or more vessels were involved. Individual skippers can, of course, have access to their own data at any time.



TIGER PRAWN RESEARCH

The proposal for the CSIRO program which was outlined in the February 1983 Information Notes has been modified insomuch as the larger vessel is concerned. It was decided not to proceed with a refit of the RV *Karin* and a chartered trawler, the FV *Maxim*, skippered by L. Grant, is being used instead.

A temporary field base has been established at Alyangula on Groote Eylandt and field sampling has started. Mapping of seagrass areas from both aerial and ground surveys has commenced and follow up surveys will further define and study such areas. The first of the routine adult sampling cruises by the FV *Maxim* was undertaken in early August when sediment samples and prawn specimens for reproductive studies were collected in addition to general prawn distribution observations.

TAGGING

At selected times over the next two years it is intended to tag and release tiger prawns in the waters around Groote Eylandt. This will include prawns on commercially exploited grounds and juveniles in shallower nursery grounds and both species will be tagged.

WATCH OUT FOR TAGGED TIGERS

As described in the October 1982 and the February 1983 Information Notes, earlier studies have indicated differences not only between species but also within the same species occurring in different areas. The results of this work will help to detail and explain some of these differences. Features to be studied will include

- growth rates of both adults and juveniles;
- natural mortality rates of both adults and juveniles;
- migration paths and times of both adults and juveniles; (and hence recruitment patterns of juveniles into the fishery) and
- fishing mortality rates of exploited stocks.

It is essential that each and every recapture be returned intact along with as much of the following information as possible:

Tag number:	Date caught:
Position caught:	Depth:
Vessel:	Reward to:
Address:	

Your cooperation in the return of recaptures from the last tag releases was excellent and we would hope that we can again expect this high level of assistance. As stated before, no returns = no information, and non-reporting of tags may result in incorrect interpretations. This may be beginning to sound all too familiar, but you do have the opportunity to contribute to your fishery both through these tagging experiments and through the log book program and the importance of such contributions cannot be overstressed.

WATCH OUT FOR TAGGED TIGERS

The now familiar plastic streamer tag which is inserted through the first tail segment will again be used and a $1 reward will be paid for returns which may be handed to or will be collected by fisheries field officers and log book agents operating in the various ports.

WATCH OUT FOR TAGGED TIGERS

STATISTICS

Once again your attention is drawn to the Commonwealth D.P.I. publication "The Northern Prawn Fishery - A Statistical Summary" which presents and discusses various features of the catching sector. The 1982 calendar year summary has been distributed as have 1983 monthly summaries which give more recent information. The following tables include some data already published by D.P.I. and some which has been derived from fishermen's log books and not previously published.

N.B.: The *figures in brackets* under the various headings in all of the following tables are the respective *catches per day fished* and are given in *kilograms*. All *other figures* are in *tonnes*.

TABLE 3. D.M.Z. Banana Prawns

	1978	1979	1980	1981	1982
Total landings	2535	4775[A]	2681	5034[A]	3046[A]
Catch/ day fished	(455)	(662)	(325)	(514)	(423)
Catch by Region					
Weipa	1045 (807)	444 (435)	481 (397)	579 (554)	927 (597)
Mitchell River	169 (336)	505 (507)	171 (206)	602 (401)	46 (185)
Karumba	387 (453)	1328 (876)	570 (416)	1434 (698)	538 (591)
Mornington Island	83 (315)	713 (1013)	99 (224)	235 (365)	52 (165)
Limmen Bight	1 (5)	516 (876)	147 (300)	188 (400)	258 (496)
Groote Eylandt	70 (91)	143 (336)	105 (243)	127 (395)	156 (341)
Gove	27 (105)	63 (680)	41 (222)	107 (375)	37 (223)
Arnhem	69 (308)	106 (488)	60 (203)	311 (574)	91 (183)
Melville	684 (321)	954 (505)	1007 (335)	1396 (491)	885 (350)

[A] Includes product from unspecified areas.

Note: Although total landings and catch by region estimates are given for the whole year and therefore include banana catches made incidental to "tiger trawling", the catch/day fished figure refers to data where only banana prawns were caught (or searched for and not caught).

TABLE 4. D.M.Z. Tiger Prawns

	1978	1979	1980	1981	1982
Total landings	3599	4218	4727	5118	4302
Catch/ day fished	(188)	(224)	(159)	(158)	(145)
Catch by Region					
Weipa	363 (149)	79 (78)	82 (88)	194 (72)	312 (96)
Mitchell River	-	-	-	10 (85)	-
Karumba	468 (190)	503 (215)	694 (142)	553 (159)	590 (156)
Mornington Island	82 (225)	412 (304)	82 (158)	404 (210)	558 (167)
Limmen Bight	97 (224)	1035 (357)	747 (246)	917 (219)	681 (212)
Groote Eylandt	1987 (207)	1595 (207)	2238 (162)	1936 (175)	1491 (139)
Gove	264 (203)	213 (219)	397 (202)	297 (201)	131 (164)
Arnhem	3 (117)	-	58 (211)	18 (131)	8 (97)
Melville	336 (130)	346 (147)	408 (97)	732 (105)	383 (101)

TABLE 5. D.M.Z. Endeavour Prawns

	1978	1979	1980	1981	1982
Total landings	1240	1213	1667	1760	1671
Catch/ day fished	(73)	(78)	(70)	(71)	(63)
Catch by Region					
Weipa	95 (47)	88 (110)	56 (74)	184 (85)	204 (71)
Mitchell River	-	-	-	-	-
Karumba	212 (102)	151 (75)	237 (67)	145 (58)	159 (59)
Mornington Island	29 (87)	89 (81)	26 (70)	104 (73)	162 (54)
Limmen Bight	7 (19)	161 (65)	101 (42)	140 (44)	115 (40)
Groote Eylandt	496 (57)	369 (58)	719 (63)	442 (51)	503 (51)
Gove	61 (53)	56 (71)	88 (57)	60 (53)	30 (47)
Arnhem	-	-	6 (35)	3 (46)	1 (15)
Melville	339 (141)	289 (150)	430 (121)	660 (121)	444 (125)

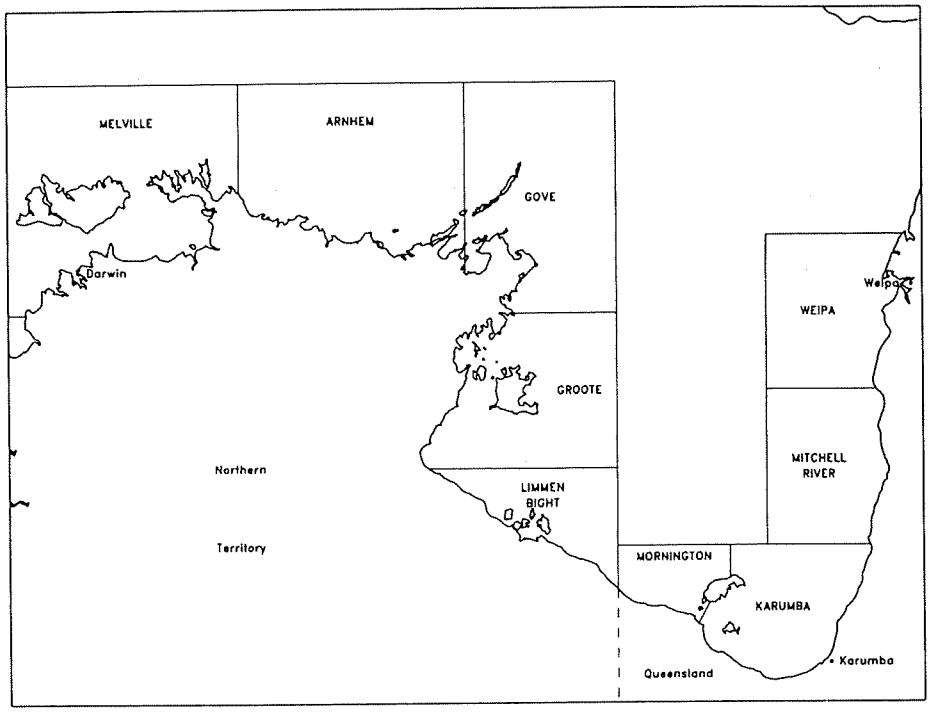


Figure 6. Statistical partitioning used in collating regional catches.

PUBLICATIONS

A Guide to the Australian Penaeid Prawns

Darryl Grey, W. (Bill) Dall and Arnold Baker

This recent publication (a review appeared in the May 1983 *Australian Fisheries*) describes all the known penaeid prawns found in Australian waters and as such includes both commercial and non-commercial species from both offshore and inshore areas.

Technical descriptions have been kept as simple as possible. Identification keys are illustrated by line drawings and supported by a glossary of terms. A unique feature of this 'prawn book' is the excellent coloured photographs accompanying the descriptions. General comments regarding distribution, habitat, size, and where appropriate, commercial importance, are also included for individual species.

The book would be an invaluable addition to the library of anyone interested in prawns. Copies are available from Fisheries Division (Prawn book sales), Department of Primary Production, P.O. Box 5160, Darwin, N.T. 5794, at a cost of $12.95 per copy which includes packaging and surface mail costs within Australia. Cheques to be made payable to 'Receiver of Territory Monies' please.

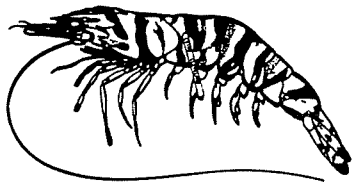
INDUSTRY LIAISON

F.I.R.T.A. has again provided funding for the industry liaison position in the financial year 1983-84. Because of the transient nature of fishing operations and the time you spend at sea, and because the liaison position is part-time only, the opportunities for personal contact with many of you are unfortunately limited. The preseason banana prawn sampling at Weipa earlier in 1983 did, however, afford the extra opportunity for both myself and others to speak to many of you personally, and it is hoped that future field work will also provide similar opportunities.

You should, nevertheless, have received over the last 18 months or so, a considerable amount of literature keeping you informed of both the results and progress of various research programs (including fishery statistical data collection and rainfall data relevant to, in particular, the banana prawn component). This literature has been disseminated mainly through log book collectors, fishery field workers, or through your company or organization office. If you prefer, however, such literature can be posted directly to you - all I need is your advice.

Many articles in the Information Notes have called for your comment or criticism as regards both content and format. Although many of the other reports etc. which have been distributed have addressed specific topics, your comments would nevertheless be appreciated. Most of this literature is prepared for your information and your comments will help to ensure you are receiving the feedback you require and in the form

you require. Don't simply assume that our feedback comes from the person next door or that your suggestions will not be considered. Communication is a two-way exchange.



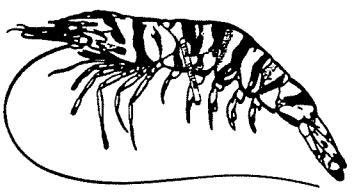
PRESEASON WORKSHOP

The preseason workshop held in Cairns in February 1983 was generally well received. As the workshops are still evolving (Cairns was only the second such meeting) it was certainly encouraging to see over 100 fishermen and other interested parties attending. Perhaps unfortunately, however, 'workshop' may be a misnomer as participation from the floor has been somewhat limited and the gatherings have tended to develop into a series of lectures rather than workshops as such.

Nonetheless, and call it what you will, the seminars have certainly proved interesting and worthwhile and they will continue. In order that the opportunity to attend be spread throughout industry, the next seminar, to be held in February 1984, will be in Darwin and hopefully will attract many who have not been able to attend those held in Karumba and Cairns. A diverse group of speakers will be assembled and it is hoped that this will include speakers from industry.

Remember that these meetings are being held so that you may participate and express your point of view either from the floor or as a speaker. We would be grateful for any suggestions regarding possible agenda items and/or speakers for future workshops, so please give this some thought during the year.

Further details about the venue and agenda for the 1984 workshop will be publicized at a later date.



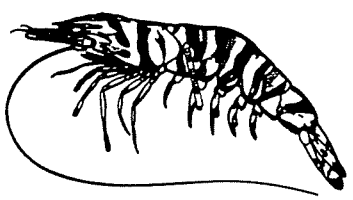
MUD CRABS IN THE GULF OF CARPENTARIA

Commercial crab fishermen handle thousands of crabs each year but most of them have never seen a female mud crab carrying eggs. The reason for this is that although mud crabs live in areas like rivers and mangrove creeks, after mating the females move out to sea and so are not captured in inshore crab pots. Female mud crabs with eggs are caught by trawlers from time to time. Because the numbers are very low, it is not practical to set up a special study of this sea dwelling stage. The large amount of commercial trawling carried out in the Gulf of Carpentaria does offer an opportunity to collect information on female mud crabs which can be of use in understanding the biology and so assist in managing mud crab fisheries.

During 1982 several skippers in the NPF recorded information about mud crabs which they captured in trawls. Valuable data came in from N. Hoschke (*Linda Jane*), R. Dooley (*Australian Pride*) and B. Ralph (*Norland*). If more records could be obtained, we could determine the time of the year that the crabs migrate to sea, the size at which they migrate and the area (depth, bottom type) to which they migrate. Any additional records would help to clarify some of these features.

If crabs are captured we should like to have the size (width between tips of last spines on shell - i.e. widest part of shell including spines - Figure 7), sex (females have a broad flap on the lower surface while males have a narrow flap - Figure 8) whether or not the crab is carrying eggs (Figure 9), date, depth, and position of capture (CSIRO grid reference or latitude/longitude or distance off coast). We don't need to have the crabs. The information could be entered into the Comments column of the NPF logbook and the logbook contractors will send the information on to CSIRO for analysis.

As a matter of interest the deepest record we have for a mud crab is 215 metres (120 fathoms). This crab was captured in a fish trap off Fiji. The furthest distance from shore record is held by a female found swimming on the surface 70 miles off Cairns. As the water at this point is about 800 fathoms deep, she was probably lost.



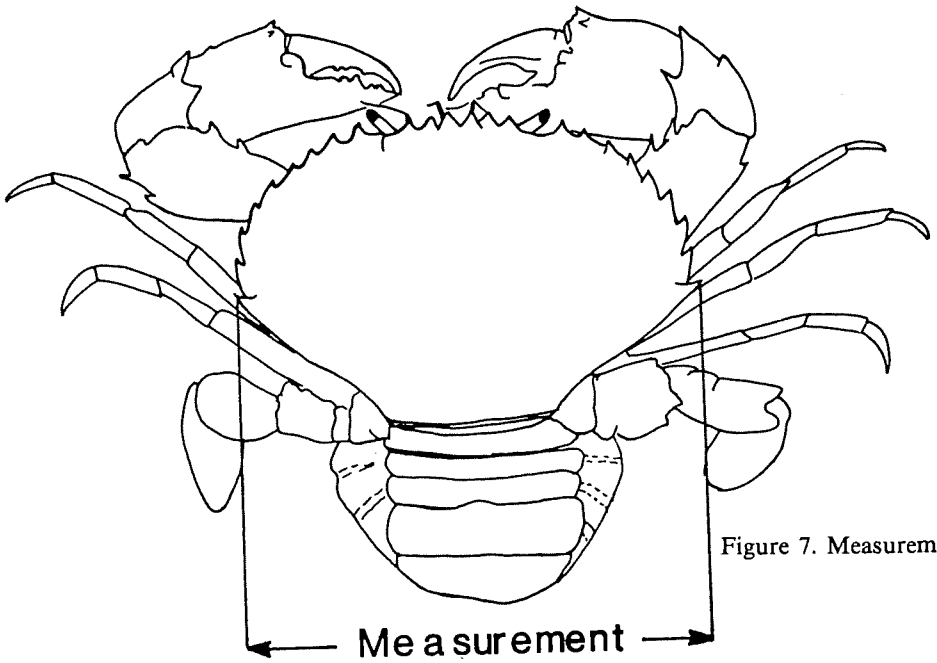
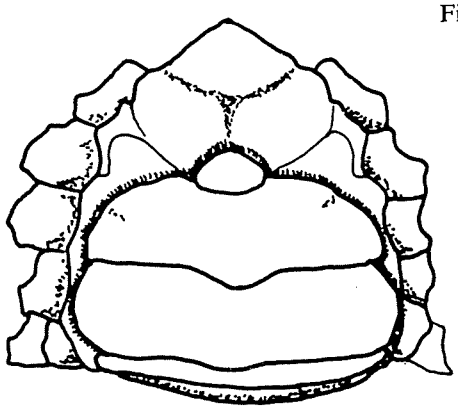


Figure 7. Measurement of a mud crab.

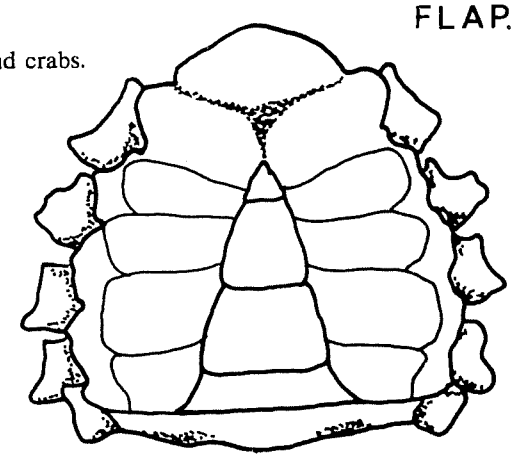
TO SEX CRAB LOOK AT UNDERSIDE -

FEMALES HAVE WIDE FLAP, MALES HAVE NARROW, POINTED FLAP.

Figure 8. Sexing mud crabs.



FEMALE



MALE

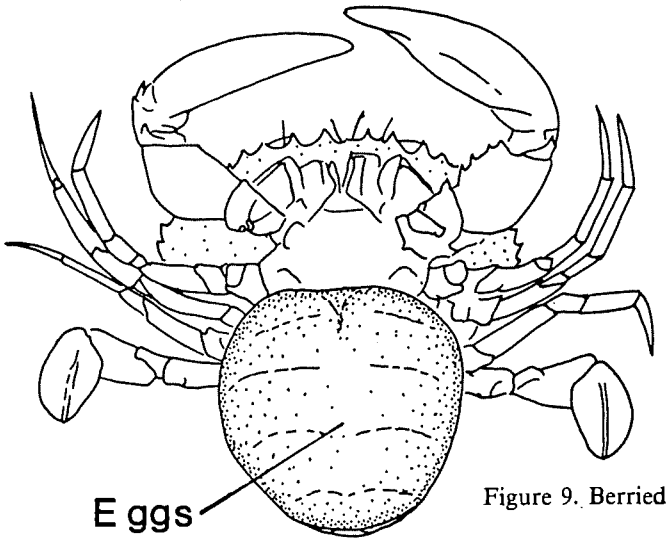


Figure 9. Berried (ovigerous) female mud crab.

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Interim changes in northern prawn fishery management. May 1983.

New Government's fisheries policy. May 1983.

A welcome guide to Australian prawns. May 1983.

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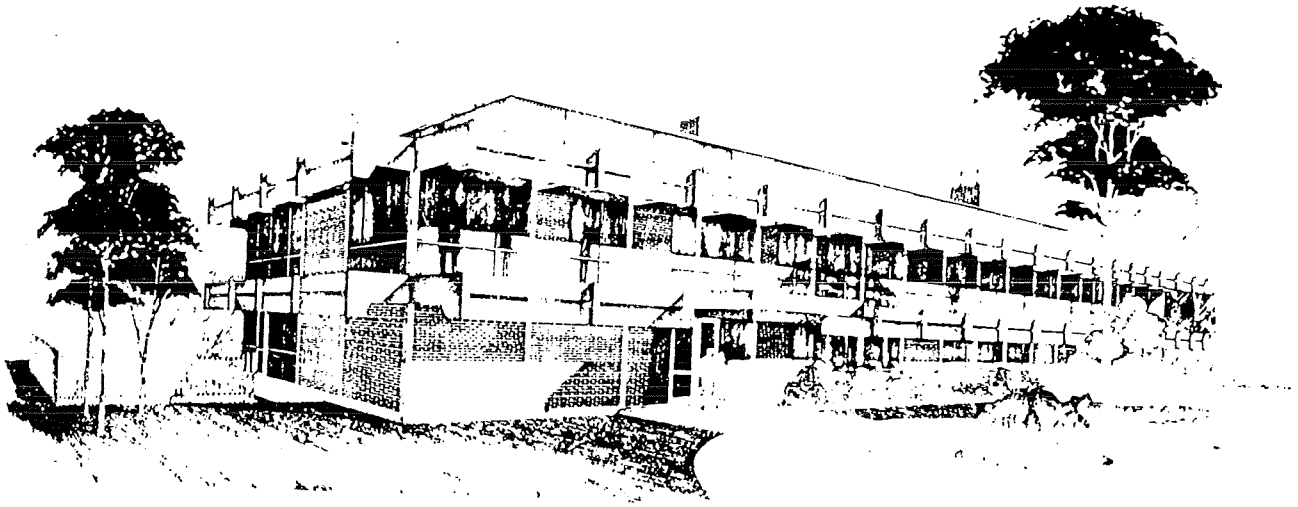


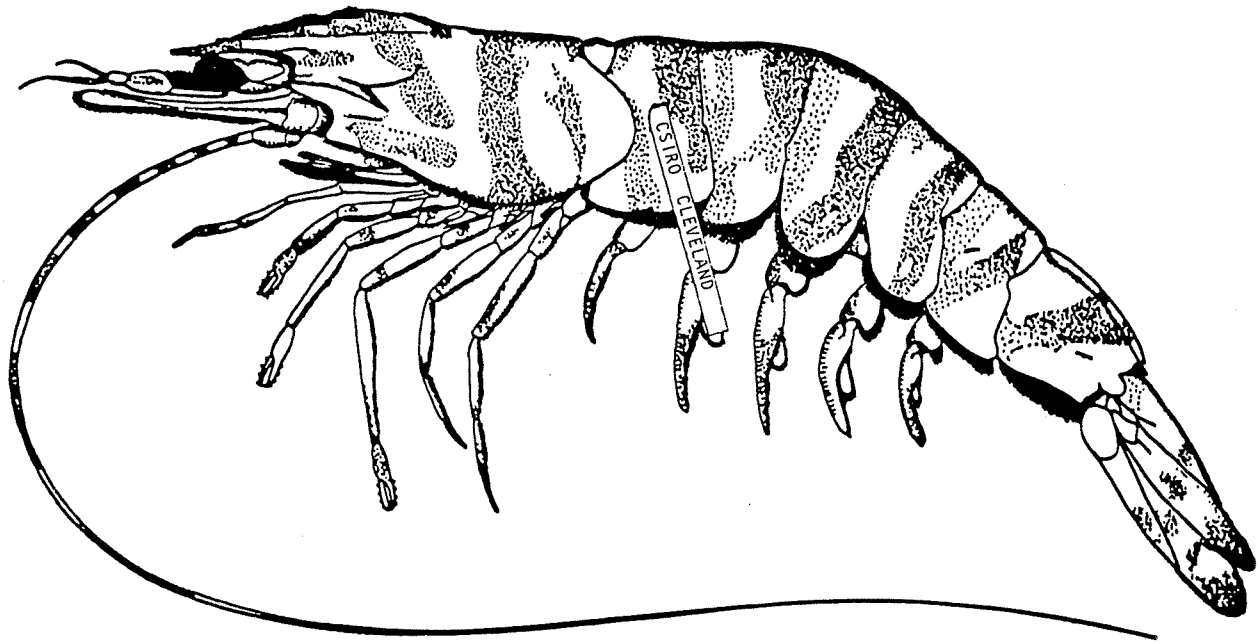
CSIRO MARINE LABORATORIES

233 Middle Street

Cleveland, Qld 4163

Australia

NORTHERN PRAWN FISHERY INFORMATION NOTES



Compiled by Brian Taylor

Industry Liaison Officer

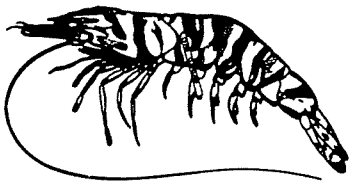
CSIRO Division of Fisheries Research

INTRODUCTION

You will notice that the general format of this issue of these notes is a little different from that of earlier editions. With the exception of the article headed 'Second National Prawn Seminar', this issue has been devoted to providing summaries of presentations which are to be made at the Preseason Prawn Workshop to be held in Darwin in February 1984. Although not all presentations are covered, and although it has not been possible to include any discussion which may arise on any of the agenda subjects, it is hoped that these notes will prove useful to both people who were able to attend, and to those who were not.

Summaries are presented under the headings of the organisations responsible for the work, and in order according to the proposed workshop agenda as shown. Further references on many subjects may be found in the publications list at the end of these notes or direct from the authors or speakers.

You are again invited to pass on any comments and/or suggestions regarding both the workshops and the *Information Notes*. I suppose 'no news is good news' but I really would appreciate some feedback. Both the workshops and the *Information Notes* were introduced for your benefit and your advice will help us to ensure that the information passed on through these avenues is useful and enlightening.



SECOND NATIONAL PRAWN SEMINAR

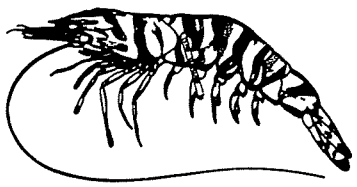
Some readers will be aware that the first National Prawn Seminar was held in Maroochydore, Queensland in 1973 and was attended by about 60 delegates. Papers were presented on a variety of topics including commercial fisheries and gear, biology, management and aquaculture. Following the seminar, a selection of papers was published in a single volume which has proved to be an extremely useful reference and which gave Australia considerable standing in the field of prawn research and management.

Since 1973 Australian prawn fisheries have expanded and advanced as has associated research and management. Hence the proposal for this second National Seminar. The size and scope of the seminar will be dependent upon both interest shown and on available funding, but it is hoped to again have a wide range of topics to be covered by contributed papers, reviews and workshops. It has been suggested that the venue again be southeast Queensland and that October 1984 be the time.

If you are interested in attending, could you please advise:

The Coordinating Committee
National Prawn Seminar
CSIRO Marine Laboratories
P.O. Box 120
Cleveland, QLD 4163

Your advice regarding your specific field(s) of interest and whether or not you are prepared to deliver a paper would also be appreciated. As planning proceeds, so further information will be forwarded to you.



PROPOSED AGENDA FOR THE 1984 PRE-SEASON PRAWN WORKSHOP

Darwin, February 20, 1984

Official welcome and opening 0830

Statistical report - 1983
Department of Primary Industry

Economic survey results
Bureau of Agricultural Economics (B.A.E.)

Operations in the Gulf of Carpentaria
M.G. Kailis

Western Gulf fishery study
Northern Territory Fisheries

Tiger prawn research
CSIRO

Morning Tea

The S.A. prawn fishery 1045
South Australian Fisheries

Export Inspection Services
Department of Primary Industry

Lunch

Management in the D.M.Z. 1330
Department of Primary Industry

Individual Transferable Catch Quotas
Northern Territory Fisheries

Common property resources
Queensland Commercial Fishermen's Organization

Afternoon Tea

Use of sled in double twin gear 1545
Darwin Community College

Biological research at Mornington Island
Queensland Fisheries

Tiger and endeavour closure study
Northern Territory Fisheries

Banana prawn pre-season sampling
CSIRO

Can banana's be overfished? and

Predictions for 1984
CSIRO

FINISH 1715

NORTHERN TERRITORY FISHERIES

The following notes were provided by Rik Buckworth who is stationed at Groote Eylandt.

Prawn Fishery Monitoring Study, Western Gulf of Carpentaria.

The aims of this program are to investigate size and species composition of the penaeid prawns and their distribution and abundance in relation to the commercial fishery in the western Gulf of Carpentaria. Also, to study trends in catch and effort, fishing areas and exploitation rates for tiger and endeavour prawns and to investigate other features of the fishery including by-catch quantity and species composition data.

Sampling is undertaken using on-board observations on commercial vessels and charter vessels, and landed catch samples of both graded and ungraded product. Size frequency distribution and species composition data are then assessed in conjunction with catch and effort data gathered through the log book program from the commercial sector. This defines trends and size and species composition on fishing grounds over time and provides a measure of growth and fishing mortality.

Analysis of results to date indicate a continuous expansion of grounds fished due to improved technology and increasing familiarity with fishing areas. This has been particularly so in the southern Groote Eylandt and Vanderlin Island areas. Analyses also suggest that the western Gulf of Carpentaria fishery is based on a number of primary fishing areas, each with characteristic species and size compositions. Some additional areas receive a relatively lower fishing effort.

Differences in spawning and recruitment times, growth rates, movements and habitat preferences of the species within each species group, and physical features (for example, distance from nursery areas, depth and bottom type) all contribute to the separation of the sub-stocks on these grounds.

A tagging program to obtain further information on growth and movements of endeavour prawns was conducted in the Groote Eylandt area in January 1984, involving the release of a number of prawns tagged with blue streamer tags.

CSIRO
DIVISION OF FISHERIES RESEARCH

A Progress Report on Tiger Prawn Field Studies

As often stated, biological studies of this magnitude and nature take considerable time and in part this is because seasonal conditions may well change the story from year to year and hence data must be collected over several years. Nevertheless, we have attempted to keep you informed on the short term progress of our work and the following notes, although perhaps sounding familiar as most of the work is simply ongoing, present a brief summary of the field work to date.

The structure of this program was outlined in the *Information Notes* of February 1983, and as mentioned therein, the study embraces all commercial species encountered in the area (north of Groote Eylandt) but the two principal tigers are the target species. A field station has been established at Alyangula on Groote Eylandt and regular field sampling is continuing.

For practical purposes it is convenient to consider present field work under two main headings.

Juvenile Ecology

These studies are restricted to inshore areas and hence generally entail small boat operations.

The preliminary study of nursery areas in the Weipa area during late 1981 and in 1982 (*Information Notes*, February 1983) indicated that only vegetative (seagrass and algae) areas are suitable habitats for juveniles of both species of tiger and the blue-tailed endeavour. As a first step then, such areas along the Groote Eylandt and adjacent mainland coast were located and mapped. This was carried out by aerial surveys and where possible, was followed up by 'ground truth' and the areas further defined by type of vegetation - some of these results assisted in the definition of the permanent nursery area closures which are now in force. Several permanent study sites have been established within these areas and periodic surveys are expected to show changes in the vegetation which may occur with changing seasons and weather patterns.

Permanent sites in North West Bay and Blue Mud Bay have also been established to monitor juvenile prawn populations. Samples are taken by both small beam trawls and set nets (in untrawlable areas) and data concerning species composition, abundance, size and growth and migration is being collected for each of the various vegetative areas. Identification of very small prawns (postlarvae) cannot be carried out in the field and even in the laboratory requires considerable time and effort. The limited information available at this time, however, along with 'eyeball' observations suggest that both beach zone vegetative areas and onshore reef flats are important habitats with the beach zones being the most important. It has also been noted that postlarvae only settle in areas where the water is less than 1 metre deep at low tide and it therefore appears that the length of the coastline where seagrass occurs in the shallows is a critical limiting factor in postlarval recruitment. Another point of interest is that whereas postlarval recruitment of both tiger species in the Weipa area was observed twice a year, it was observed only once (spring) during 1983 in the Groote area.

Adult Ecology and Reproductive Studies

As previously reported, field work for these studies is being carried out from the chartered fishing vessel *Maxim*.

A total of seven cruises at about one monthly intervals have now been carried out over a systematic grid system to the north of Groote Eylandt. Each trawl station provides information on the species composition, abundance, size, reproductive status and the incidence of bopyrid parasites on the prawns. Observations on hydrographic features and substrate type are also recorded. The bopyrid parasite, incidentally, occurs mainly on the green or grooved tiger prawn and certainly affects the reproductive organs. It also appears as if it may affect the seaward migration of infected prawns.

A mini-computer is used for preliminary and onboard processing of data, although some specimens, and certainly those required for histological reproductive examination, are required at the Cleveland laboratory for further study.

* * * * *

The tiger prawn tagging work being carried out is part of the adult ecology group's program. Approximately 2,500 tagged tigers (both species) were released in North West Bay toward the end of 1983 and in January 1984 a further 4,650 were tagged and released in various areas to the north and northwest of Groote Eylandt. The January tagging was a joint CSIRO/Northern Territory Fisheries Division program and as well as the tigers, 4300 endeavours were also tagged and released.

Your cooperation in the return of any tagged prawns would be appreciated. Considerable publicity about this tagging work has already taken place and you are probably aware that tag return 'kits' are available from fisheries staff or the log book collectors in all major ports. Recoveries should be returned through these same people. A reward of $2 is payable.

NORTHERN TERRITORY FISHERIES

These notes were prepared by David Campbell from the Darwin office and were originally published in the Northern Territory Fishing Industry News (NORFIN), December 1983.

Individual Transferable Catch Quotas

The introduction of new measures designed to reduce fishing effort in the Northern Prawn Fishery has sparked debate in industry and government circles over the advantages of implementing a scheme known as Individual Transferable Catch Quotas (I.T.C.Q.).

In this article, some of the arguments for and against the I.T.C.Q. scheme are presented. The topic will be the subject of a Fisheries Technical Report, to be published in early 1984, for people wishing to know more about the scheme.

Individual Transferable Catch Quotas, in a nutshell, is a system whereby fishermen, companies and processors are allocated a proportion of the total allowable catch of a particular fishery in accordance with a predefined formula.

The aim of the scheme is to allow fishermen to enjoy the maximum economic benefits obtainable, while protecting the resource base.

The quota would represent an asset which individuals can sell, subdivide and/or lease as they please. The main advantages of this system would be to allow -

- individual boat operators to arrange their operations so as to minimize costs;
- fishermen greater freedom in arranging their lives around fishing operations. Beside an easing of family pressures, such freedom would lower the incidence of a range of work related diseases;
- transferability of quotas within the open market thus letting the fishing industry establish its own level of effort (which in the long run would be in the region of where costs are minimised);
- present fishermen to realise capital gains on their quota as decreasing costs become expressed by increasing quota values;
- the above benefits to be achieved with a minimum of government interference;
- government resources to be allocated to other concerns such as examining timing of entry to the fishery and protection of spawning grounds.

The areas most likely to cause headaches include determining how quotas should be allocated, how to police the scheme, and predicting catch rates.

The boat-unit formula to be introduced into the Northern Prawn Fishery could form the basis of the allocation criteria. Other means by which quotas could be allocated include:

- individual landing quotas according to participation, e.g. proportion of catch over three years;
- individual landing quotas based on individual catch ability, e.g. number and size of nets;
- an equal share among all fishermen in the particular fishery;
- by placing catch share open to bidding;
- a mixture of the above; and
- a proportion of the total allowable catch being allocated through some mechanism, and the remainder being left for fishermen to establish through capture. Such a system, of course, defeats the purpose of establishing a quota system. It is, however, apparently the system being used in the Canadian Pacific abalone fishery.

By allowing fishermen to buy and sell quotas the I.T.C.Q. scheme provides fishermen with the opportunity to adjust their quota according to need. Quota transferability is therefore the key to the scheme. Transferability means that if a fisherman's boat breaks down he can sell his rights for the year while he repairs his boat. Alternatively, he could lease his quota to another party.

On the other hand, if a quota is too small to support the level of capital investment a fisherman has in the fishery he can increase his quota by entering the market as a buyer.

In the longer term, the I.T.C.Q. scheme may bring about a change in the Industries Assistance Commission's approach to applications by the fishing industry for a Rural Adjustment Scheme similar to those offered to pastoralists. If industry and government can argue that the implementation of I.T.C.Q. schemes represent 'significant changes to existing management strategies' and offer 'an unequivocal improvement in the efficiency with which fishing resources are currently managed' it would be consistent with the I.A.C.'s terms of reference and approach.

Abuses of the scheme will no doubt occur. Methods to counter incorrect catch reports need to be thoroughly investigated. However, there are a number of countries that have implemented national quotas as well as boat quotas and whose supervisory methods could be adapted to suit local conditions.

Catch rate predictions could pose a problem in seasons when the actual catch falls below the predicted allowable catch. As fisheries administrators learn more about the behavioural patterns of particular fisheries the gap between predicted catches and actual catches should diminish. There can be no guarantee, however, against changes in rainfall patterns and other environmental factors which will affect the amount of available catch.

QUEENSLAND FISHERIES

The following notes were provided by Robert Coles and Warren Lee Long from the Queensland Fisheries research laboratories at Cairns.

Preliminary Results from a Study of Juvenile Prawn Populations at Mornington Island

Tiger Prawn Biology

Adult tiger prawns spawn at sea. Fertilized eggs sink to the ocean floor and within a short time hatch into a series of planktonic larval stages. These are carried by water movement into shallow inshore areas of the coast where they settle out as postlarvae. In these "nursery" grounds the prawns feed and grow before migrating offshore to the fishing grounds to spawn and complete their life cycle.

The diverse nature of the habitats occupied by tiger prawns during their life cycle means that a wide range of factors may influence survival at each stage and so affect the abundance of prawns available to the fishery. The current research on the biology of tiger prawns will help us to identify these factors as well as improve our understanding of the details of the life history of the prawns.

Research

For the past 18 months Queensland Fisheries research branch has been sampling populations of juvenile prawns in the shallow inshore areas around Mornington Island. The purpose of this study is to examine, by taking monthly samples, changes in the mean size and abundance of juvenile prawns and to examine the movement of very small prawns into the nursery areas and the subsequent emigration back to the fishery. A study has also been made on the habitat requirements of juvenile prawns and the extent of the areas of bottom utilized by them is being estimated. Data collected on all these aspects is presently being analysed. The preliminary results described here came from one sampling site in the Dugong River, Mornington Island (Figure 1).

The Dugong River is a shallow inlet (mean depth approximately 2 metres) on the south west shore of Mornington Island and the bottom is covered by a thick growth of seagrass and algae. Water temperatures during the sampling period (September 1982 - September 1983) ranged from a minimum of 16°C in July to a maximum of 32°C in February (Figure 2). The late wet season rains during this time are clearly indicated by salinity measurements with a minimum of 17 parts per thousand occurring in March 1983 (Figure 3).

The total number of juvenile brown tiger prawns caught is shown in Figure 4. (Note that very few green or grooved tigers occur in this area, and hence all the following comments refer to the brown tiger prawn.)

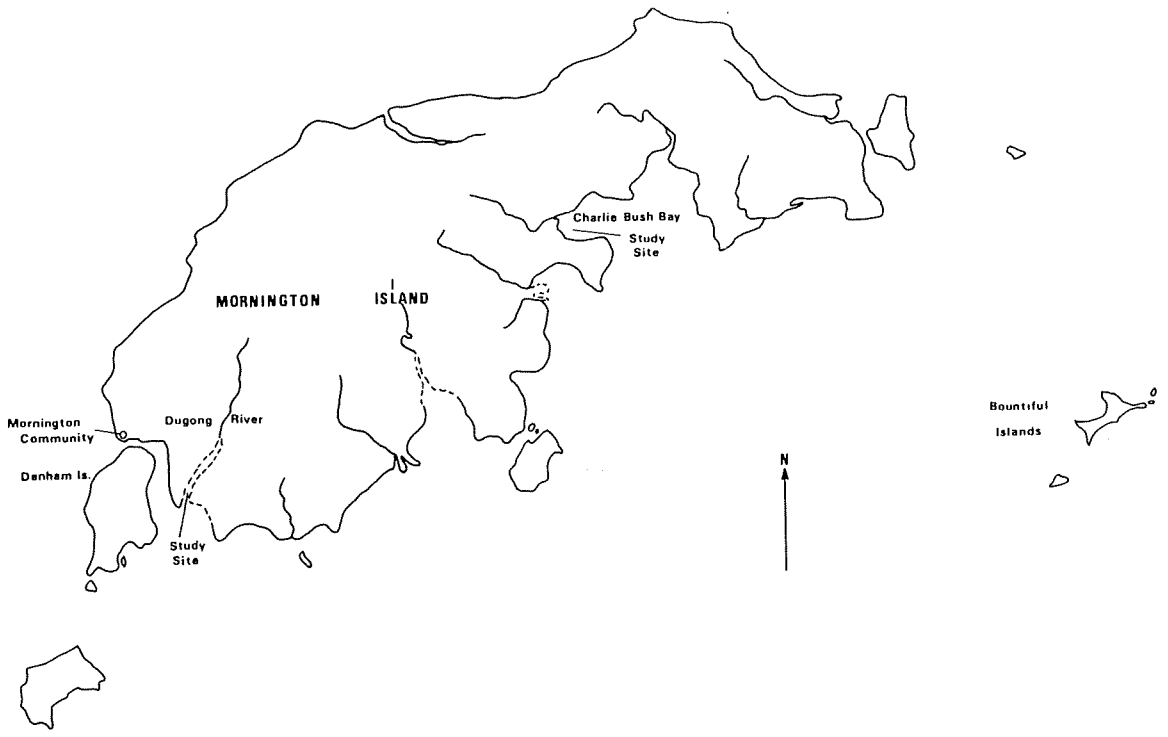


Figure 1. Mornington Island showing the Dugong River study site.

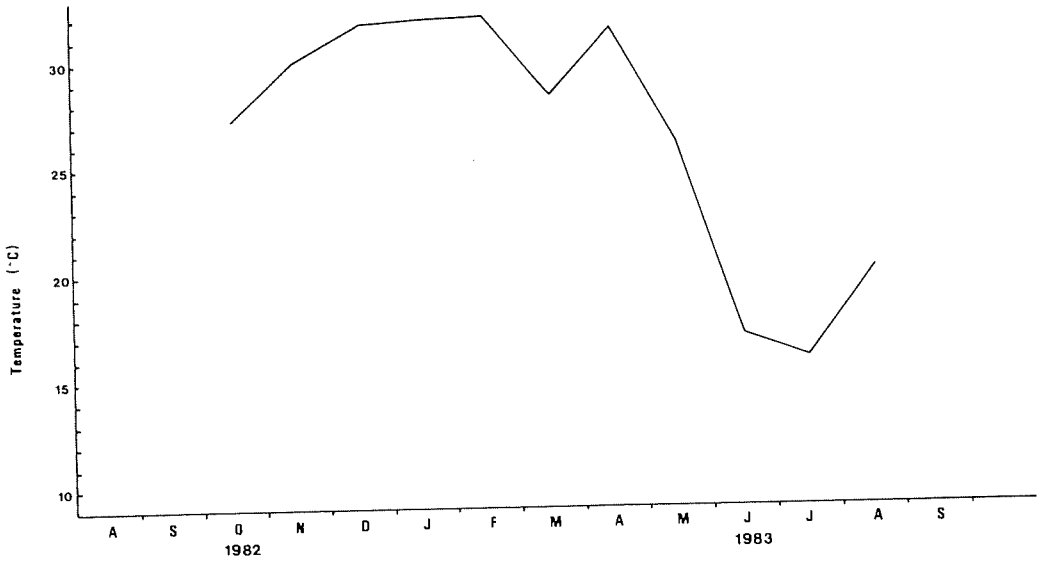


Figure 2. Water temperature at the Dugong River for 1982-1983.

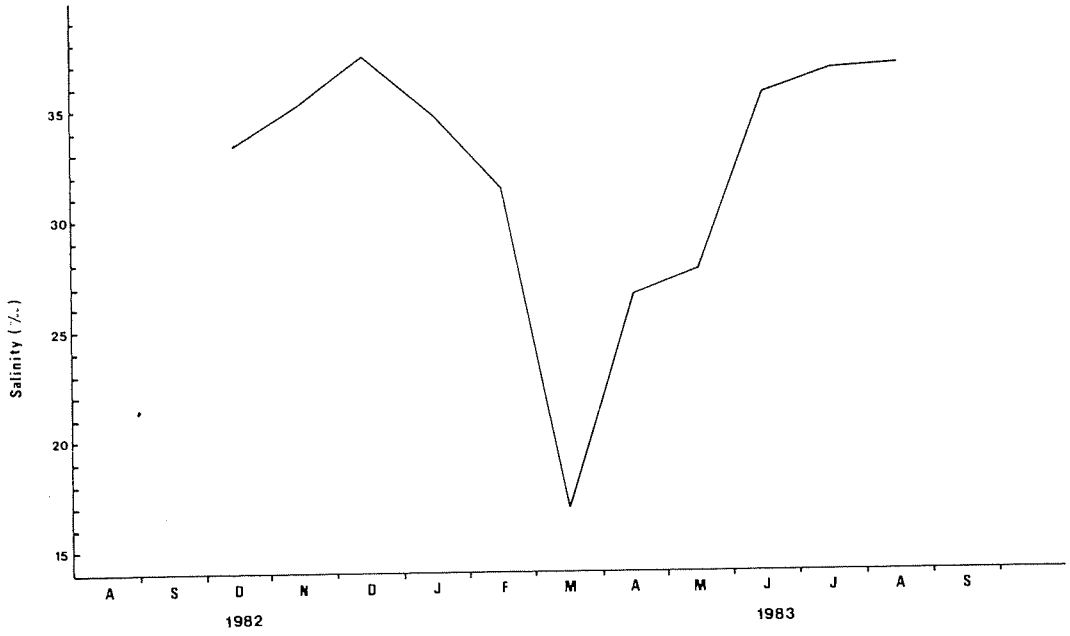


Figure 3. Water salinity at the Dugong River for 1982-1983.

Most prawns were caught in late winter and spring with numbers falling to very low levels between December and June. Movement out of the Dugong River appears to have occurred before the March rains and in this case there seems to be little correlation between the flushing effect of rainfall and the migration out into the commercial fishery.

Immigration of postlarval and juvenile prawns into the Dugong River was measured by the appearance of prawns with a carapace length of less than 5 mm. Immigration occurred in winter with a peak in July (Figure 5). This is earlier than would be expected from previous results in other areas. In Trinity Inlet, Cairns (a similar latitude), immigration was recorded from October to December (*Information Notes*, October 1982). Preliminary results from Groote Eylandt indicate a September-October period and Weipa appears different again with two recruitment periods; September-October, just before the wet season and in March-April, just after the wet season (*Information Notes*, February 1983).

This early recruitment at Mornington Island may allow the juvenile prawns a longer period of growth in the nursery area or may lead to an earlier migration of prawns back to the fishery. Continuing data analyses

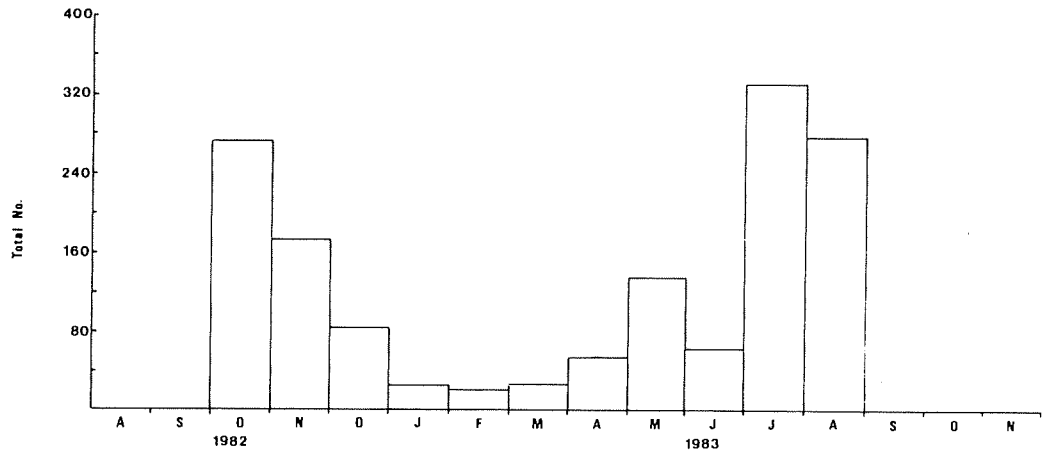


Figure 4. Total number of brown tiger prawns caught per month in the Dugong River.

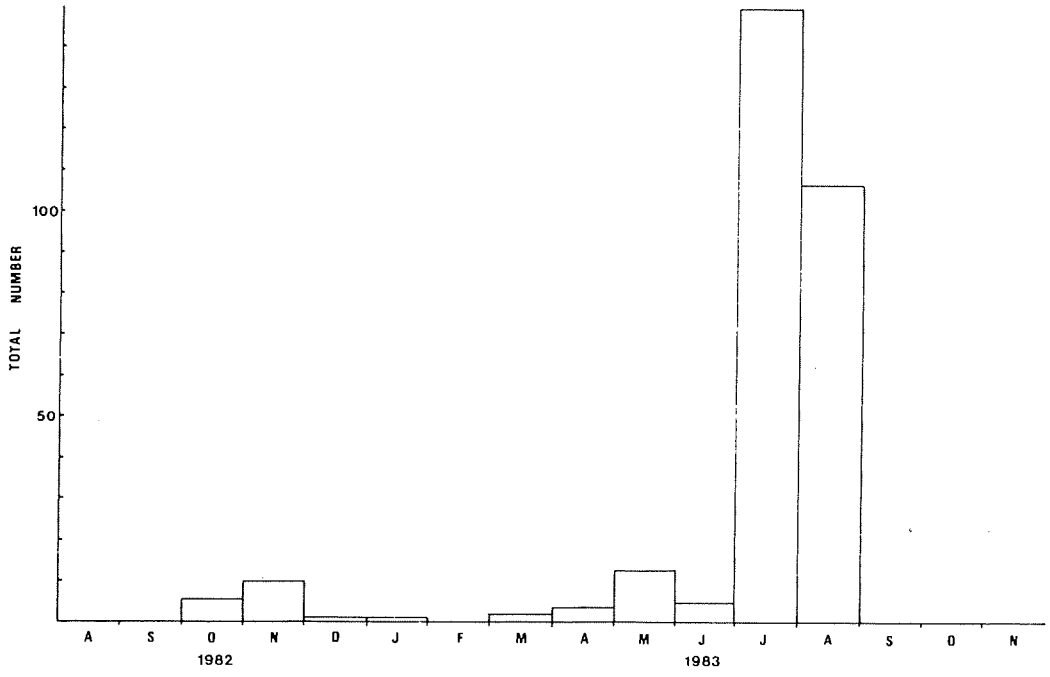


Figure 5. Number of prawns with a carapace length 5 mm or less caught in the Dugong River.

will enable us to examine these and other questions in more detail. With the field work program associated with this project finishing in December 1983, we expect to be able to look closely at these results during 1984.

* * * * *

The following notes were provided by John Robertson also from the laboratories in Cairns.

Adult Prawn Population Study at Mornington Island

The area surrounding Mornington Island is the centre of a large commercial fishery and comprises the major tiger/endeavour prawn fishery of the south-eastern Gulf of Carpentaria. This fishery is relatively isolated from the coast and other prawning areas and may be considered an essentially closed system. The bulk of juvenile recruitment into the fishery is almost certainly derived from local sources, i.e. shallow inshore seagrass and/or seaweed nursery zones and in particular those around Mornington, Bountiful and Bentinck/Sweers Islands. However, the extent of movement of these new recruits into the fishery and factors influencing it are not well documented. The current study aims to gather biological information on which to base management decisions.

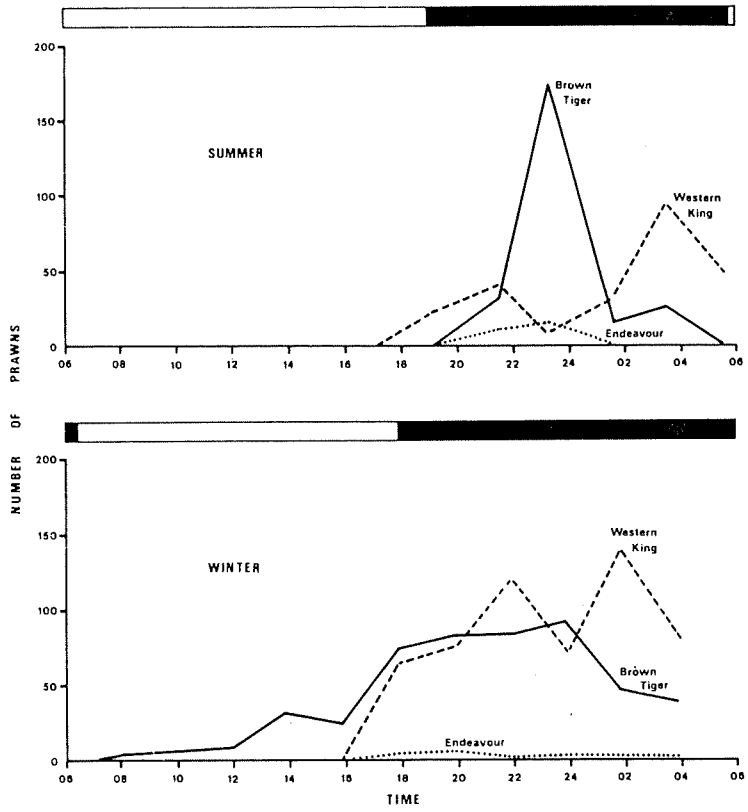


Figure 6. Patterns of catchability of the three major prawn species in summer and winter.

Sampling Program

Since January 1983, Queensland Fisheries research staff have been conducting a sampling program around Mornington Island using the *R.V. Gwendoline May*. Thirty-eight trawlable sites were selected within this region at depths ranging fom 9 to 42 meters. These sites are intended to encompass the bulk of the fishery and incorporate transects that originate close to nursery areas and terminate near the outer limits of the fishery. Sampling has been conducted each lunar month to examine and describe seasonal patterns and variations in the distribution, movement, population structure, growth, activity and breeding status of tiger prawns (principally the brown tiger *Penaeus esculentus*) and the endeavour prawn (*Metapenaeus endeavouri*) in the south-eastern Gulf. Although the study concentrates on these two species, data has also been collected on other commercial species.

In addition, a 24-hour study site was selected in a high catch zone to the south of Bountiful Island to examine day/night changes in species composition and abundance throughout the year. Hydrographic data (surface and bottom salinities and temperatures) and substrate samples were taken at each site to assess their influence on prawn distribution and movement. The offshore adult prawn study is aimed to complement the concurrent inshore juvenile prawn research to provide an overall picture of tiger and endeavour prawn life history and timing in the south-eastern Gulf.

Preliminary Results

The sampling extended over a period of 12 months from January 1983 to December 1983. Although formal analyses has yet to be carried out on much of the data, the following trends were detected:

(i) a widespread occurrence of brown tiger prawns (*Penaeus esculentus*) around Mornington Island. The grooved tiger (*P. semisulcatus*) forms a minor component of the catch to the north and west of Mornington which increases with distance offshore. The blue-tailed endeavour prawn (*Metapenaeus endeavouri*) and the western king prawn (*Penaeus latisulcatus*) occur in low numbers throughout the sampling area, the latter being abundant at some sites west of Mornington Island and south of Bountiful Island. The banana prawn (*Penaeus merguiensis*) forms a very minor component of the catch and only sporadic sightings of the red spot king (*Penaeus longistylus*) have been made. There is an absence of the red-tailed endeavour prawn (*Metapenaeus ensis*) on the study site.

(ii) In the earlier months of the year there appears to be a general inshore to offshore increase in the mean size of brown tiger prawns. This trend, however, is not consistent in other commercial species. This may be the result of young recruits entering the fishery in the early part of the year. Catches of small prawns were most prominent from November to January on

sites south-west of Mornington Island and north of Sweers and Bentinck Islands. These sampling areas appear to be significant recruitment areas for young tiger prawns.

(iii) Over a 24-hour sampling period, the three commercial prawn species show different patterns of catchability (Figure 6). In summer, brown tigers show a definite peak occurring around midnight. Endeavour prawns show a similar, although weaker pattern of catchability. Western king prawns appear later, peaking towards early morning. This difference in time of appearance between brown tigers and western kings occurs again in winter. The period when all species can be caught is longer in winter, possibly because of the increase in night-time hours.

Results are currently being analysed and will be published throughout 1984.

NORTHERN TERRITORY FISHERIES

Closure Study 1982-1983

As outlined in the *Information Notes*, October 1982, a survey to study both the closed and adjacent areas in the western Gulf of Carpentaria was to be carried out by the research branch of Northern Territory Fisheries Division in the period October 1982 to March 1983 inclusive. The following notes have been prepared from a report covering that survey, which was subsequently carried out from November 1982 to March 1983.

The basic aim of the survey was to collect, on a lunar monthly basis, information on the abundance and size of prawns in the general area from about Cape Shields to the Vanderlin Island group, thus allowing an assessment and, if necessary, modification of the previously declared closed areas which were based on anecdotal information. The two species of tiger (the brown and the grooved or green) and the two endeavour species (the red-tailed and the blue-tailed) were the main species of interest. Information on other species (both prawns and fish) was also collected, however, as was considerable data on environmental features.

The trawler F.V. *Paulwin* was chartered and samples were taken over a systematic grid system using standard double-twin gear. A total of 282 trawls resulted in over 81,000 prawns being measured and examined.

The length frequency distribution of each species in each grid for each month was converted to a weight distribution and tables and figures were compiled to show the percentage of prawns of each species falling into each of the commercial grades. Figures 7 and 8 show the grids around both Groote Eylandt and the Vanderlin Island group where the proportion of small tiger prawns (arbitrarily decided as being smaller than 30 count per pound) was more than 10% of the total tiger catch. The months where this occurred is indicated by the letter(s) in the appropriate grid. These figures, although showing the proportion of small tigers, do not show the actual concentrations and so the data was further refined to show the actual catch per hour of these small prawns. To show these results, however, is beyond the scope of this summary and you are referred to the original report. It is worthy of particular note though, that both North West Bay (Groote Eylandt) and the West Island-North Island area of the Vanderlin group had not only a high proportion of small tigers, but that the catch rate was also quite high. This was a feature in all five months when sampling took place. Both these areas are relatively shallow and have seagrass beds in close proximity and the small prawns caught reflect direct recruitment from these seagrass nursery areas (as described in the CSIRO tiger research progress report, seagrass areas are the subject of continuing studies).

The detailed data collected during the survey was presented to the closure sub-committee of the Northern Fisheries Committee (N.F.C.) in June 1983. In general the data supported and justified the 1982-83 closures although some modifications were made in the recommendations for the 1983-84 closures.

Further work would be required before the actual dollar value of the closures could be estimated, but indications are that there is certainly considerable value in these closures. It should be noted that the strength and/or timing of recruitment may vary from year to year with varying seasonal conditions.

Tiger and endeavour prawn closure study: Grey and Buckworth. Fisheries report number 10, Department of Primary Production, September 1983.

As some readers would be aware, a summary of this report has also appeared in NORFIN (volume 1 number 2), October 1983.

CSIRO

DIVISION OF FISHERIES RESEARCH

These notes were provided by Derek Staples from the Cleveland Marine Laboratories

Can Banana Prawn Stocks Be Overfished?

From a biological point of view, the most important objective of any fishery management strategy is to ensure that an adequate supply of spawning stock remains after the fishery has taken its share of the resource. In practice, however, it is very difficult to define accurately what an adequate spawning stock is. All too often, it is not until after a fishery has collapsed that managers can say that the spawning stock should have been maintained at a given level. Obviously, what is needed is a method where the effects of fishing can be predicted some time before major catastrophic stock reductions occur. A mathematical model based on a sound understanding of the prawn's (or fish's) biology can provide such a tool although the model needs constant evaluation and updating. *For banana prawns in*

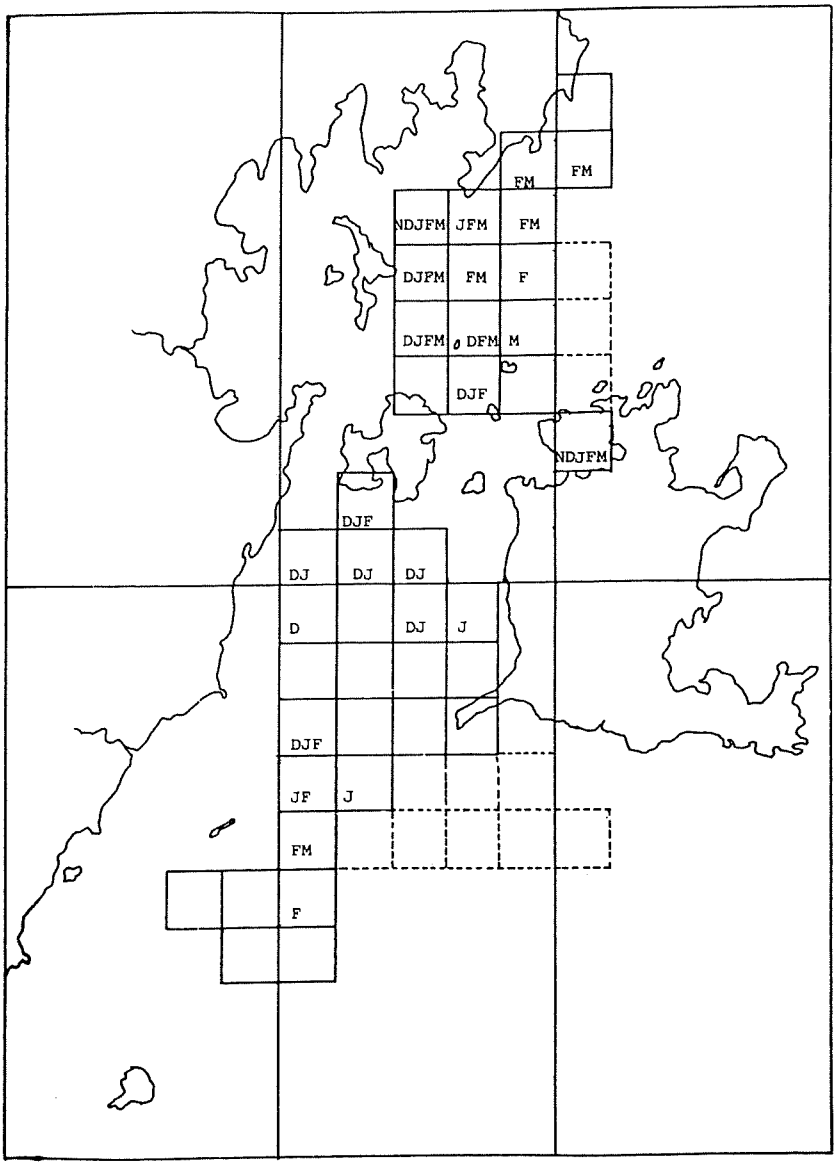


Figure 7. Grid and time where small tigers comprised more than 10% of the total tiger catch - Groote Eylandt area.

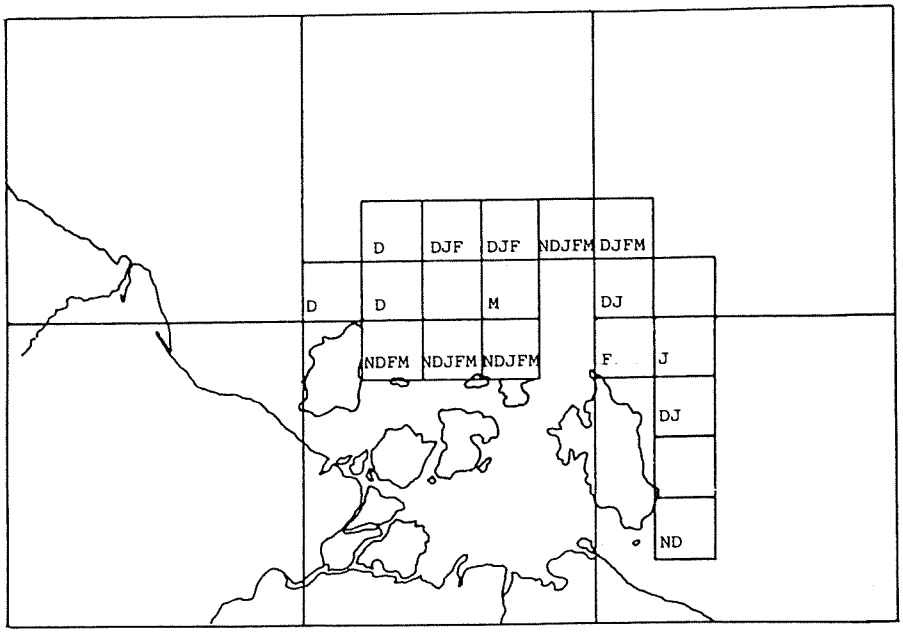


Figure 8. Grid and time where small tigers comprised more than 10% of the total tiger catch - Vanderlin Islands area.

the south-eastern Gulf of Carpentaria, the CSIRO have reached a point, after many years of research, where such a model can be developed and tested.

The first step in the model is to define accurately the timing of various stages in the life history of the banana prawn in the south-eastern Gulf. We know that banana prawns have two spawning seasons each year; one in spring (September-October), and one in autumn (March-April). Due to favourable currents, larvae from the spring spawners consistently reach the coast and enter the estuaries and rivers. These spring juvenile prawns grow rapidly in the estuaries and migrate back offshore during the wet season. After passing through the gauntlet of the autumn commercial fishery, the survivors overwinter in the Gulf and form the bulk of the next spring's spawners. Autumn spawned larvae, on the other hand, are carried offshore as a result of unfavourable currents and this generation contributes little to the commercial catch.

On the basis of log book summaries, it appears that the number of spring spawners present each year is proportional to the number of prawns taken six months earlier during the commercial banana prawn season. Sampling of juvenile prawns in the major rivers around the south-eastern Gulf has also shown that the differences seen in the number of juvenile prawns arriving in the estuaries each year is related to the number of spawners offshore. High juvenile prawn populations in the river, however, do not necessarily mean that good adult catches will follow. It is at this point in the life history where rainfall has a very important effect on the number of prawns leaving the river. In good rainfall years a much higher proportion of the resident juvenile prawns will move offshore and higher catches result. There must, however, be a point below which juvenile numbers become so low that offshore catches are negatively affected. Obviously if few juveniles were present in the rivers then even a large rainfall will not produce a large catch. The important question is at what point will this happen? According to our model, if catches in the Karumba region are less than 200 tonnes in any one year, there will be insufficient spawners in the following season and next year's catch will be affected by both the low juvenile numbers as well as rainfall.

Following the dry monsoon period of 1982-83, the catch of banana prawns in the Karumba region has been estimated as only 333 tonnes. Rainfall over the 1983-84 wet season up to the end of January was 372 mm. From past experience, if only rainfall affects catches then the prediction for the Karumba region for 1984 is 970 tonnes. If the actual catch is significantly below this figure then we suspect that spawning stocks and juvenile numbers were too low for the healthy continuation of this fishery and management restrictions will have to be considered.

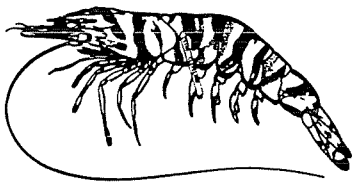
Rainfall to the end of January and catch predictions for the south-eastern regions of the Gulf are as follows:

	Rainfall (mm)	Catch Prediction (tonnes)
Karumba	372	970
Mornington Island	430	220
Limmen Bight	348	280

Predictions for the Weipa, Mitchell River and Groote Eylandt regions are not possible and the average catches over the past few years are shown:

Weipa:	625 tonnes
Mitchell River:	350 tonnes
Groote Eylandt:	110 tonnes

Updated figures to the end of February will be distributed through company offices and fishermen's organizations as soon as available in March. These figures will also be available from CSIRO at Cleveland. Contact Dave Vance, Derek Staples, or Brian Taylor.



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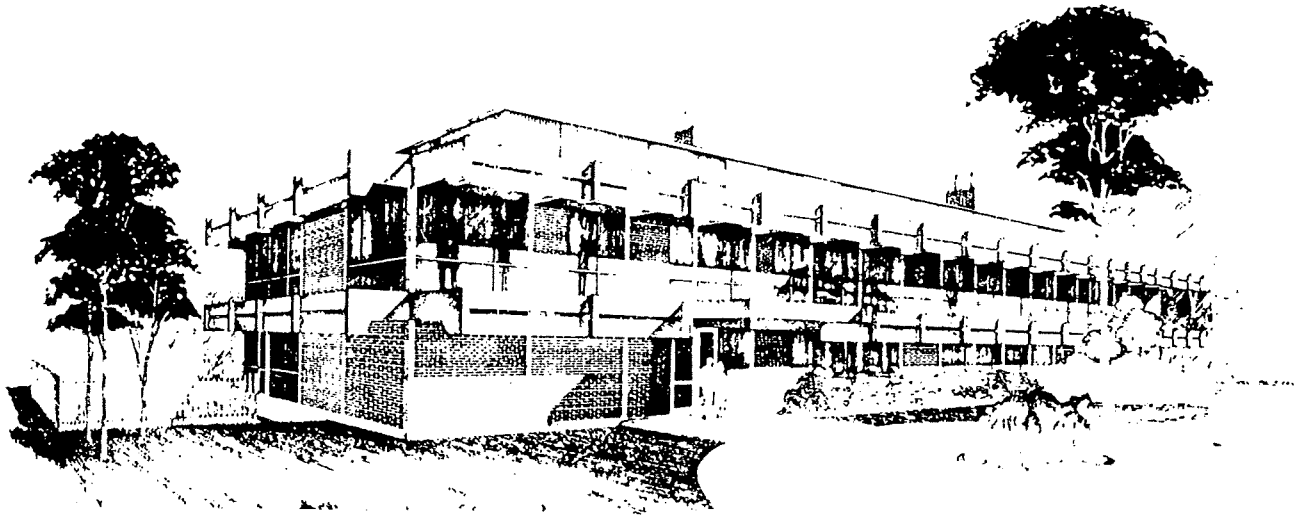


CSIRO MARINE LABORATORIES

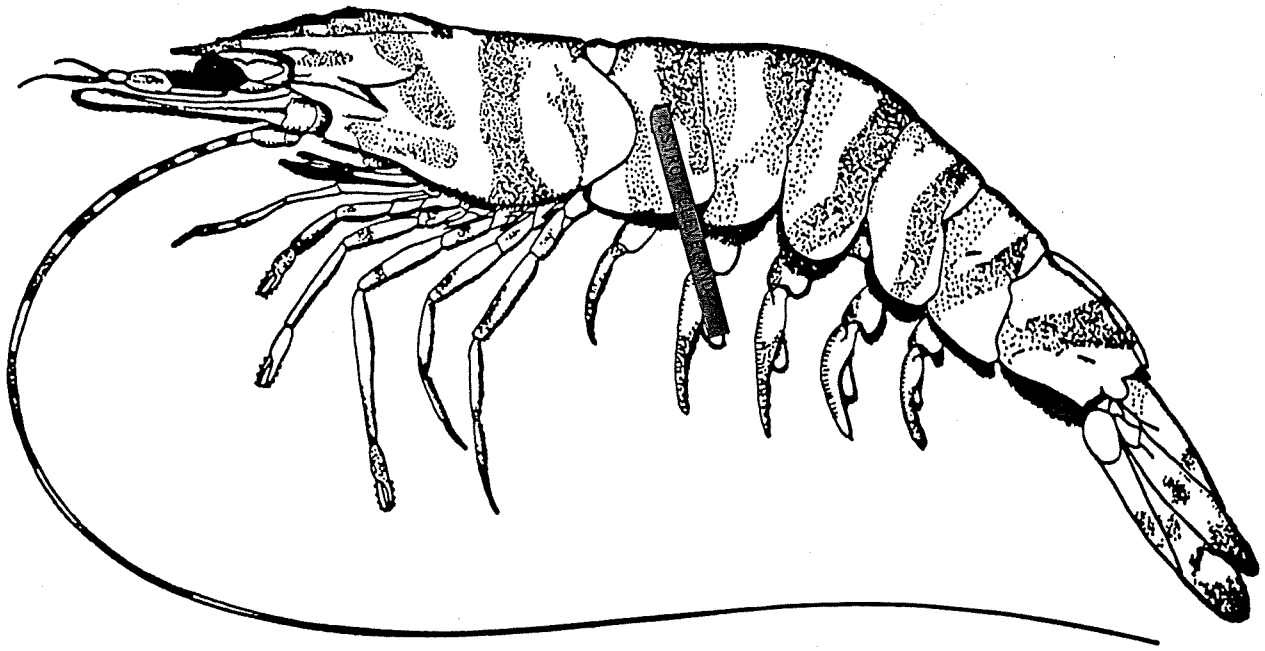
233 Middle Street

Cleveland, Qld 4163

Australia

NORTHERN PRAWN FISHERY INFORMATION NOTES

NUMBER 6 OCTOBER 1984



Compiled by Brian Taylor

Industry Liaison Officer

CSIRO Division of Fisheries Research

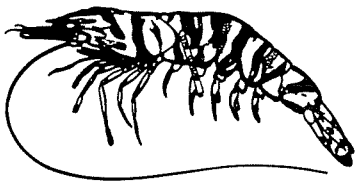
INDUSTRY LIAISON

As you may recall from earlier 'Information Notes' and perhaps from your then NORPAC representative's reports the position of part time industry liaison officer (Northern Prawn Fishery) was created by CSIRO in mid-1981 and occupied by Brian Taylor later that year. With the exception of the financial year 1981-82 when the position was created, funding has been provided by FIRTA (Fishing Industry Research Trust Account) and we have recently been advised that funding for 1984-85, the last year of that covered by the initial FIRTA application, has been approved.

The position was created 'to provide industry with data computed from log books, with banana prawn stock prediction data and other results from scientific research, and generally, to act as a liaison between fisheries research and industry.

Insomuch as these duties are concerned, information from the government agencies involved in research has been distributed in the written and verbal form. Various reports, reprints and the 'Information Notes' series have been widely distributed throughout industry and you should have received a considerable volume of this literature over the past 2-3 years. I acknowledge however a recent comment that crew members of trawlers may not always have the opportunity to read this literature and hence an extra copy marked 'galley copy' will now be distributed to all vessels. Where and whenever possible I have attempted to make personal contact to further discuss research work and results and considerable information has also been disseminated by speakers at the preseason prawn workshops through an agenda organised as part of these liaison activities.

Although I have heard several encouraging comments I feel that with your active participation we can further improve this service. As mentioned in earlier 'Information Notes', it is not possible to contact all of you personally but if you have a contribution to make (for example, we need to know the exact data you would like to see published from log book summaries) please contact Brian at the CSIRO Cleveland Laboratory.



NORMAC

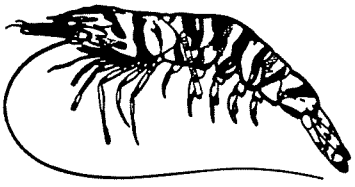
Northern Prawn Fishery Management Committee

As from January 1, 1984 this committee replaced NORPAC. The new committee will, however, report directly to AFC (Australian Fisheries Council) through SCF (Standing Committee on Fisheries) and therefore assumes greater responsibility in management than did its predecessor.

Member organisations of NORMAC are listed below and your attention is drawn to the terms of reference which were given in the April 1984 issue of *Australian Fisheries*.

Northern Fishing Companies Association
Northern Territory processors
Northern Territory producers
Queensland processors
Queensland producers
United Prawn Trawler Operators Association
Western Australian producers

Commonwealth Department of Primary Industry
CSIRO, Division of Fisheries Research
Northern Territory Department of Primary Production
Queensland Department of Primary Industries
Western Australian Department of Fisheries and Wildlife



1984 PRESEASON PRAWN WORKSHOP

The Northern Territory Minister for Primary Production, the Honourable Ian Tuxworth, officially opened the Third Northern Prawn Fishery Workshop in Darwin on February 20 1984. The one-day workshop, which was held in the auditorium of the N.T. Museum, was convened to provide a further avenue of communication between the commercial sector and the government agencies involved in this fishery. Some 90 or more people attended the workshop.

Most of the varied agenda items were of direct relevance to the fishery and covered such subjects as statistics, economics, biological research, management, export inspection services and an outlook to the future. A discourse on the South Australian prawn fishery also proved most interesting and informative.

Each presentation was followed by a brief question and discussion period and it was most encouraging to see many fishermen among those participating from the floor and helping to make the day a success. All speakers are to be congratulated for their fine efforts. So, too, are the chairmen of each of the sessions for helping to adhere to the rigid time limits imposed by the full agenda.

Many participants enjoyed the hospitality offered by N.T. AFIC immediately following the workshop and many worthwhile discussions including planning of future workshops, were continued during this time. In the light of the experience gained from both this and previous workshops it is felt that further improvements can be made and that the workshops are evolving into an extremely valuable and worthwhile event.

THE 1985 PRESEASON WORKSHOP WILL
BE HELD IN CAIRNS.
THE TIME, AGENDA AND OTHER DETAILS
WILL
BE PUBLICISED AT A LATER DATE.

FIRTA (FISHING INDUSTRY RESEARCH TRUST ACCOUNT)

From time to time enquiries are received regarding the structure and operation of the fund. FIRTA was established by the Australian government under the Fishing Industry Research Act and the account is administered by the Fisheries Division of the Department of Primary Industry in Canberra. Monies collected from various license fees by the States which are then paid into 'approved accounts' are matched by the Australian government and the matching finance makes up the FIRTA funds.

Applications for grants are considered by the Fishing Industry Research Committee which is made up of members representing both industry and government. This committee is also responsible for the publication of an annual report which presents a detailed financial statement and lists and summarises all current and terminating projects.

Finance is provided for all types of research including product development and marketing, gear technology, education, extension and any other development projects for the benefit of the Australian fishing industry. This year approximately $3.9M from the fund will be spent on various projects. It should be made quite clear that any individual or organisation who may be able to contribute is eligible to apply for a grant and all applications are considered on their merits. Some complaints have been made that industry is not receiving funding, but few applications have in fact been received from industry. Perhaps those trials you propose doing or a theory you can check may be eligible for supportive funding.

Dr Dean Bottrill is the executive officer-technical advisor of the research committee and if you have any queries or if you require a copy of the 1982-83 Annual Report then please contact Dean at 8 Brook Avenue, Glen Osmond, S.A. 5064 or phone (08)79-4869. Grants are issued on a financial year basis and as the closing date for applications for 1984-85 is December 30th, now is the time to contact Dean to discuss your proposal. You are referred firstly, however, to the article 'Can FIRTA help you' which was featured in the January 1984 *Australian Fisheries*.

SECOND NATIONAL PRAWN SEMINAR

The Second Australian National Prawn Seminar is to be held at Kooralbyn Valley (SE Queensland) during the week 22-26 October, 1984. It was in November 1973 that the first seminar was held, and in the past decade Australian prawn fisheries have expanded and developed to become the nation's most valuable fisheries resource. Along with this expansion of the commercial fisheries has been an increase in both research and management effort and more recently there has been considerable interest in the potential of prawn aquaculture in Australia. It seemed appropriate then, to completely review our prawn fisheries.

Speakers from all parts of Australia and from overseas are to participate, thus giving both a national and international perspective to proceedings. Topics will include research and management as well as commercial fisheries, marketing, economics and aquaculture.

Initially, abstracts of all papers to be presented will be available and a book of the full proceedings will be prepared at a later date. These publications should prove to be an extremely valuable source of detailed information and reference material.

NORTHERN SHARK, MACKEREL AND TUNA TAGGING PROJECT

Stephanie Davenport
Division of Fisheries Research
CSIRO, Cronulla.

CSIRO Fisheries Division, Cronulla, is currently undertaking a shark, mackerel and tuna tagging project in the northern Australian region. Tagging is primarily directed at two species of black-tip shark (*Carcharhinus limbatus* and *C. sorrah*) as well as narrow-barred spanish mackerel (*Scomberomorus commerson*) and long-tail tuna (*Thunnus tonggol*).

The tagging studies form part of the Northern Pelagic Fish Stock Research Programme which commenced in January 1984. This is a cooperative study between CSIRO Fisheries, Department of Primary Industry (Canberra), and the Northern Territory, Queensland and Western Australian Fisheries Authorities. The objectives are to obtain information on the size, distribution, mortality, recruitment and yield potential of northern pelagic fish stocks, which currently support a Taiwanese fishery of approximately 9,000 tonnes annually and a small developing Australian fishery. The field study comprises a series of 8 cruises aboard the 21 metre commercial gill net vessel "Rachel", on charter to CSIRO for the duration of the programme. The area of operation lies between the Joseph Bonaparte Gulf in the west and the eastern Gulf of Carpentaria. The information gained from this study will be used by the Department of Primary Industry (DPI) for planning and implementation of improved management strategies for the fishery.

At the time of writing, 6 cruises have been completed and over 7,000 sharks and 100 mackerel have been tagged. Seventy-five tagged sharks have been recaptured, some of which have travelled large distances across Northern Australian waters. For example, a *C. limbatus* tagged off Port Essington travelled a straight-line distance of 1148 km to near Wellesley Island in the southeastern Gulf of Carpentaria in 77 days. A *C. sorrah* tagged in Anson Bay moved 741km in 329 days and was recaught in the Taiwanese commercial grounds west of the Wessel Islands. Several other sharks have moved from inshore regions closed to foreign fishing out into the offshore commercially fished area.

It is requested that anyone capturing any of these tagged species retain the fish intact with the tag in place, and record the date and position of capture. A reward of $5.00 plus the market value of the fish is offered.

If it is not possible to retain the whole fish, the length should be measured as a straight line distance from the tip of the snout to the fork of the tail as indicated. The tag should then be returned with capture details recorded as above.

REWARD

獎賞

A reward plus market price for tagged sharks returned with information.

WHAT TO DO:

1. Record date, position, tag colour and number.
2. Where possible freeze the shark with the tag still in place, otherwise record fork length of shark, measured as a straight line distance (see below), not over curve of body.
3. Contact CSIRO or local Fisheries Office.

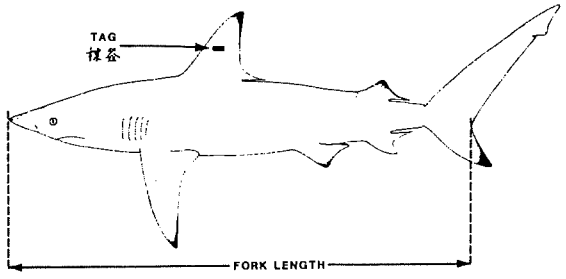
協助事項

一.立即記下捕到魚的經度緯度深度標簽號碼及顏色、捕獲日期

二.把所捕獲的魚或黑魚予做標簽進行冷凍

三.在作業後檢查時應將捕獲的標識魚及其記錄資料提交檢查員並領取獎賞

Thank you 謝謝



CSIRO MARINE LABORATORIES P.O. BOX 21 CRONULLA NSW 2230.
TELEPHONE: (02) 523 6222

THE FATE OF PRAWN TRAWLER BY-CATCH IN MORETON BAY, QUEENSLAND

T.J. Wassenberg
CSIRO Division of Fisheries Research, Cleveland

Fisheries worldwide capture an incidental component along with the target species. This incidental component or by-catch is usually discarded in whole or part depending on the marketable value. The by-catch represents a burden to fishermen during sorting, a potential loss to themselves and other fishermen as well as a possible pollutant.

Third world countries are examining ways to utilize the by-catch for food or fertilizers and most research has been devoted to this problem. Other research has investigated ways to avoid taking by-catch species. The effects of trawling on the seabed communities and on fish communities have also been examined but very little work has been done to examine the fate of the by-catch. Where does it all go?

It is often assumed that the by-catch is dead when it is returned to the sea. A study carried out in Moreton Bay, Queensland indicates that this is not the case. Fish with swim bladders do generally die (Figure 1) and float for up to eight hours. They are scavenged by birds, dolphins, sharks, turtles and other large fish. These floating fish represent 10% of the by-catch in Moreton Bay. There is a differential survival of the fish without a functional swim bladder. As much as 70% of some species survive exposures of up to 20 minutes on the sorting tray. Crustacea (72% of the by-catch) generally have a high survival with about 95% of sand crabs and 69% of clickers (a small type of shrimp) surviving exposures of 20 minutes on deck.

Damage to Crustacea is generally minor. Lethal damage occurs in 2% of sand crabs and up to 13% in the clickers. Damage to fish is usually physiological and difficult to measure. Less than 1% of fish are actually damaged by crabs in the trawls.

The rate at which the by-catch is sorted, the time it has been in the net and several physiological parameters determine the survival of by-catch species. In this study, trawls have been of about one hours' duration and most catches were sorted in an average of 23 minutes. Sorting rates are fairly constant for all species examined (Figure 2) but crabs and large animals are removed from the sorting tray before small animals. Hence crabs and large animals have a better chance of survival than small 'trash fish'. This study is continuing and hopes to quantify the proportions of the by-catch going to birds and dolphins. The fate of the by-catch will be pursued to the bottom of the sea to determine its ultimate rate of reabsorption into the system and to identify the pathways.

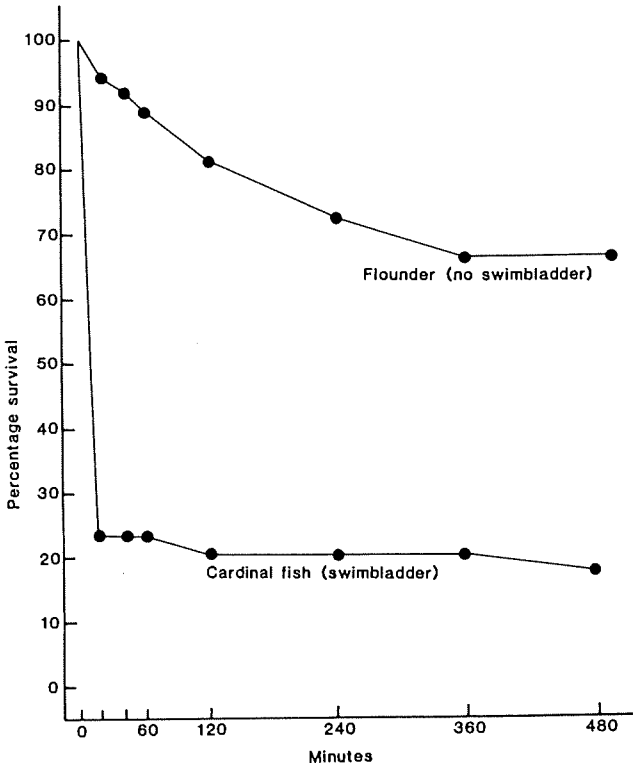


Figure 1. Survival rate with time on sorting tray.

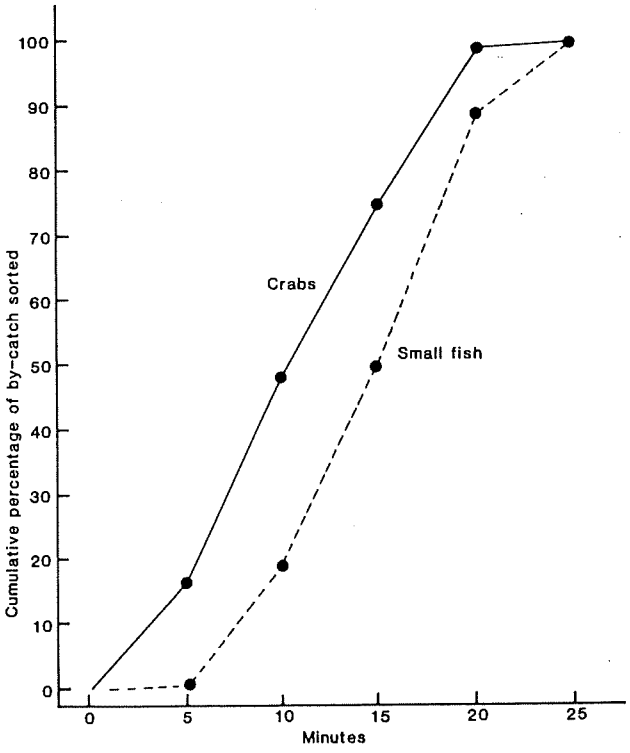


Figure 2. By-catch sorting times.

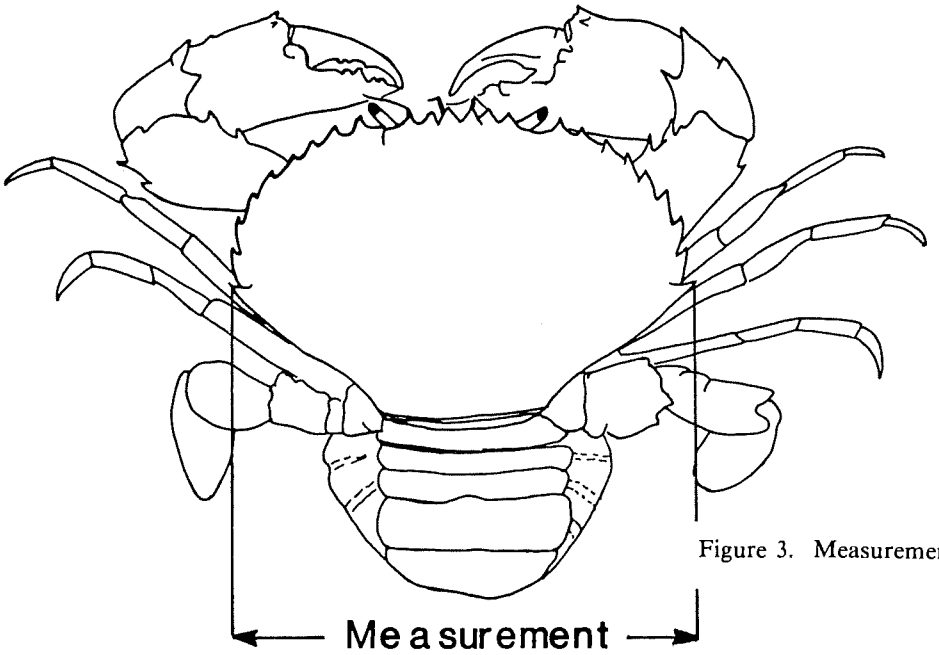
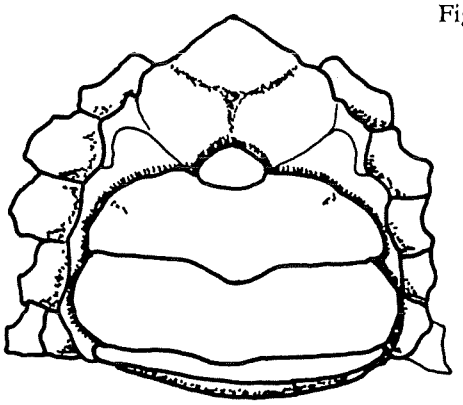


Figure 3. Measurement of a mud crab.

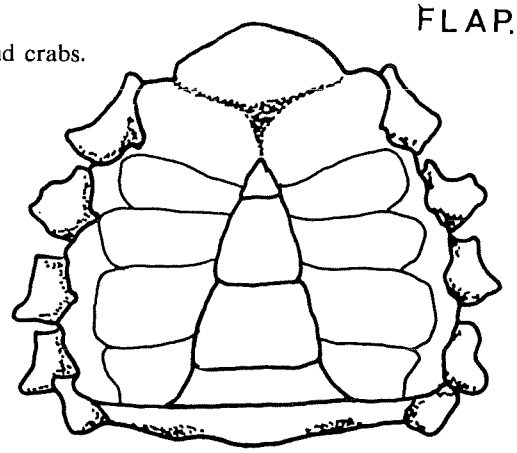
TO SEX CRAB LOOK AT UNDERSIDE -

FEMALES HAVE WIDE FLAP, MALES HAVE NARROW, POINTED FLAP.

Figure 4. Sexing mud crabs.



FEMALE



MALE

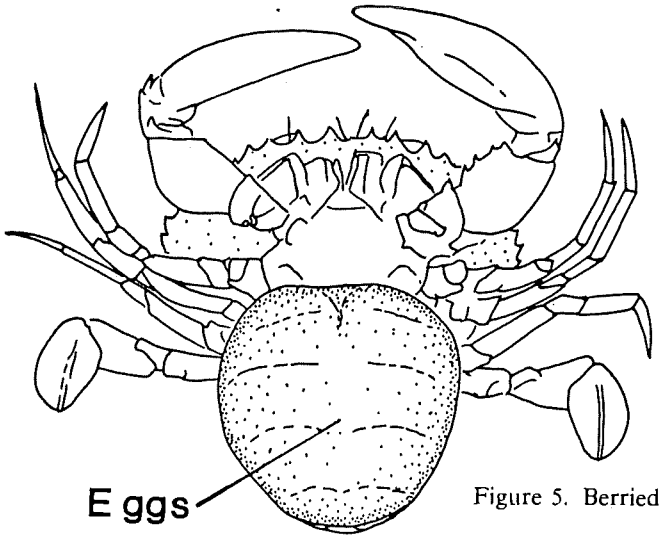


Figure 5. Berried (ovigerous) female mud crab.

MUD CRABS IN GULF TRAWLS

Burke Hill
CSIRO Division of Fisheries Research, Cleveland

Trawlers operating in the Gulf of Carpentaria occasionally catch mud crabs in their trawls. Over the past three years several trawler skippers have passed on information about their catches of mud crabs and this has provided interesting details of a part of the mud crab life cycle which was previously unknown.

Mud crabs generally live in inshore areas such as the tidal reaches of rivers and sheltered areas behind islands. These areas are ideally suited to the establishment of mangroves and so mud crabs tend to be associated with mangroves - hence the name, in some areas, of mangrove crab.

Female mud crabs can be mated only when they have just moulted and have a soft shell. Before moulting the female extrudes a chemical which attracts males and the most aggressive one (or the speediest) wins the female. He then physically picks her up and carries her around for a few days until moulting occurs. They then mate and the male continues to carry the female around until her shell has hardened. He then releases her. Some time later - we don't know how long - the female moves downriver and out to sea. Until skippers began to pass on information on mud crabs caught in trawls, this part of the life cycle of the females was a mystery.

The main details which have emerged are the size of the migrating females, the months in which they spawn and where they go. Most of the females caught have a shell width of 150mm (6 inches) or larger although there have been several smaller individuals. Females carrying eggs have been reported mainly in October and November indicating quite a narrow spawning period. Two areas of the Gulf of Carpentaria appear to have the highest incidence of mud crabs at sea. These are off Albatross Bay and to the north of the Vanderlin Islands. I have no reports of mud crabs from commercial trawls from anywhere between Mornington Island and Pera Head and only two from between Groote Eylandt and Gove. Around 3% of the mud crabs captured in trawls are males indicating that although the seaward migration is basically a female process a few (misguided or enthusiastic ?) males accompany them.

Additional records of mud crabs from trawls would be greatly appreciated. Ideally, the crabs should be measured and the sex and presence or absence of eggs on females noted (see Figures 3, 4 and 5). In addition, the position, date and depth of capture should be noted. This can be done in the DMZ logbook but the logbook collectors should be advised about the record and they will pass the information on to me at CSIRO. Alternatively, the information can be sent directly to me at CSIRO, P.O. Box 120, Cleveland, Queensland, 4163 where it will be received gratefully.

STATISTICS

Statistical data are collected from the commercial sector for several general reasons including economic and biological research purposes, assessment of the size, value and importance of the fishery and for management considerations.

The results and consequent recommendations and actions taken under these general headings may hide the true value of statistical data and it is yet again stressed that accurate and comprehensive data are absolutely essential as a base for sound decision making.

Although not always recognized, statistical data may also be used to help you plan your operational strategies. If statistics are regarded as a grouping of measurable experiences then perhaps this last point becomes more obvious. As CSIRO have access to a considerable data set then we may be able to help but we require your advice.

The two main sources of continuously collected data are the processors monthly returns and fishermens daily log records. Data from the processors returns are published regularly (monthly and annually) by the Fisheries Division of the Department of Primary Industry in Canberra and it is the publication of log book derived data we are concerned with here.

Log data is, however, provided in confidence, and as pointed out in the September 1983 'Information Notes', it was decided by (then) NORPAC/NFC that some restriction be placed on the publication of summarised log data to avoid any possible or potential breach of this confidence. Data collated on a monthly basis, although necessitating some omissions, allows for a more complete data set to be published and the following pages show log data for 1982 collated to a monthly and regional basis.

Your advice required - If data in the format given is useful (and if not we would appreciate your advice regarding a useful format!) then how many years back would you like to see published? Remember that data from earlier years when effort was not so high would have more omissions.

Whilst looking at the following summaries please remember that (1) log data represents only a proportion of the real catch; (2) omitted data is indicated by asterisks but such data is included in the totals and in averages; (3) the figures given may change slightly from time to time as further data becomes available.

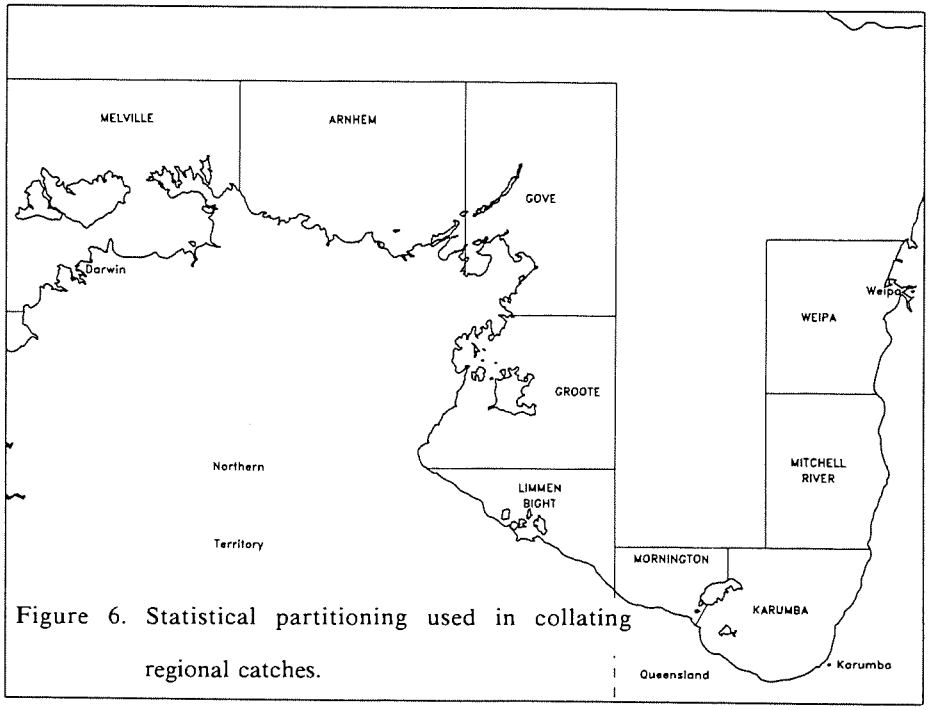


Figure 6. Statistical partitioning used in collating regional catches.

1982 LOGBOOK CATCH AND EFFORT SUMMARY - DECLARED MANAGEMENT ZONE run on 1/10/84

Month	Banana prawn fishery			Mixed species prawn fishery						
	Logbook Catch (kg)	Logbook Effort (boat days)	CPUE (kg/day)	Logbook Catch (kg)					Logbook Effort (boat days)	CPUE (kg/day)
				Incidental Banana	Tiger	Endeavour	King	Total		
JANUARY	3733	38	98	10272	93350	34202	1180	139004	728	190
FEBRUARY	46944	184	255	53481	98648	23509	932	176570	749	235
MARCH	737635	1323	557	44363	47124	4901	1078	97466	328	297
APRIL	212519	621	342	46714	198706	33220	4423	283063	1191	237
MAY	105237	266	395	38561	237775	63114	7160	346610	1691	204
JUNE	64560	149	433	33510	207197	81151	9736	331594	1517	218
JULY	6463	52	124	13996	322680	127635	15309	479620	2197	218
AUGUST	48	18	2	18932	404331	262793	9203	695259	2985	232
SEPTEMBER	8685	33	263	49273	482174	177884	4723	714054	2721	262
OCTOBER	694	25	27	57349	338860	178958	2080	577247	2249	256
NOVEMBER	0	12	0	12926	230617	150655	1696	395894	2011	196
DECEMBER	36	24	1	3723	118327	97131	1466	220647	1304	169
TOTAL	1186554	2745	432	383100	2779789	1235153	58986	4457028	19671	226

1982 LOGBOOK CATCH AND EFFORT SUMMARY - GULF CENTRE+TI

run on 1/10/84

Month	Banana prawn fishery: Logbook Catch (kg)	Banana prawn fishery: Logbook Effort (boat days)	Banana prawn fishery: CPUE (kg/day)	Mixed species prawn fishery: Logbook Catch (kg): Incidental Banana	Tiger	Endeavour	King	Total	Mixed species prawn fishery: Logbook Effort (boat days)	Mixed species prawn fishery: CPUE (kg/day)
JANUARY	*	*	*	2076	13	377	0	2466	13	189
FEBRUARY	0	0		0	0	0	0	0	0	
MARCH	*	*	*	0	0	0	0	0	0	
APRIL	*	*	*	0	2395	1937	0	4332	14	309
MAY	*	*	*	3000	13796	4380	0	21176	75	282
JUNE	0	0		0	16079	7922	264	24265	81	299
JULY	0	0		26	15123	4243	110	19502	91	214
AUGUST	0	0		46	9758	2417	90	12311	64	192
SEPTEMBER	0	0		3966	22017	1979	30	27992	88	318
OCTOBER	0	0		37482	6244	10668	786	55180	109	506
NOVEMBER	0	0		1114	1632	896	0	3642	20	182
DECEMBER	*	*	*	0	2764	380	0	3144	21	149
TOTAL	816	14	58	47710	89821	35199	1280	174010	576	302

1982 LOGBOOK CATCH AND EFFORT SUMMARY - WEIPA

run on 1/10/84

Month	Banana prawn fishery: Logbook Catch (kg)	Banana prawn fishery: Logbook Effort (boat days)	Banana prawn fishery: CPUE (kg/day)	Mixed species prawn fishery: Logbook Catch (kg): Incidental Banana	Tiger	Endeavour	King	Total	Mixed species prawn fishery: Logbook Effort (boat days)	Mixed species prawn fishery: CPUE (kg/day)
JANUARY	0	0		0	3943	340	0	4283	33	129
FEBRUARY	19072	33	577	13824	18674	974	0	33472	116	288
MARCH	374444	560	668	29911	2929	337	0	33177	55	603
APRIL	236	18	13	0	0	0	0	0	0	
MAY	2490	15	166	*	*	*	*	*	*	*
JUNE	9676	15	645	623	10532	2346	5	13506	78	173
JULY	5451	21	259	2930	25307	11071	181	39489	239	165
AUGUST	*	*	*	4888	47458	32046	175	84567	505	167
SEPTEMBER	*	*	*	2428	47326	48766	336	98856	511	193
OCTOBER	*	*	*	14327	66006	75669	646	156648	751	208
NOVEMBER	*	*	*	6936	40330	39908	30	87204	559	156
DECEMBER	0	0		24	12447	8258	39	20768	157	132
TOTAL	411410	684	601	76099	276122	219870	1412	573503	3013	190

1982 LOGBOOK CATCH AND EFFORT SUMMARY - MITCHELL

run on 1/10/84

Month	Banana prawn fishery			Mixed species prawn fishery						
	Logbook Catch (kg)	Logbook Effort (boat days)	CPUE (kg/day)	Incidental Catch (kg)					Logbook Effort (boat days)	CPUE (kg/day)
				Banana	Tiger	Endeavour	King	Total		
JANUARY	*	*	*	0	0	0	0	0	0	
FEBRUARY	0	0		0	0	0	0	0	0	
MARCH	17747	98	181	0	0	0	0	0	0	
APRIL	980	11	89	0	0	0	0	0	0	
MAY	*	*	*	*	*	*	*	*	*	*
JUNE	*	*	*	0	0	0	0	0	0	
JULY	*	*	*	*	*	*	*	*	*	*
AUGUST	0	0		0	0	0	0	0	0	
SEPTEMBER	0	0		0	0	0	0	0	0	
OCTOBER	0	0		0	0	0	0	0	0	
NOVEMBER	0	0		0	0	0	0	0	0	
DECEMBER	0	0		0	0	0	0	0	0	
TOTAL	18727	120	156	0	561	257	7	825	4	206

1982 LOGBOOK CATCH AND EFFORT SUMMARY - KARUMBA

run on 1/10/84

Month	Banana prawn fishery			Mixed species prawn fishery						
	Logbook Catch (kg)	Logbook Effort (boat days)	CPUE (kg/day)	Incidental Catch (kg)					Logbook Effort (boat days)	CPUE (kg/day)
				Banana	Tiger	Endeavour	King	Total		
JANUARY	0	0		0	0	0	0	0	0	
FEBRUARY	0	0		*	*	*	*	*	*	*
MARCH	107079	226	473	6978	31731	1058	864	40631	169	240
APRIL	38082	73	521	12300	68525	5772	2037	88634	427	207
MAY	41454	31	1337	3736	57545	11112	1750	74143	393	188
JUNE	8790	21	418	555	32312	10781	922	44570	220	202
JULY	*	*	*	741	61099	18917	1727	82484	377	218
AUGUST	*	*	*	355	48794	34634	1678	85461	327	261
SEPTEMBER	*	*	*	1548	12287	9798	260	23893	125	191
OCTOBER	*	*	*	110	5884	1349	216	7559	68	111
NOVEMBER	*	*	*	0	1197	180	29	1406	17	82
DECEMBER	*	*	*	0	860	140	0	1000	11	90
TOTAL	195405	362	539	26323	320304	93761	9483	449871	2135	210

1982 LOGBOOK CATCH AND EFFORT SUMMARY - WEST MORNINGTON

run on 1/10/84

Month	Banana prawn fishery			Mixed species prawn fishery						
	Logbook Catch (kg)	Logbook Effort (boat days)	CPUE (kg/day)	Logbook Catch (kg)					Logbook Effort (boat days)	CPUE (kg/day)
				Incidental Banana	Tiger	Endeavour	King	Total		
JANUARY	0	0		0	1060	695	0	1755	12	146
FEBRUARY	*	*	*	0	4387	404	138	4929	39	126
MARCH	14930	44	339	5	1616	144	101	1866	20	93
APRIL	4500	22	204	4690	32029	7000	444	44163	183	241
MAY	1034	16	64	3303	44548	12357	843	61051	284	214
JUNE	*	*	*	608	54271	12411	2526	69816	312	223
JULY	*	*	*	3305	95055	22977	9362	130699	518	252
AUGUST	*	*	*	3055	67307	37367	2519	110248	398	277
SEPTEMBER	*	*	*	143	28730	8868	1233	38974	153	254
OCTOBER	0	0		0	2782	254	155	3191	16	199
NOVEMBER	0	0		*	*	*	*	*	*	*
DECEMBER	0	0		*	*	*	*	*	*	*
TOTAL	20632	93	221	15109	333534	102575	17325	468543	1950	240

1982 LOGBOOK CATCH AND EFFORT SUMMARY - LIMMEN BIGHT

run on 1/10/84

Month	Banana prawn fishery			Mixed species prawn fishery						
	Logbook Catch (kg)	Logbook Effort (boat days)	CPUE (kg/day)	Logbook Catch (kg)					Logbook Effort (boat days)	CPUE (kg/day)
				Incidental Banana	Tiger	Endeavour	King	Total		
JANUARY	*	*	*	0	9028	1465	184	10677	58	184
FEBRUARY	*	*	*	63	8510	828	144	9545	49	194
MARCH	109828	104	1056	*	*	*	*	*	*	*
APRIL	39091	69	566	*	*	*	*	*	*	*
MAY	4873	26	187	2463	5931	851	94	9339	42	222
JUNE	*	*	*	14807	22650	3037	1012	41506	135	307
JULY	*	*	*	4313	52828	12767	2621	72529	277	261
AUGUST	*	*	*	2456	50994	22730	2517	78697	333	236
SEPTEMBER	210	10	21	3090	185417	17290	1557	207354	608	341
OCTOBER	*	*	*	168	115002	14761	47	129978	455	285
NOVEMBER	*	*	*	1320	58705	24417	51	84493	391	216
DECEMBER	*	*	*	66	9941	3615	0	13622	86	158
TOTAL	154022	233	661	29882	519996	101841	8460	660179	2446	269

1982 LOGBOOK CATCH AND EFFORT SUMMARY - GROOTE EYLANDT

run on 1/10/84

Month	Banana prawn fishery			Mixed species prawn fishery						
	Logbook Catch (kg)	Logbook Effort (boat days)	CPUE (kg/day)	Logbook Catch (kg)					Logbook Effort (boat days)	CPUE (kg/day)
				Incidental Banana	Tiger	Endeavour	King	Total		
JANUARY	2175	12	181	1925	47430	13746	387	63488	332	191
FEBRUARY	*	*	*	3	48024	9106	470	57603	281	204
MARCH	18647	29	643	577	9435	2381	101	12494	49	254
APRIL	10759	38	283	12023	88662	15608	1644	117937	447	263
MAY	3640	15	242	8312	95704	21978	3016	129010	694	185
JUNE	*	*	*	1139	56315	31196	3737	92387	547	168
JULY	*	*	*	326	53760	41123	1241	96450	526	183
AUGUST	*	*	*	432	125810	79535	1867	207644	1025	202
SEPTEMBER	*	*	*	1980	119684	20798	1027	143489	725	197
OCTOBER	*	*	*	1511	106303	20184	92	128090	561	228
NOVEMBER	*	*	*	1628	78256	28590	610	109084	538	202
DECEMBER	*	*	*	44	59053	45654	346	105097	585	179
TOTAL	37105	127	292	29900	888436	329899	14538	1262773	6310	200

1982 LOGBOOK CATCH AND EFFORT SUMMARY - GOVE

run on 1/10/84

Month	Banana prawn fishery			Mixed species prawn fishery						
	Logbook Catch (kg)	Logbook Effort (boat days)	CPUE (kg/day)	Logbook Catch (kg)					Logbook Effort (boat days)	CPUE (kg/day)
				Incidental Banana	Tiger	Endeavour	King	Total		
JANUARY	0	0		0	6575	3620	369	10564	46	229
FEBRUARY	*	*	*	*	*	*	*	*	*	*
MARCH	3352	13	257	*	*	*	*	*	*	*
APRIL	3490	31	112	*	*	*	*	*	*	*
MAY	*	*	*	73	681	183	1279	2216	17	130
JUNE	*	*	*	*	*	*	*	*	*	*
JULY	0	0		*	*	*	*	*	*	*
AUGUST	*	*	*	12	13137	1086	167	14402	55	261
SEPTEMBER	*	*	*	0	31897	4091	280	36268	166	218
OCTOBER	*	*	*	0	14101	4171	138	18410	68	270
NOVEMBER	*	*	*	12	23625	7405	976	32018	140	228
DECEMBER	*	*	*	0	15083	5060	941	21084	153	137
TOTAL	14127	73	193	679	106243	25956	4378	137256	670	204

1982 LOGBOOK CATCH AND EFFORT SUMMARY - ARNHEM

run on 1/10/84

Month	Banana prawn fishery			Mixed species prawn fishery						
	Logbook Catch (kg)	Logbook Effort (boat days)	CPUE (kg/day)	Incidental Catch (kg)					Logbook Effort (boat days)	CPUE (kg/day)
				Banana	Tiger	Endeavour	King	Total		
JANUARY	*	*	*	*	*	*	*	*	*	*
FEBRUARY	16884	88	191	*	*	*	*	*	*	*
MARCH	15271	61	250	0	0	0	0	0	0	
APRIL	8130	55	147	0	0	0	0	0	0	
MAY	*	*	*	*	*	*	*	*	*	*
JUNE	*	*	*	*	*	*	*	*	*	*
JULY	*	*	*	0	1776	74	24	1874	13	144
AUGUST	0	0		*	*	*	*	*	*	*
SEPTEMBER	0	0		*	*	*	*	*	*	*
OCTOBER	0	0		0	0	0	0	0	0	
NOVEMBER	*	*	*	*	*	*	*	*	*	*
DECEMBER	*	*	*	*	*	*	*	*	*	*
TOTAL	42565	218	195	1058	5356	498	24	6936	54	128

1982 LOGBOOK CATCH AND EFFORT SUMMARY - MELVILLE

run on 1/10/84

Month	Banana prawn fishery			Mixed species prawn fishery						
	Logbook Catch (kg)	Logbook Effort (boat days)	CPUE (kg/day)	Incidental Catch (kg)					Logbook Effort (boat days)	CPUE (kg/day)
				Banana	Tiger	Endeavour	King	Total		
JANUARY	878	15	58	6271	25033	13947	240	45491	229	198
FEBRUARY	10988	47	233	38533	18573	11999	0	69105	253	273
MARCH	76201	169	450	6052	893	929	0	7874	28	281
APRIL	107251	290	369	16835	5854	2683	16	25388	101	251
MAY	45215	141	320	17367	15374	11180	35	43956	159	276
JUNE	43040	89	483	15227	8634	8937	918	33716	111	303
JULY	892	14	63	2355	16272	16086	36	34749	142	244
AUGUST	*	*	*	7688	36450	49955	0	94093	246	382
SEPTEMBER	*	*	*	36118	32589	65753	0	134460	329	408
OCTOBER	*	*	*	3751	19851	51479	0	75081	204	368
NOVEMBER	*	*	*	1724	24650	49028	0	75402	327	230
DECEMBER	*	*	*	3589	17351	33973	136	55049	281	195
TOTAL	291745	791	368	155510	221524	315949	1381	694364	2410	288

REGIONAL CATCH PER UNIT EFFORT (kg/day) - 1982

MONTH	T.I.+G.C.	WEIPA	MITCHELL	KARUMBA	W.MORN.	LIMMEN	GROOTE	GOVE	Run on 1/10/84 ARNHEM	MELVILLE	DMZ
TIGER PRAWNS											
JANUARY	1	119			88	155	142	142	*	109	128
FEBRUARY		160		*	112	173	170	*	*	73	131
MARCH		48		187	80	*	192	*		31	141
APRIL	171			160	175	*	198	*		56	166
MAY	183	*	*	146	156	141	137	40	*	96	140
JUNE	198	135		146	173	167	102	*	*	77	135
JULY	166	105	*	162	183	190	102	*	136	114	146
AUGUST	152	93		149	169	153	122	238	*	148	135
SEPTEMBER	250	92		98	187	304	165	192	*	99	177
OCTOBER	57	87		86	173	252	189	207		97	150
NOVEMBER	81	72		70	*	150	145	168	*	75	114
DECEMBER	131	79		78	*	115	100	98	*	61	90
AVERAGE	155	91	140	150	171	212	140	158	99	91	141
ENDEAVOUR PRAWNS											
JANUARY	29	10			57	25	41	78	*	60	46
FEBRUARY		8		*	10	16	32	*	*	47	31
MARCH		5		6	7	*	48	*		33	14
APRIL	138			13	38	*	34	*		25	27
MAY	58	*	*	28	43	20	31	10	*	70	37
JUNE	97	30		49	39	22	57	*	*	80	51
JULY	46	46	*	50	44	46	78	*	5	113	58
AUGUST	37	63		105	93	68	77	19	*	203	87
SEPTEMBER	22	95		78	57	28	28	24	*	199	65
OCTOBER	97	100		19	15	32	35	61		252	79
NOVEMBER	44	71		10	*	62	53	52	*	149	74
DECEMBER	18	52		12	*	42	78	33	*	120	74
AVERAGE	61	72	64	43	52	41	52	38	9	130	62

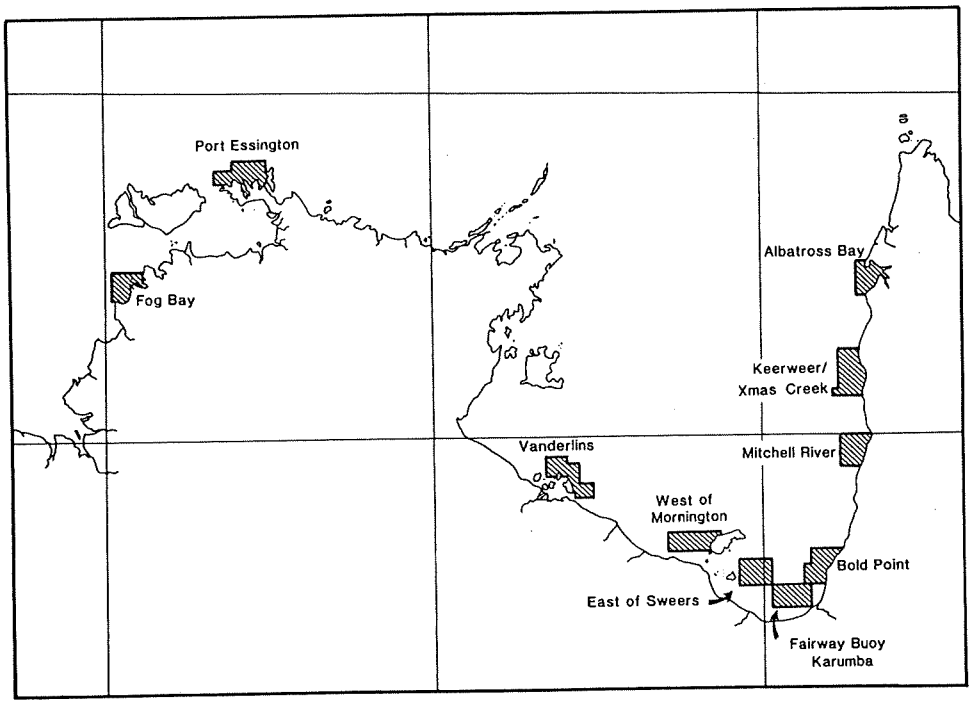


Figure 7. Regions sampled during preseason survey.

1984 BANANA PRAWN SAMPLING

The following notes have been reproduced from a report prepared by Ian Somers (CSIRO) and David Carter (KFV Fisheries).

Following a successful feasibility study of preseason sampling in the Weipa region in 1983, a more extensive study was undertaken prior to and during the 1984 banana prawn season. The study was basically an attempt to ascertain the size composition of the banana prawn stocks of the whole of the Declared Management Zone prior to the fishing season and, in conjunction with information on prevailing market values, estimate the best opening date for the fishing season. Sampling of the banana prawn stocks was carried out in ten regions throughout the DMZ in early March. Although the opening date of the fishing season had been set at 1st April, the results of the preseason sampling indicated an optimal opening date of 23rd April.

In order to assess the accuracy of the preseason survey estimates, samples were also taken from the commercial catch during the fishing season. Analysis of the size composition data obtained from these samples suggested an optimal opening date for 1984 as 19th May. An opening date of 23rd April as suggested by the preseason survey would have resulted in a total revenue some 3% below the maximum possible whereas the actual opening date (1st April) has resulted in revenue 12% (approximately 2.5 million dollars) below the maximum.

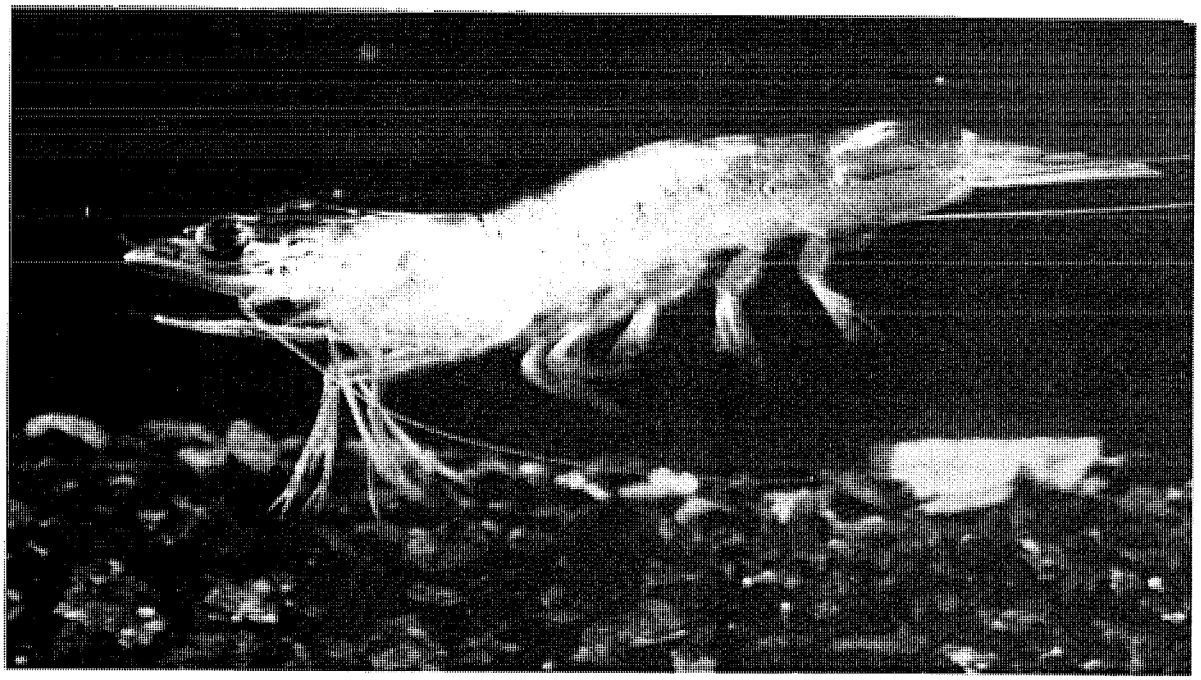
Although a 23rd April opening date would have resulted in significantly higher total revenue (about 2 million dollars) than the 1st April, the extent of error (3%) associated with that recommendation was significantly worse than that predicted from the 1983 Weipa study.

In all regions with the exception of Weipa, the size composition data obtained during the 1984 preseason survey was not representative of the prawn population which was fished three weeks later. In each case the average size of prawns found in the commercial fishery on 1st April was smaller than that predicted from the preseason survey results. It is thought that the primary reason for this bias in the results is that recruitment of small prawns into the fishery continued after the end of the survey and thus continued to depress the average size of prawns in the population.

The main conclusion one can draw from the results of the 1984 survey is that with the present lack of knowledge of banana prawn recruitment patterns, an opening date estimated through preseason sampling must be viewed as the earliest opening date to the fishing season.

Table 1. Summary of prawns measured and their average sizes during the preseason survey and from the subsequent commercial catch samples.

Region	Preseason Sampling (8/3/84)		Commercial Catch Sampling (1/4/84)		
	Number measured	Average count	Number measured	Expected count	Actual count
Albatross Bay	588	26.4	1250 (7)	20.5	20.3
Cape Keerweer	422	22.6	813 (3)	18.3	21.3
Mitchell River	103	20.3	0 (0)	16.9	na
Bold Point	211	21.7	380 (2)	17.7	19.1
Fairway Buoy	131	26.3	242 (1)	20.4	26.4
East of Sweers	1337	24.0	2989 (17)	18.1	23.6
West Mornington	275	20.4	787 (4)	16.9	22.4
Vanderlins	15	32.8	6276 (32)	na	31.0
Port Essington	347	17.8	473 (2)	15.2	23.9
Fog Bay	411	24.5	2983 (17)	19.5	25.6
DMZ Total	3840	22.9	16193 (85)	18.5	23.0



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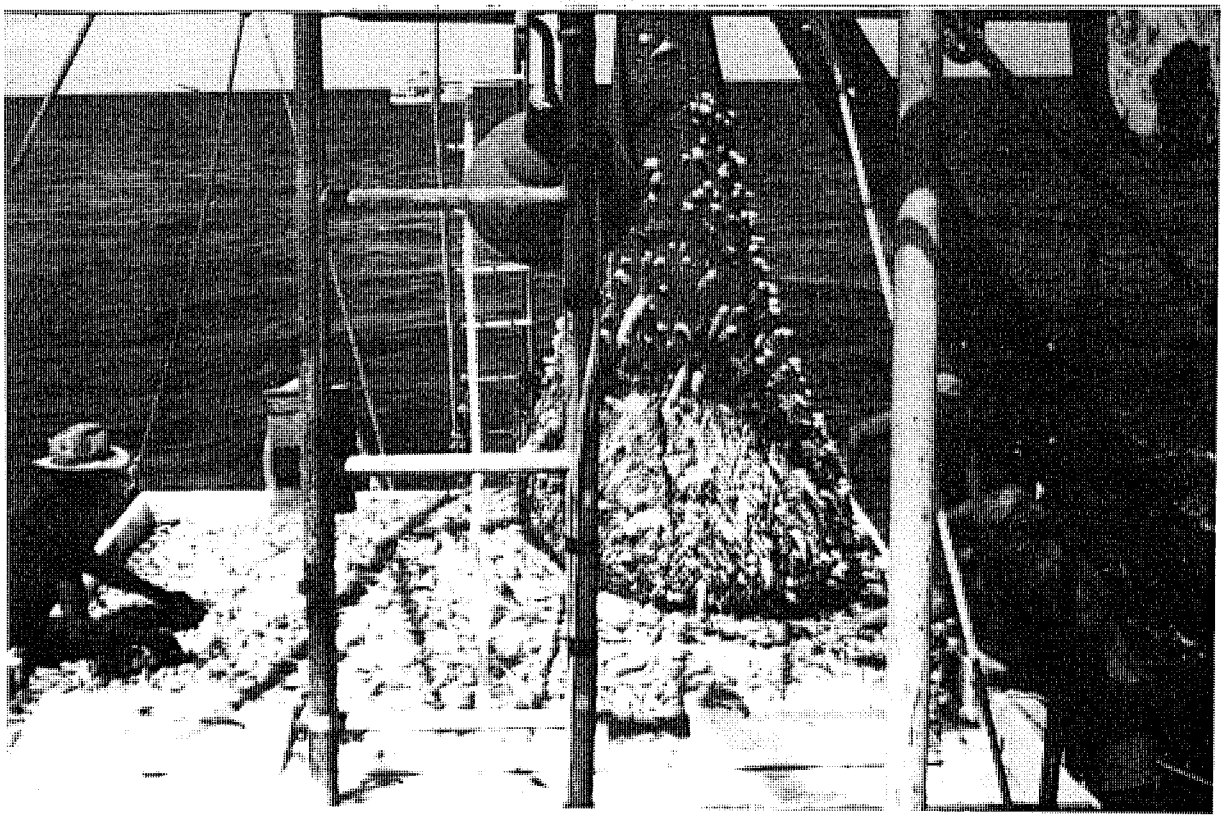
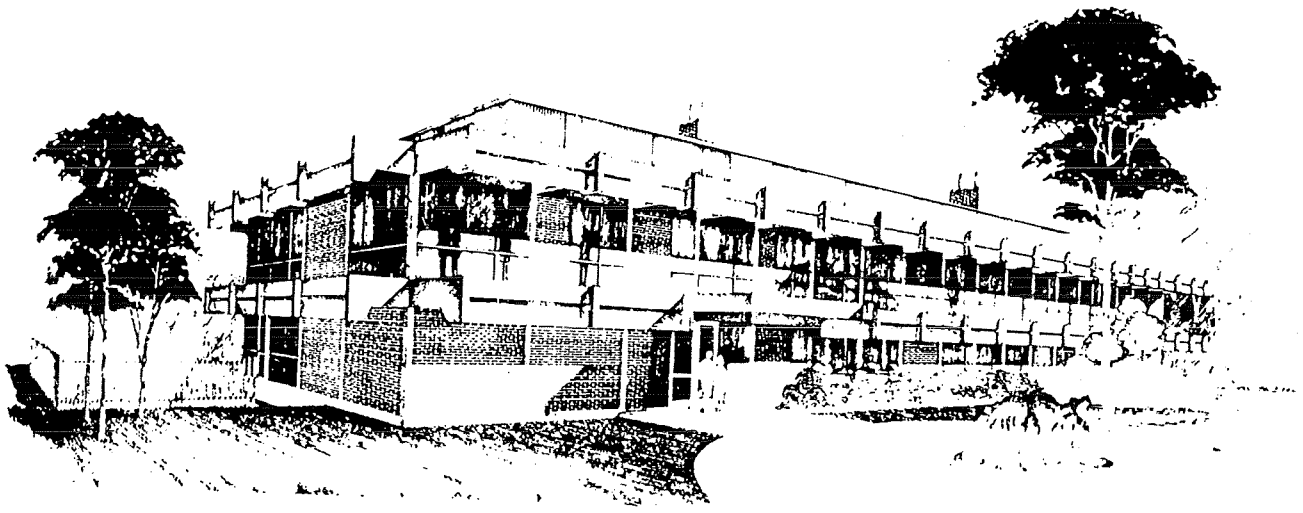
A Guide to the Australian Penaeid Prawns. (available from N.T. Fisheries Division.)





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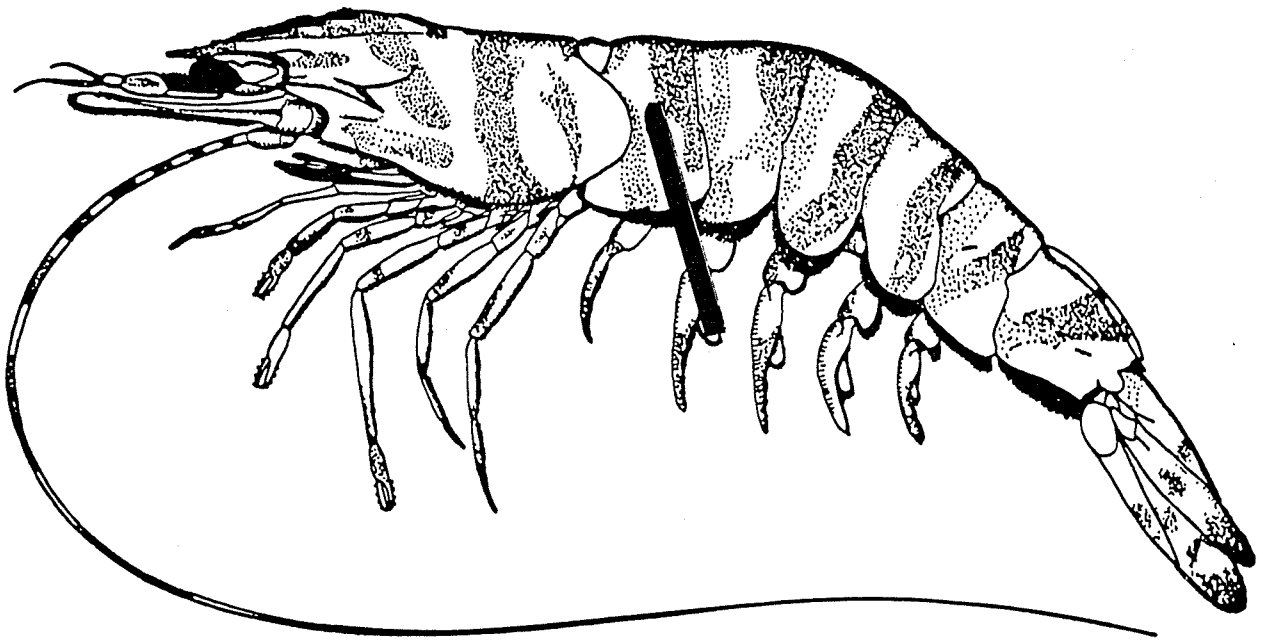
NORTHERN PRAWN FISHERY INFORMATION NOTES

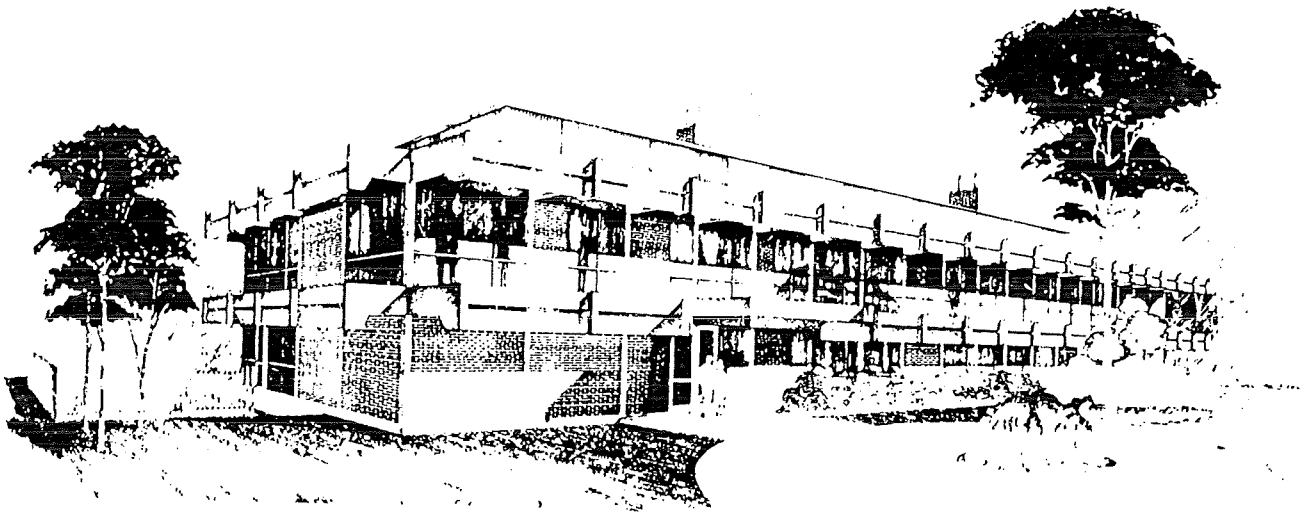
NUMBER 7 FEBRUARY 1985



Compiled by Brian Taylor

Industry Liaison Officer

CSIRO Division of Fisheries Research



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INDUSTRY LIAISON

Over recent years there have been several steps taken to improve communication between industry and government in the northern prawn fishery.

- in the financial year 1981-82 CSIRO first made funds available to create the industry liaison position (operating funds have subsequently been provided by FIRTA - Fishing Industry Research Trust Account).

- in early 1982 NFCA - Northern Fishing Companies Association - conducted the first of the preseason prawn workshops in Karumba (these have since been organised and run by CSIRO and the Northern Territory and Queensland Fisheries Authorities).

- in February 1984 NORMAC - Northern Prawn Fishery Management Committee - with its increased industry representation and management responsibilities, held its first meeting in lieu of the advisory body NORPAC - Northern Prawn Fishery Advisory Committee.

It is the first two points we are concerned with here, however, and as arranging the agenda and speakers for the preseason prawn workshops has become the responsibility of the liaison officer, perhaps we can consider written and verbal communication through these channels.

Written information has been disseminated on a regular basis through the *Northern Prawn Fishery Information Notes* and other papers have been distributed on a more or less opportunistic basis. The publication list in the *Information Notes* indicates material relevant to the northern prawn fishery which has been published over recent years and copies of many of the papers listed under *Australian Fisheries Articles* and *Other Publications* have been distributed throughout industry. Distribution is through fishing companies, fishermens organizations, log book agents, fisheries field officers (including the liaison officer) and by direct mailing. It concerns me then when I hear from time to time, that some people are not receiving this material. Your comments about this distribution network have been called for on previous occasions, but again I ask that if you are not regularly receiving written material please let me know. Your name is easily added to the direct mailing list.

It is ironic on the other hand to occasionally hear the comment 'I've heard it all before'. As both written and verbal communication covers many of the same subjects then this comment could be taken to refer to either or both. For the benefit of new readers of the *Information Notes* and by way of background for more recent work and results, it has been considered necessary to sometimes include at least a summary of earlier work. As the venue of the preseason workshop has been changed each year to spread the opportunity to attend, so again it has often been considered necessary to present at least a summary of some of the earlier work. I ask therefore that if you have, in fact, 'heard it all before', please bear with me for the benefit of others.

Both the workshops and the *Information Notes* (and many of the other written articles) are presented at least in part as a result of industry agitation for improved communication, and they are essentially for your benefit. Whilst the flow of information from government to industry has certainly improved as a result of these initiatives (in fact one way of looking at the 'I've heard it all before' comment is that the channel from government to industry is working particularly effectively) it must be remembered that communication is a two way flow. I need your advice and your suggestions about both the workshops and the *Information Notes* to help ensure that subjects are of interest and that material is presented in a useful style. Any other comments or criticisms would also be helpful so please contact me at any time. I do acknowledge, by the way, that this request has probably been heard before.

SECOND NATIONAL PRAWN SEMINAR

This week-long seminar was organized by CSIRO and held at Kooralbyn Valley in Southeast Queensland in October 1984 and attracted some 130 participants from both industry and government. The 60 papers presented (including several from invited overseas speakers) were divided broadly into three major topics - biology, aquaculture and commercial fisheries.

A review of the seminar has been given by Martin Bowerman in the November 1984 issue of *Australian Fisheries* along with a listing of the papers presented.

During 1984 a booklet of abstracts of these papers was distributed throughout industry and you are again reminded that a book of proceedings is being prepared and should be available later this year or early in 1986. Enquiries regarding this book should be directed to Dr Burke Hill at the CSIRO Marine Laboratories at Cleveland.

Second National Prawn Seminar, Kooralbyn

BANANA PRAWN SAMPLING

Background

Expressions of concern by industry about the decline in the size of banana prawns taken in the commercial catch during the late 1970's and early 1980's resulted in CSIRO conducting a study to reassess seasonal opening dates given the current levels of fishing effort. The ensuing report to N.F.C. (Northern Fisheries Committee) in August 1982, although noting the year to year and area by area variations in optimal opening dates, indicated that a later opening date would be beneficial. The 1983 season was subsequently declared open from April 1 (from March 15 in the previous few years). It was further agreed that CSIRO should plan and coordinate a study to test the feasibility of fine tuning annual opening dates with the optimum date being that corresponding to a time when the maximum catch value could be achieved.

1983 Study

The first of these joint industry/government studies was conducted in the Weipa area and in March 1983 the first sampling phase, to ascertain the size composition of prawns in the population prior to the commencement of the season, was started. Data collected during this preseason survey phase was processed and analysed and a predicted optimum opening date calculated.

The second phase of the sampling involved commercial catch measuring to ascertain the size composition of prawns caught in the first week or so of the season so enabling a check on the accuracy of the prediction. This showed that the predicted opening date would have resulted in a product value within 0.5% of the maximum possible value.

1984 Study

Encouraged by the 1983 result in the Weipa region, it was decided to extend the sampling in 1984 to include ten areas throughout the entire Declared Management Zone (DMZ). As this sampling was seen as an extension of the feasibility study, the opening date remained fixed at April 1. Data from the preseason sampling were processed for each region and in order to calculate a common optimum opening date for the entire DMZ, it was necessary to allocate weighting factors. These were determined by the relative abundance of prawns located in each area (there were for example, relatively more prawns located in the Bold Point area than in the Mitchell River area and so a greater weighting factor was placed on the Bold Point sample). All data were then pooled and a common date calculated.

Analysis of data from the commercial catch samples which were subsequently taken showed, however, that the predicted opening date was not as accurate as might have been expected. With the exception of the Weipa area, where prawns of expected size were taken, all areas produced prawns which were smaller than predicted and hence the suggested opening date would have been too early to achieve maximum value. The prawns caught at the start of the season were not at a size representative of those caught during the preseason sampling and it is probable that recruitment of juveniles from rivers and closer inshore regions continued after the survey. You are no doubt only too

aware that two cyclones passed through the Gulf after the preseason survey was completed. Net selectivity (mesh size) and perhaps insufficient sampling effort might also have contributed to this error.

It is worthy of note though, that the suggested opening date would have resulted in product value within 3% of the maximum possible and this would have been about 10% (approximately $2M or more) higher than that actually achieved with the April 1st opening. **The main conclusion from this result then was that the predicted date should be regarded as the earliest advisable date for the opening.**

Pre-season sampling 1985

At further joint industry/government meetings concerning the 1984/85 DMZ seasonal closures, it was decided that banana prawn pre-season sampling would be an integral part of the closure management despite the problems of continued recruitment experienced in 1984. It was also decided that the banana prawn stocks of the south-eastern Gulf of Carpentaria would be used as the yardstick on which the 1985 fishing season would be opened. With these decisions in mind, it has been decided that the 1985 pre-season sampling would be concentrated in the south-eastern Gulf and that sampling strategies would be adopted which would at least illuminate and possibly alleviate, the sampling error in 1984.

The objectives of the 1985 pre-season survey are to:

1. Assess the size composition of the banana prawn stocks of the south-eastern Gulf of Carpentaria and hence calculate the optimal opening date for the 1985 fishing season.
2. Assess the level of sampling intensity necessary to carry out the above in the longer term.
3. Assess changes in catchablity of banana prawns with respect to moonphase in order that the timing of future surveys can be set accordingly.
4. Assess the percentage escapement through previously used codend mesh by covering codends with smaller mesh.
5. Attempt to survey areas inshore of previously defined sampling areas in the south-eastern Gulf in an attempt to overcome the late recruitment problem experienced in 1984.

Four vessels will be carrying out an extensive survey during the period from 27th February until 14th March (first quarter to last quarter). The survey will incorporate both searching and systematic trawling in the sampling strategy. Each vessel will be provided with a standard set of try gear for the duration of the survey. The codend of each net will be covered with finer mesh to check for and, if necessary, to quantify the escapement of prawns according to size.

The results of the survey will be reported via radphone each day to CSIRO headquarters at Cleveland where the data will be analysed and an opening date calculated.

Commercial Catch Sampling 1985

Extensive on-board commercial catch sampling will take place in all areas throughout the DMZ when the season opens. Although the predicted opening date will be based on preseason sampling in the southeastern Gulf, it is absolutely essential that the commercial catch from all areas be sampled. This allows a check on the suitability of using results from the southeastern area as a yardstick and it will also add to our understanding of recruitment patterns in all areas thus allowing further modification to sampling strategies should this prove necessary. Data from the southeastern Gulf will, of course, allow verification of the result from the preseason sampling in this area.

Reporting

As was the case in 1983 and 1984, progress reports on the preseason sampling phase will be sent via telex to a list of organizations as compiled by the Northern Prawn Fishery Management Committee (NORMAC). Detailed written reports on the preseason sampling phase will also be distributed as soon as possible after this sampling is completed and a final report will be presented to NORMAC when data from the commercial catch sampling phase has also been collated and analyzed.

As the preseason sampling is to finish on March 14, it is expected that a report on this work, along with the *suggested* optimum opening date, will be given at the preseason prawn workshop in Cairns on March 19. **Please note however that the official opening date notices are to be issued by the relevant authorities as soon as possible after the suggested date is available. As agreed previously by NORMAC, the season is to open no earlier than April 1 and no later than April 15.**

BANANA PRAWN CATCHES: TRENDS AND PREDICTION

D.J. Staples
CSIRO Division of Fisheries Research, Cleveland

Many factors affect the catch of banana prawns taken from the different regions of the Gulf of Carpentaria each year. These include environmental factors such as rainfall, biological factors such as the timing of prawn migrations with respect to fishing season closures, and

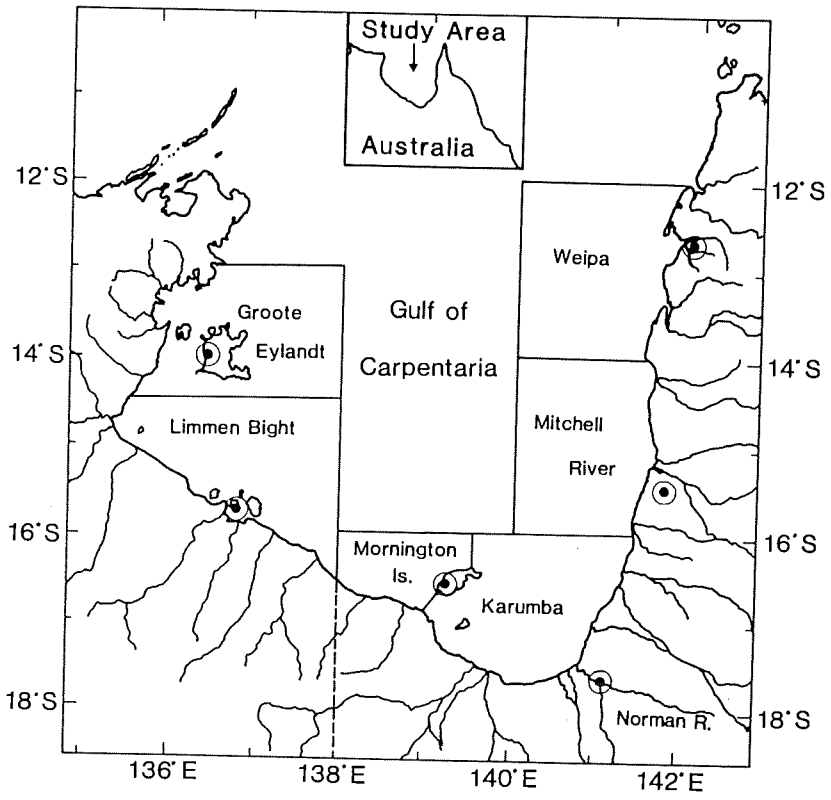


Figure 1. Regions used to calculate catch and rainfall statistics.

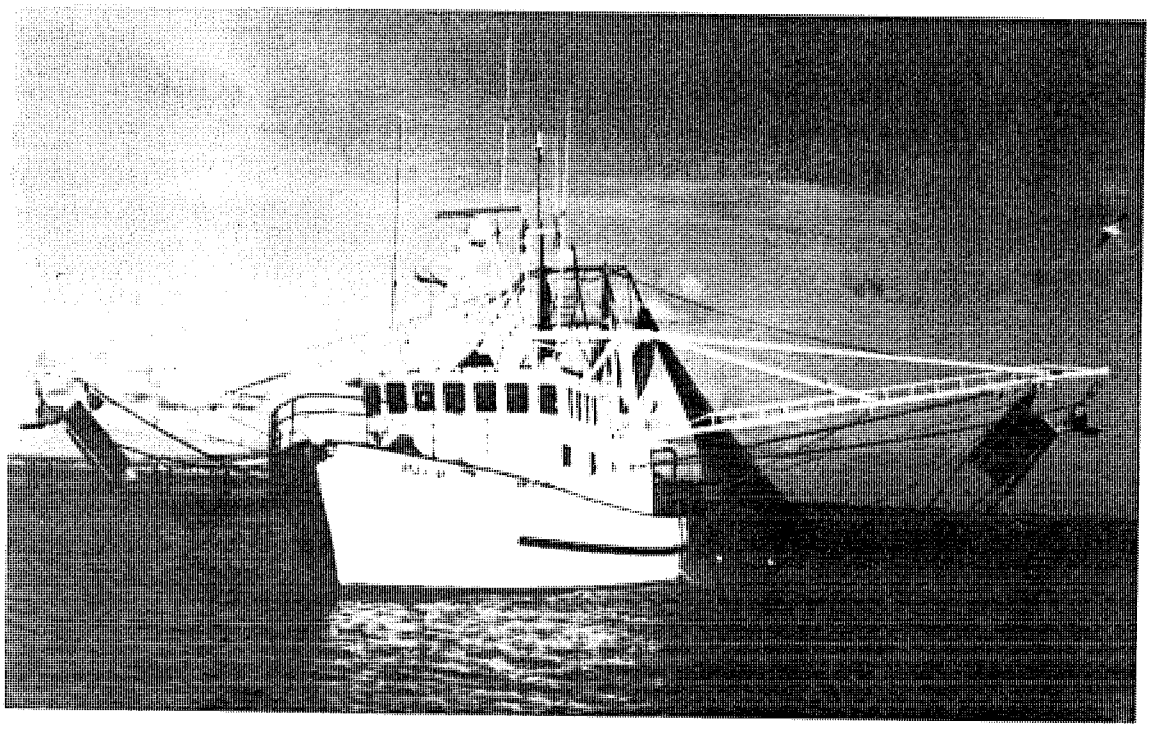
possible man-induced changes due to overfishing. In recent years, the amount of time spent searching or fishing by the fleet as a whole has had little effect on the amount of product actually taken but has dramatically altered the length of time during which economical catches can be taken. Research by CSIRO has shown that in the southern Gulf, provided the number of juveniles in the nursery areas is above a critical level, the main factor affecting the catch each year is the amount of rainfall received during the summer monsoon period. In dry years only a small proportion of the resident juvenile prawns is stimulated to migrate from the estuaries, whereas in wetter years a much larger proportion emigrates. Because a significant proportion of juveniles has usually moved from the estuaries by the end of January, predictions of catches are possible using rainfall data accumulated up to the end of January. In northern areas of the Gulf, on the other hand, because of differences in the time of spawning and migration of juvenile stages, rainfall has a much less direct effect on catches, and predictions, (apart from looking at averages) are not possible at this stage. The effects of other factors such as temperature and wind are being examined. Table 1 gives expected catch (based on rainfall in southern regions) and actual catch for the six main regions of the Gulf since 1970.

The most striking feature of these catches is of course the large year-to-year fluctuations. An extreme example is the Limmen Bight region where catches of zero in some years bounced back to reasonable catches the year after. Over the past decade the actual catches have followed the expected catches within our confidence limits, especially in the Karumba region. Over and above this year-to-year variation, however, a downward trend in catches is discernible in most regions with catches during many years of the 1980's being below the fifteen-year average. In the southern Gulf, rainfall has also been below average over this period and the low catches have been attributed to this factor. A good test of this theory will be a wet year when much better catches can be expected. Rainfall during the last wet season (1983-84) in the Karumba, Mornington Island and Limmen Bight regions were all higher than the previous year but still below average. On the basis of this increased rainfall increased catches were predicted. Table 1 shows that in these three regions increased catches did occur. In fact, the increase in the Limmen Bight region was well above that expected. Mornington Island was right on expected and Karumba was slightly lower. Using statistical techniques, it is possible to determine whether this difference could be due to chance alone or whether other factors such as decreased spawning stock are involved. In this case, the difference between expected and actual catch could be attributed to chance alone, although because the catch was below that expected in the Karumba region, this area should be monitored closely in the future. The low catches in the Weipa and Mitchell River areas are also some cause for concern. Unfortunately, we do not know enough about these regions to analyse them as rigorously as the Karumba region, and the causes of the declines are unknown. If funds are made available, CSIRO is planning more long-term research in these regions in the future.

Table 1. Expected catches (on the basis of rainfall) and actual banana prawn catches in the six regions of the Gulf of Carpentaria 1970-1983 (actual catch provided by Commonwealth Department of Primary Industry).

Year	Weipa		Mitchell River		Karumba		Mornington Island		Limmen Bight		Groote Eylandt		TOTAL GULF
	Expected	Actual	Expected	Actual	Expected	Actual	Expected	Actual	Expected	Actual	Expected	Actual	
1970	-	1020	-	984	557	556	112	57	262	5	-	38	2660
1971	-	1672	-	3034	998	1667	387	178	555	32	-	169	6752
1972	-	1921	-	1348	1337	524	384	222	177	216	-	122	4353
1973	-	615	-	1927	900	817	343	398	558	632	-	381	3870
1974	-	1313	-	835	3651	3854	922	1580	898	1375	-	768	9705
1975	-	819	-	497	855	735	329	136	364	0	-	6	2193
1976	-	746	-	615	2104	1255	870	319	256	391	-	159	3485
1977	-	641	-	864	1523	2701	594	796	176	520	-	124	5646
1978	-	1045	-	169	356	387	76	83	26	1	-	70	1755
1979	-	444	-	505	1370	1328	505	713	156	516	-	143	3649
1980	-	485	-	171	806	570	0	91	254	149	-	105	1579
1981	-	607	-	619	1346	1439	481	241	284	193	-	134	3233
1982	-	1001	-	498	519	453	0	43	432	255	-	155	2405
1983	-	405	-	104	282	333	0	30	0	66	-	56	994
1984	-	366+	-	157+	852	575+	210	226+	372	838+	-	194+	2356+
Average		873		761		1146		341		346		175	3642

+ Preliminary estimates only.



Chartered vessel F.V. *Maxim*

Sampling the catch

CSIRO TIGER PRAWN STUDIES

As reported in previous *Information Notes*, field studies in the Groote Eylandt area commenced in August 1983. This intensive field sampling is to finish before the middle of 1985 when it is expected that the late 1984 spawned generation of tiger prawns will have moved into the commercial fishery. Some monitoring work may be continued, however.

Much of the sampling has been carried out from the chartered trawler FV *Maxim* which has been skippered by Steve Ivicic since December 1983. Despite various problems which have arisen from time to time, the vessel has completed 21 regular monthly sampling cruises to date as well as several other one-off cruises. Most of these have been completed on schedule with all objectives being achieved, and the patience and help of Steve and his crew, Butch, Robert and Karen, in sorting samples and recording data as well as running the vessel, is gratefully acknowledged.

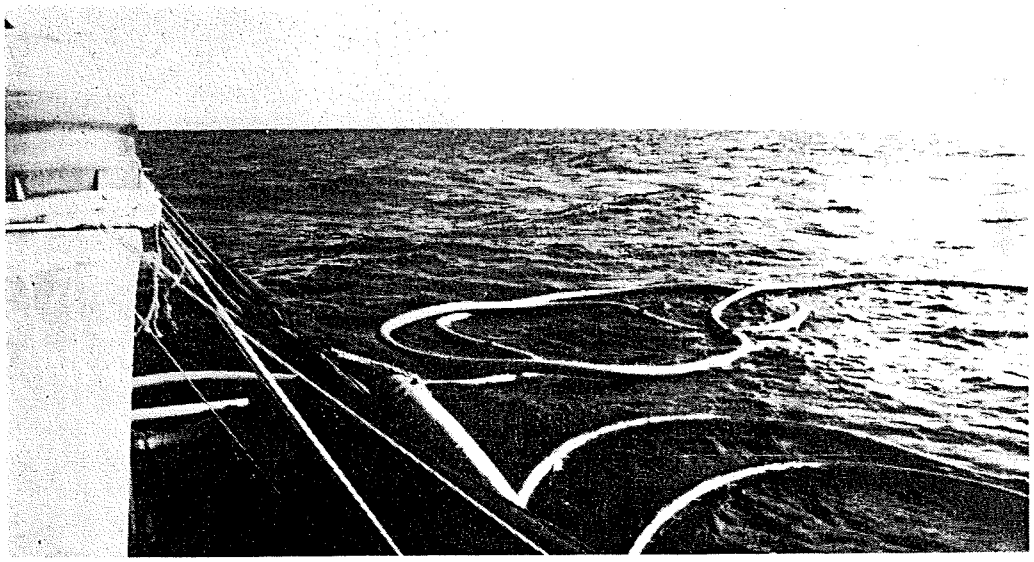
Although the two tiger species were of prime concern, data on other species has also been collected and specimens of the blue endeavour, *Metapenaeus endeavouri* have been collected for Ric Buckworth of N.T. Fisheries and parasitised prawns of all species have been passed on to Leigh Owens at James Cook University at Townsville. Water temperatures and salinities have also been recorded and substrate samples have been collected and analysed to see if the distribution of the adults of the different species changes with substrate.

The major objectives and some preliminary observations from both the **adult population studies** group (Ian Somers and Peter Crocos) and the **juvenile studies group** (Derek Staples, Dave Vance, Don Heales and Rob Kenyon) have been given previously, and with more time soon to be available for processing and analysis, some detailed results should become available from early 1986. Experimental laboratory work carried out directly by these groups is being continued, however, as are other studies (physiology, behaviour, bacterial and seagrass productivity) which seek to help explain field observations and expand upon our knowledge of the biology and ecology of these species.

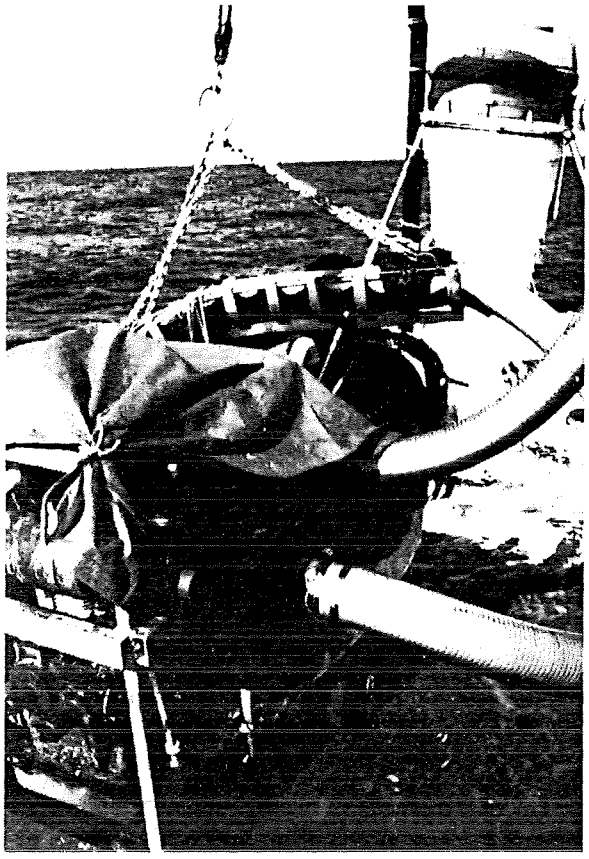
A recent one-off cruise by the FV *Maxim* for the **larval ecology group** (Peter Rothlisberg, Chris Jackson and Bob Pendrey) should prove to be of sufficient interest to describe in more detail and the following notes have been prepared by Peter Rothlisberg.

As you have heard before, there are two species of tiger prawn (the brown, *Penaeus esculentus*, and the grooved or green *P. semisulcatus*) in the area north of Groote Eylandt. While both species appear to use similar nursery grounds and spawn at the same time of the year, the spawning locations are quite different. Most of the brown female tiger prawns spawn relatively close to shore, while the grooved females move farther offshore and extend into much deeper water. A sampling cruise in November 1984 by Peter and Bob was aimed at understanding the mechanisms whereby the tiger prawn larvae get from the spawning grounds to the nearshore nursery grounds.

A plankton pump was used to sample the larvae at various depths in the water column. The unit is an 8 hp air-cooled Deutz diesel close-coupled to a 3 inch bronze Pacific centrifugal pump. It can deliver approximately 1000 litres/minute. A weighted inlet device is attached to the main trawl warp and coupled



Plankton net and hose



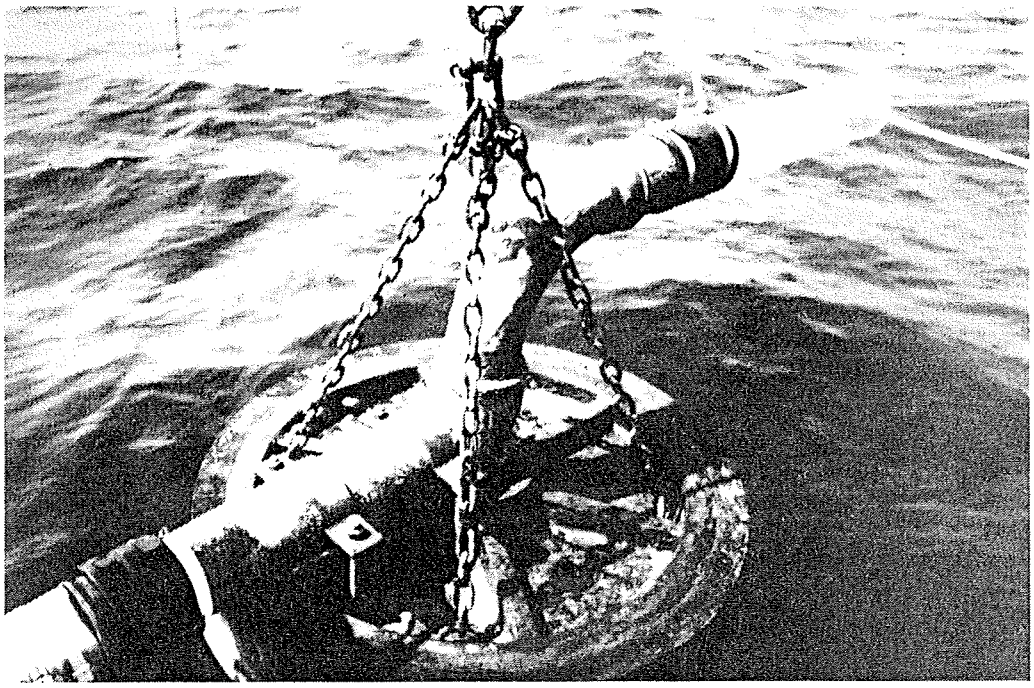
Plankton pump and net

to the pump with 60 metres of 4" suction hose. The pumped water is discharged into a spinner on deck and the water falls through a fine mesh net which retains the prawn larvae and associated microscopic animals. Four depths were sampled (surface, bottom and two intermediate depths) every two hours for four days. The first location, in 23 metres of water southwest of Burn's Shoal, is in an area where the spawning activity of the two species overlaps. We want to see if the larvae of the two species behave differently with respect to day/night activity patterns, depth preferences, extent of vertical migration and reaction to light intensity.

Another four days of pumping was undertaken at a station approximately 12 nautical miles southeast of Cape Grey in 43 metres of water. Here only the grooved tigers are found, but because of the increased depth of water, a large thermocline develops in the summer months. Here we wanted to see if the thermocline affected the distribution or movements of the grooved tiger larvae and if so, how that would affect their horizontal transport to the nearshore areas.

A third station was sampled for two days in the mouth of Northwest Bay. Here too a plankton pump was used to monitor the day/night and tidal activity of the tiger prawn postlarvae as they enter this nursery area.

The cruise was very successful in that 416 samples were collected in 10 days of sampling. The samples have been returned to the laboratory at Cleveland for microscopic examination and results of the study will be presented as the sorting of the samples and analyses are completed. For further reading on the interaction of larval behaviour and currents and how this affects larval transport, see Rothlisberg (1982) and Rothlisberg, Church and Forbes (1983).



Weighted inlet

FOG BAY BANANA PRAWN STUDY - 1985

The following notes have been provided by John Glaister of Northern Territory Fisheries.

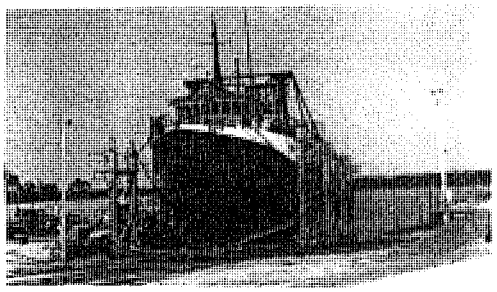
The fisheries research section of the Department of Ports and Fisheries has chartered the Bluff Fisheries vessel *Gemini*, skippered by Shane McKennay, to investigate the area south-west of Darwin. Funding for the charter has been provided by the Northern Territory Fishing Industry Research Trust Account.

A total of 17 fishing days are contained within the charter and two periods of 10 days and 7 days in February and March respectively, have been allocated based on moon phase. At the time you are reading this, the February trip will have been completed and the March trip nearly so, and hopefully 15,000 lively banana prawns with blue N.T. Fisheries streamer tags will be out swimming in and around Fog Bay.

What is the purpose of this exercise? As described in the November 1984 issue of *Australian Fisheries*, we are hoping to further our understanding of banana prawn distributions by area, size and time, and to define likely nursery areas and migratory pathways. Knowing the size at release, date recaptured and size of recaptured tagged prawns should also allow us to better understand the growth rates of banana prawns at this important stage of their life history

The cruise plan for February is to steam to Fog Bay and conduct a sounder survey over the first day in the Bay proper. This is to be followed by a survey over the total available area together with tag and release of banana prawns. The tagging will be over as wide an area as possible, in the greatest depth range, and with the largest size range of prawns. Length frequency data and other biological information will be recorded for samples as in previous studies.

Naturally tagging experiments on banana prawns are more difficult than for those conducted on species such as tigers and endeavours that are more widely distributed than the schooling banana. Thus the chances of deckies (and all those skippers who like to sort) picking out tagged prawns from full sorting tables are perhaps not as good as with tiger fishing. So the important message to you in the industry from us in research is to keep your eyes open for tagged banana prawns, record the recapture details as soon as possible, and look for us on the wharf. It really is pointless spending resources getting tags in the water if we don't get the small percentage recaptured back. Normal tag rewards will apply, and in addition, the skipper and crew of the top tag return vessel will be awarded a "suitable" tee-shirt each.



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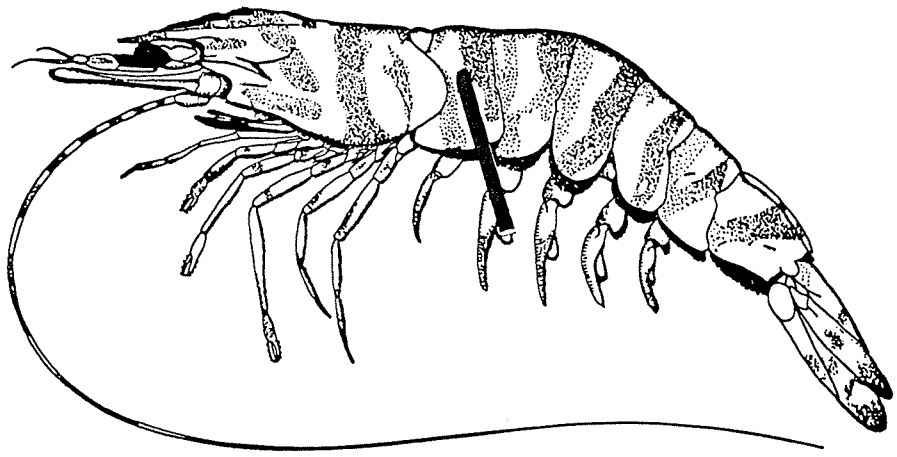
NORTHERN PRAWN FISHERY INFORMATION NOTES

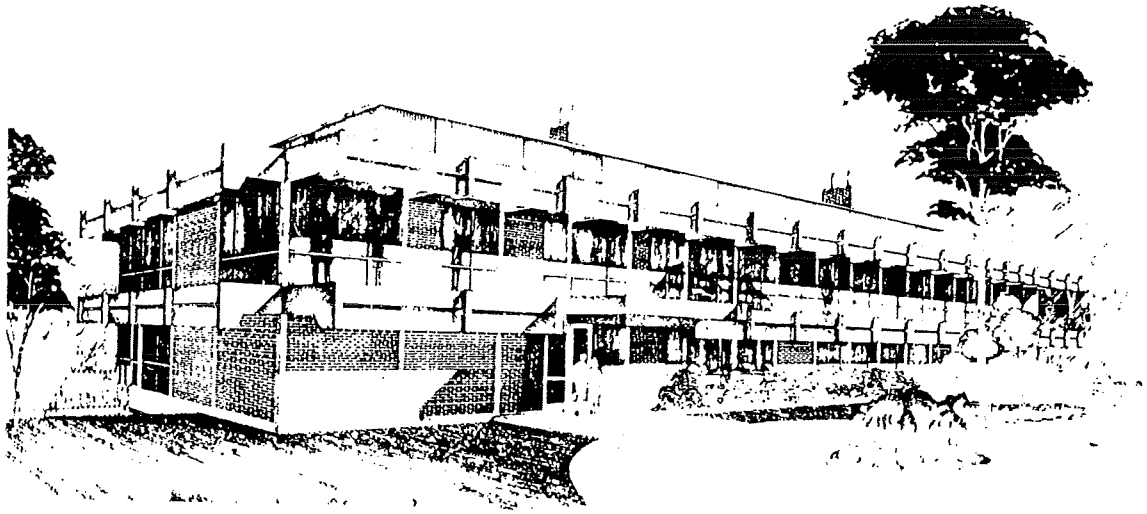
NUMBER 8 OCTOBER 1985



Compiled by Brian Taylor

Industry Liaison Officer

CSIRO Division of Fisheries Research



CSIRO MARINE LABORATORIES

233 Middle Street

Cleveland, Qld 4163

Telephone (07) 286 2022

CSIRO CLEVELAND LABORATORY INVOLVEMENT IN THE NORTHERN PRAWN FISHERY

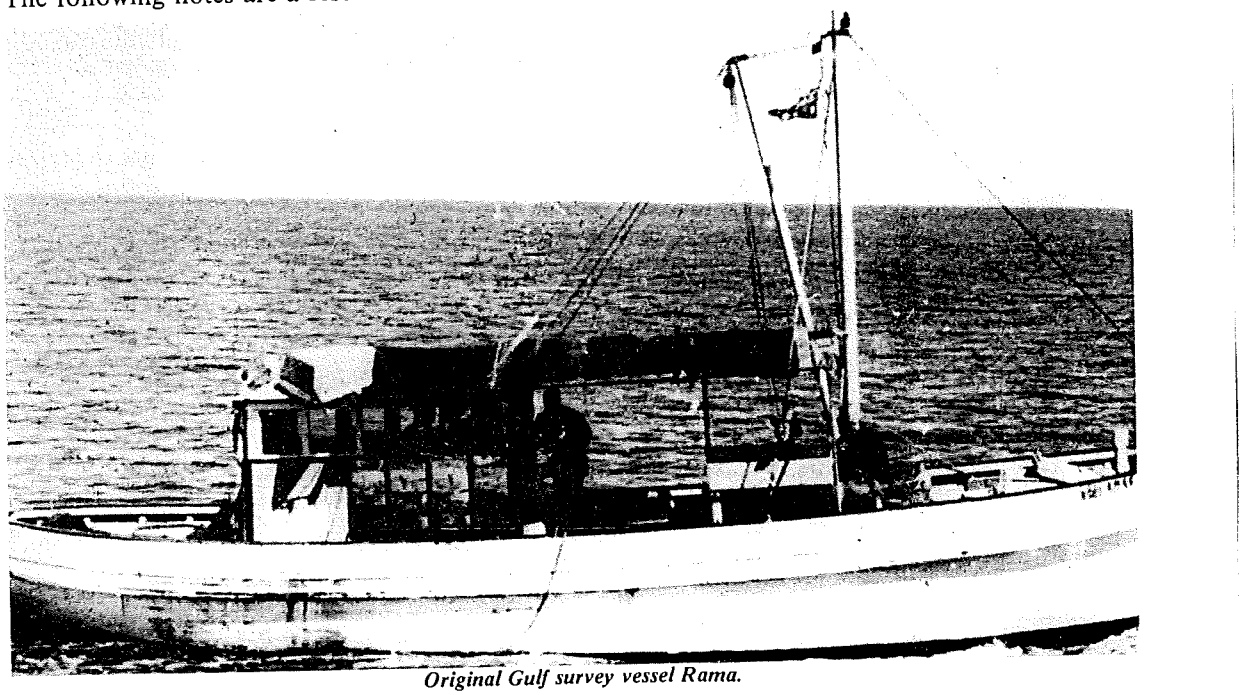
CSIRO have been involved with research in the northern prawn fishery for many years now and in fact commercial trawling in the Gulf of Carpenteria first started toward the end of a joint government and industry survey which was led by Ian Munro of CSIRO and which showed, among other things, the commercial prawning potential of this area. Field work for this **original Gulf survey** was carried out during 1963 and 1964 and was concluded during 1965. Another major field survey commenced toward the end of 1969, this time as part of the FIRTA funded **Northern Prawn Project** under the leadership of Stan Hynd. This latter project finished during 1974. Both projects were organised from headquarters in Sydney and field stations were established in Karumba and other northern ports.

In 1975, with Dr. Bill Dall as leader, the **Tropical Prawn Project** was established. Field work for this project commenced in September 1975 and although the Cleveland (near Brisbane) regional laboratories were not occupied until August 1976, this project was directed from temporary accommodation in Cleveland.

The following notes are a rēsumē of CSIRO involvement in the Gulf of Carpentaria fishery over this past decade or so since the establishment of the Cleveland laboratories. No attempt has been made to present detailed results nor to reference particular publications arising from particular projects. Detailed results have been given in previous *Information Notes* and in other articles and reports which have been distributed throughout industry. Much of the more recent work has also been discussed at the preseason prawn workshops. You are referred to the publication list at the end of these notes however.

Before reading on it is appropriate to note two points:

1. The CSIRO programs in the Gulf of Carpentaria are generally not carried out in isolation as these projects, and those of Northern Territory and Queensland Fisheries, are often planned to complement each other.
2. The importance of your contribution as commercial operators, in the ongoing collection of data (log books and processors returns) and in one-off experiments such as tagging should not be overlooked. This data is essential, not only to compile a statistical base for management and political consideration, but it also forms an integral part of many research activities. The most obvious, from our point of view, is that concerning studies of the population dynamics of the exploited resource where such a contribution is absolutely vital.



Original Gulf survey vessel Rama.

River sampling was not always like this!

Tropical Prawn Project

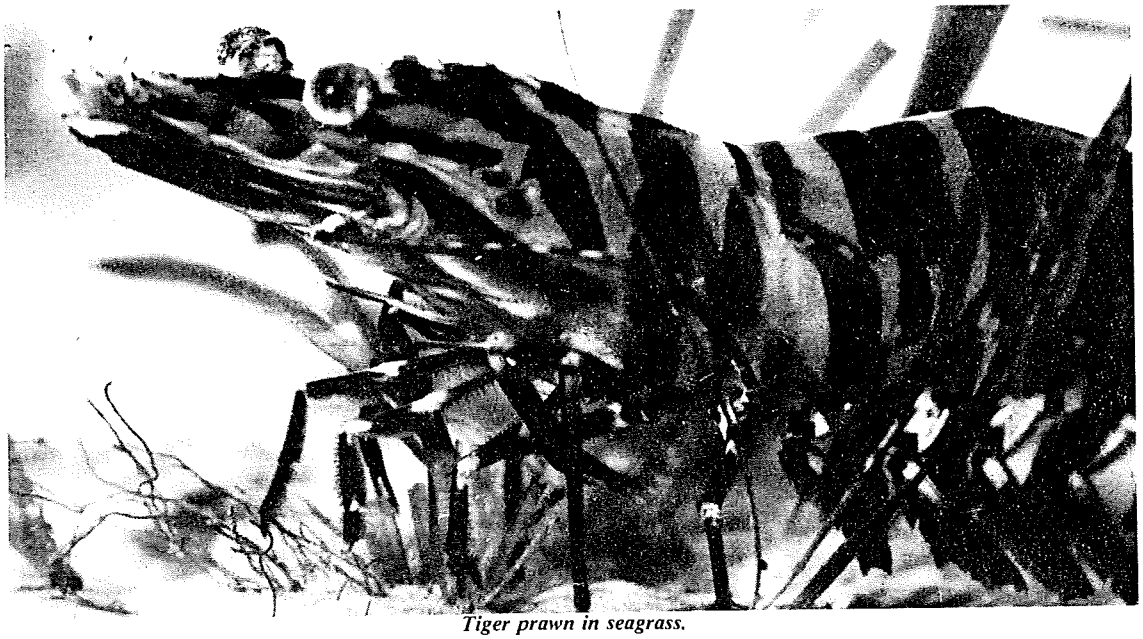
During the period 1975-78 all work was covered by appropriation funding (direct government allocations) and although information concerning all species was gathered, work was aimed essentially at the banana prawn. It was apparent from the results of the Northern Prawn Project that more biological and ecological data were essential if the year to year and area by area fluctuations in abundance were to be understood and explained.

Two main avenues of approach were followed in the Tropical Prawn Project. Field studies covered the three main stages in the life history of the prawn (larval, juvenile and adult stage) including the collection of data on the commercially exploited resource. Experimental laboratory studies covered food and nutrition, physiology and behaviour. Laboratory work was also carried out by the groups working in the field with perhaps the most notable being that of the larval ecology group who were required to culture numerous species of prawns in the laboratory in order to identify the larvae of species taken during field sampling. Our most notable presence in the field was undoubtedly the juvenile ecology group who used floatplanes to sample remote and inaccessible rivers.

Some fishermen might also remember the *Kalinda, Judy B, Sprighty* and other vessels which were used from time to time to sample offshore stations.

It was noted during these early studies that the influx of banana prawn postlarvae into the rivers did not relate to the time of major populations of spawning females offshore. In 1978 a FIRTA funded project to examine this question by studying tides and currents in the Gulf commenced. Models of tides and currents were developed, modified and finally verified by observations from current meters, bottom drifters and satellite tracked buoys which were deployed in the Gulf during 1978, 1979 and 1980. Biological data on larval behaviour was introduced into these models to compute the possible horizontal transport of larvae from spawning grounds to nursery area. It was found that this did explain the apparent discrepency between spawning adults offshore and observed recruitment of postlarvae into the rivers.

During 1978 and 1979 the appropriation funded parts of the Tropical Prawn Project also continued and all field work was completed by September 1979 when the larval ecology group left Karumba.



Tiger prawn in seagrass.

Tiger Prawn Studies

With the increasing importance of the general trawl or tiger prawn component of the commercial fishery, emphasis shifted to a study of these species and in 1980 a study of the population dynamics of the exploited resource north of Groote Eylandt commenced. Unfortunately, fishermen's log books do not distinguish between the two major tiger prawn species (nor the two endeavour prawn species) but recoveries of tagged tiger prawns released in this project showed that the species tend to separate offshore and hence the log data has now become more effective as we are able to estimate, for some areas, which of the individual species we may be dealing with. (This has been supported by more recent work where regular samples taken by the chartered trawler *FV Maxim* have shown the geographic distribution of the individual species with time). The tagging work also provided data on growth which showed that each species grows at a different rate, so emphasizing the need for management to consider each species separately.

During 1981 and 1982 a preliminary study of the nursery ground requirements of various species was carried out in the Weipa area and this work clearly established that seagrass beds are an essential habitat of both tiger prawn species.

Data provided by these latter two projects (along with some from previous studies) was used as a planning base for a major tiger prawn survey which started in January 1983. This project can also be best described in the field work/laboratory studies format. Field work for this project was concentrated mainly in the area north of Groote Eylandt and included regular sampling of the adult population, tagging, nursery ground definition and juvenile sampling, and the collection of larval samples. Ecological observations were made throughout the field sampling which was completed earlier in 1985. Laboratory studies again included food and nutrition, physiology and behaviour but this time of course dealt with the two species of tiger prawns. The chartered trawler *FV Maxim* and the recovery of tagged prawns probably provided the most visible signs of our presence during this program. Much of the data collected is still being analysed and detailed results will be published as they become available.

Funding

Each of the three recent CSIRO projects on tiger prawns, as well as the tide work in the Gulf, have received considerable funding from FIRTA particularly as regards field work. Details of this funding are given in Table 1. Appropriation funding has, of course, also continued to support the projects particularly as regards laboratory work and general running, maintenance and administrative costs.

It is appropriate to add that the operating expenses for the industry liaison position have also been provided by FIRTA since 1982-83 and it was recently announced that further funds for 1985-86 have been made available. As is the case with the other projects, appropriation funds also contribute to the maintenance of this position.

TABLE 1: Recent FIRTA grants to CSIRO for projects in the northern prawn fishery.

Years of Grant	Title	Grant ($)
1978/79	Tide and current analysis of the Gulf of Carpentaria	33 500
1979/80	" " "	28 500
1980/82	Circulation in the Gulf of Carpentaria and its relation to banana prawn larval dispersion	26 000
1980/82	Population dynamics of exploited tiger prawn stocks off Groote Eylandt, Gulf of Carpentaria	27 200
1981/82	Preliminary study and feasibility survey of tiger prawns in the Gulf of Carpentaria	112 975
1983/85	Investigations of the biology of tiger prawns in the western Gulf of Carpentaria	1 209 089

Summary

All these projects have of course provided an enormous data base and have vastly increased our knowledge and understanding of the biology and ecology of these species. In particular, however, they have enabled us to provide management and industry with:

For banana prawns

- recruitment data and a yield per recruit model so enabling advice regarding catch maximization by effective closure dates.
- a stock assessment and exploitation rate.
- a prediction model for the southeastern Gulf.
- evidence that the critical spawning stock is not subject to high fishing pressure in the southeastern Gulf.

For tiger prawns

- advice on seasonal closure times and areas.
- maps of nursery grounds (permanent closures).
- a means of identifying individual tiger prawn species from catch records.

Nevertheless, new questions keep arising with changing circumstances and some older ones are yet to be answered satisfactorily.

Present Situation

Up until recent times it was generally believed that there was no relationship between the abundance of prawns in one year and the subsequent abundance in the next year. It was thought that the high fecundity (egg production) of females together with varying environmental factors would over-ride any effects due to varying numbers of spawners. In the light of experience in the fisheries of the Persian Gulf (grooved or green tiger), the western parts of the South Australian fishery (western king prawns) and in Exmouth Gulf where, as you probably know, the brown tiger prawn component of the fishery almost totally collapsed, this assumption is now being questioned. Indications are that perhaps major pertubations of the environment (e.g. drought and cyclones) have a more significant effect on heavily fished populations (such is the case in the Gulf) than on lightly or unexploited populations.

With data now available allowing us to estimate the catches of the individual tiger prawn species in the Groote Eylandt area, it has been shown that the catch of the brown tiger prawn has been steadily declining since 1980. The catch of the grooved or green tiger prawn shows no similar trend, but field sampling has indicated that recruitment of sub-adults into the fishery during 1984 and 1985 was considerably less than 1983.

With this situation in mind, CSIRO submitted to FIRTA a proposal seeking funds to identify the main factors controlling recruitment (and hence abundance of adults) of both tiger and banana prawns. After considerable debate a modified proposal was approved by FIRC (Fishing Industry Research Committee). As before, appropriation funding will continue to give considerable support to this project.

Three main objectives have been set for this new work:

1. Identify the factors which significantly affect growth and mortality in each of the major stages in the life history of prawns.

2. Establish a long term sampling program of juvenile and adolescent prawns to determine the extent to which the above factors and stages may limit the fishable stock of prawns.

3. Develop quantitative models of recruitment in the three major commercially important species of prawns (banana, grooved or green and brown tiger) and describe the form of stock-recruitment relationship in each species.

Progress reports will of course be published from time to time to keep you informed about this program.

DEEPWATER EXPLORATORY TRAWLING

For about 3 months from November this year, the 53m CSIRO charter vessel *Soela* will be conducting exploratory crustacea fishing trials in deep water off the northeastern coast of Australia. The vessel will work from Townsville and will trawl outside the Barrier Reef in depths from 250-600 metres. A 33 fathom Engel deepwater lobster net will be towed and this will allow a direct comparison with results from the continental slope off northwestern Australia where scampi and other crustacea were located.

SEAGRASS AND CYCLONES

Rob Kenyon
CSIRO Division of Fisheries Research
Cleveland

In April 1984, CSIRO conducted a survey of seagrass communities between the Sir Edward Pellew Group and Cape Barrow (southern end of Blue Mud Bay) in the western Gulf of Carpentaria. Previous work had demonstrated that juvenile tiger and endeavour prawns use seagrass beds as a nursery habitat (refer *Information Notes*, February 1983 and February 1984) and the more recent survey was undertaken to define any such potential nursery habitat in the western Gulf. Using the *FV Maxim* as a mother ship, we examined coastal shallows to determine the distribution and species composition of seagrass beds in this region. Seagrasses were found along much of the coast with particularly extensive beds existing from the Sir Edward Pellew Group to the Limmen Bight River and from Edward Island to Rantyirrity Point. Results of this survey have been used as a base for inshore commercial closures to protect both juveniles and sub-adults as they leave the nursery areas.

Approximately one year after this survey, cyclone *Sandy* swept through the western Gulf (Figure 1) nearing the coast at the Sir Edward Pellew Group and travelling parallel to and crossing the coast north of the Roper River.

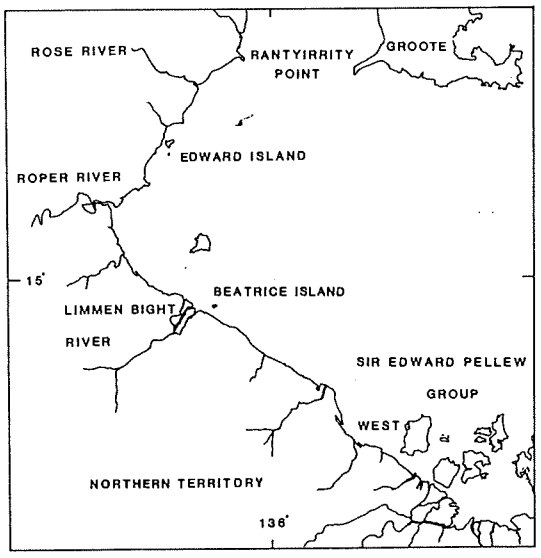


FIGURE 1 — Map of the western Gulf of Carpentaria.

During its passage, *Sandy's* 220 kph winds produced huge seas with the potential to cause severe destruction to seagrass beds. Nothing was known of the disturbance that such a natural phenomenon might cause to seagrass communities in the Gulf and it was speculated that any possible reduction in potential nursery area may cause a reduction in juvenile and subsequent adult prawn numbers. Furthermore, any model developed to help evaluate indices of abundance (thus helping to explain variations in adult tiger and endeavour prawn catches) might fail completely if it did not account for possible cyclonic disturbance to seagrass habitats.

Thus a post cyclone survey was undertaken in 1985 using the chartered vessel *FV Halcyon*, a Groote Eylandt based mackeral boat skipped by Mr. Tom Collis. With Tom's assistance, CSIRO staff examined two sections of the seagrass beds which had been previously surveyed. The first was between West Island (Sir Edward Pellew Group) and the Limmen Bight River, the second between Edward Island and Rantyirrity Point, adjacent to the Rose River. Using a chart showing the precise locations of sites quantified in the 1984 survey, replicate stations were carried out recording data such as:

- seagrass species present.
- water depth.
- distance from shore.
- sediment type.

Seagrass samples were also taken to be analysed for leaf area and shoot density.

The results from this work suggest that cyclonic winds have the potential to significantly alter the distribution of seagrass communities. Between West Island and the Limmen Bight River, on sections of coast exposed to the open sea, shallow water inshore seagrass beds examined during the previous year could not be located. Presumably their absence could be attributed to the cyclonic seas uprooting and washing away these inshore species. On adjacent beaches we found dead seagrass deposited in mounds up to one metre deep. Seagrasses in deeper water further offshore were still present but severe disturbance was evident. Wave action had created washouts up to 20cm deep and within these washouts uprooted plants and exposed roots and rhizomes were evident. In some cases only 30% of the seagrass cover remained with the above ground portions worn but regrowing. In many places in this deeper

Exposed seagrass bed.

water a thick layer of extremely fine oozy mud covered the beds and adjacent bare areas possibly rendering them uninhabitable to prawns. Behind protective islands such as West and Beatrice, however, the beds survived without any apparent damage.

The seagrass community adjacent to the Rose River did not evidence any significant disturbance. Shallow inshore seagrass beds remained and no damage to offshore beds could be detected. The centre of *Sandy* passed 60 kilometres south of the Rose River and despite destructive winds in the area, the healthy seagrass community suggests wind velocity did not reach a point where damage to these beds occurred. It would seem, therefore, that the destructive swathe of a cyclone in respect to seagrass is a relatively narrow region near the cyclone's centre.

So what suggestions can be put forward with regard to the effect on the commercial trawl fishery of disturbance caused to seagrass beds during cyclones? **The good news** — The destructive swathe of a cyclone is narrow and lies near the centre. Consequently, for a cyclone to destroy large areas of seagrass it would have to travel parallel to the coast for some distance. If a cyclone neared the coast and crossed it immediately, disturbance should be restricted to a small area either side of the point where the centre passed over. **The bad news** — *Sandy* did travel parallel to the coast and in this case the area of seagrass nursery habitat was reduced significantly. As mentioned before, it would seem intuitive that such a reduction would cause a corresponding reduction in juvenile numbers and thus affect subsequent adult catches in the commercial fishery. Whether this is the case is at present unknown.

Related CSIRO research suggests that the potential reduction in prawn numbers due to cyclonic disturbance of seagrass beds may be even more serious. Results obtained during the recent Groote Eylandt Tiger Prawn Project demonstrated that the settlement of postlarval tiger and endeavour prawns occurs in the shallowest sub-tidal seagrass zones. That is, in seagrass less than one metre deep at low tide. Deeper seagrass further offshore contains far fewer juveniles and attracts no postlarval settlement. A combination of these results then suggests that the most important nursery habitat for tiger and endeavour prawns is also the area most damaged by the destructive seas associated with cyclonic winds.

If tiger and endeavour prawn catches between Groote Eylandt and the Sir Edward Pellew Group decrease during the next few years, the proposed link between seagrass disturbance and reduced commercial catch may be validated although of course many other factors could also cause such a drop.

1986 PRESEASON WORKSHOP

The 1986 workshop is to be held in Cairns on a date yet to be finalised but sometime during both the DMZ and Queensland northeastern coast total closures. Notices will be circulated as soon as the date is settled.

MOVEMENTS OF TAGGED TIGER PRAWNS IN THE GROOTE EYLANDT REGION

Ian Somers
CSIRO Division of Fisheries Research
Cleveland

An extensive tagging program carried out in 1981 by CSIRO, with the assistance of Northern Territory and Queensland Fisheries, revealed much about the tiger prawn migration patterns in the Groote Eylandt region. In that study, approximately 13000 brown tiger prawns and 7000 grooved or green tiger prawns were tagged and released. The patterns of movement observed during the study have been documented by Somers and Kirkwood (1984) — see the publication list at the end of these *Information Notes*. In that paper the authors described the general offshore movement of the tiger prawns, noting that differences in the patterns for each species resulted in effective separation of the two species in the offshore fishery.

Building on the knowledge gained in that tagging program, an intensive study of the tiger prawn populations north of Groote Eylandt (Figure 2) was carried out from August 1983 until March 1985 using the chartered commercial prawn trawler *FV Maxim*. Although this more recent

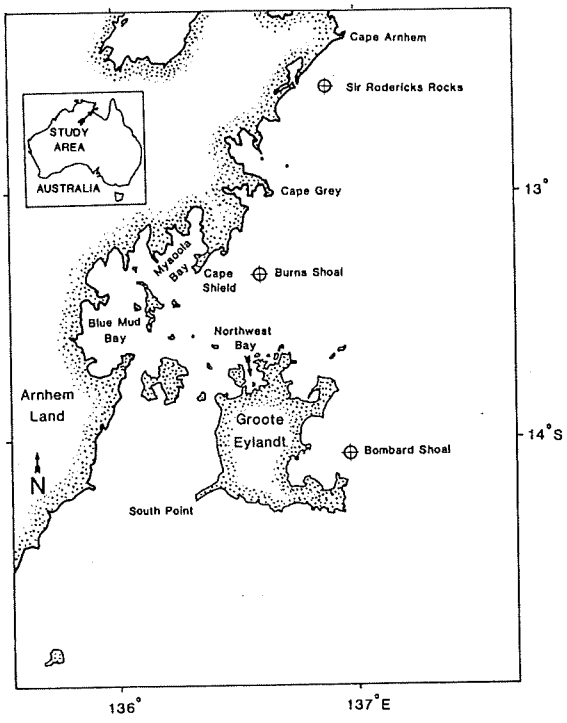


FIGURE 2 — Map of the Groote Eylandt region of the western Gulf of Carpentaria.

research program primarily involved the monitoring of a generation of tiger prawns over its life span, it also included the release of a further 14000 tagged tiger prawns.

Unlike the earlier program however, most of the prawns were tagged and released within waters closed to fishing (Blue Mud Bay and Northwest Bay) and the results may be of direct interest to fishermen in that they give some indication of which fishing grounds are most influenced by these inshore closures.

An exception to the inshore releases was a series in August 1984 when releases were made in the area southeast of Cape Grey.

Blue Mud Bay Releases

The distribution of recaptures from releases in the Blue Mud Bay/Myaoola Bay region (Figure 3) was similar to those of the 1981 tagging experiments with the two species separating offshore through generally different directions of movement. The movement of grooved or green tiger prawns was generally northeast toward Cape Grey, one prawn being recaptured near Sir Rodericks Rocks (120 km from the point of release). In contrast to this, the distribution of brown tiger prawn recaptures was south and east of the release area with the majority being recaptured between Nicol Island and Groote Eylandt.

Northwest Bay Releases

During the 1981 tagging program, Northwest Bay was open to fishing. The results from tag releases in Northwest Bay during that study showed that very few prawns were reaching the offshore fishery. All but 2 of the 207 recaptures were taken in Northwest Bay. What happens to the prawns of Northwest Bay now that it is closed to fishing? The distribution of recaptures of prawns released in Northwest Bay and the adjacent Bartalumba Bay (Figure 4) from the most recent study gives an indication of their relative contribution to the various offshore fishing grounds. It is interesting to note that although most of the brown tiger prawn recaptures were immediately adjacent to the northern part of Groote Eylandt, several recaptures were taken on the fishing grounds around South Point. Grooved or green tiger prawn recaptures however, were generally taken further northward towards Burns Shoal and Cape Grey as well as several recaptures east of Groote Eylandt near Bombard Shoal.

Cape Grey Releases

Virtually all prawns tagged in the releases near Cape Grey were grooved or green tiger prawns. As there are no significant nursery grounds for tiger prawns between Cape Shield and Cape Arnhem, it is reasonable to assume that the

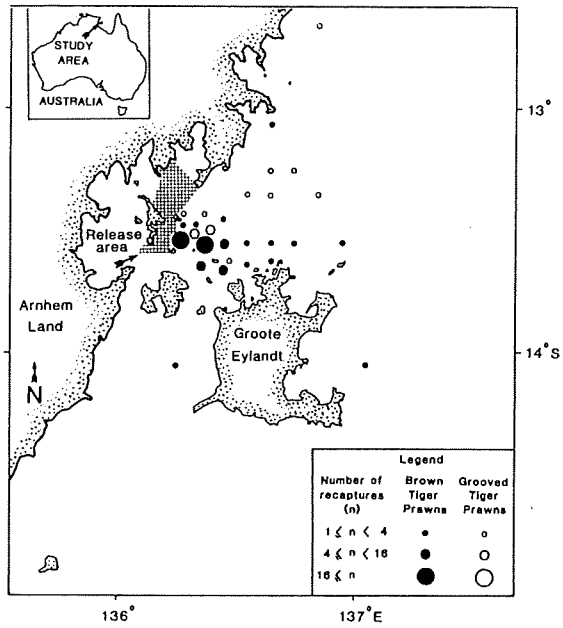


FIGURE 3 — Distribution of recaptures of brown and grooved tiger prawns from releases in Blue Mud Bay and Myaoola Bay.

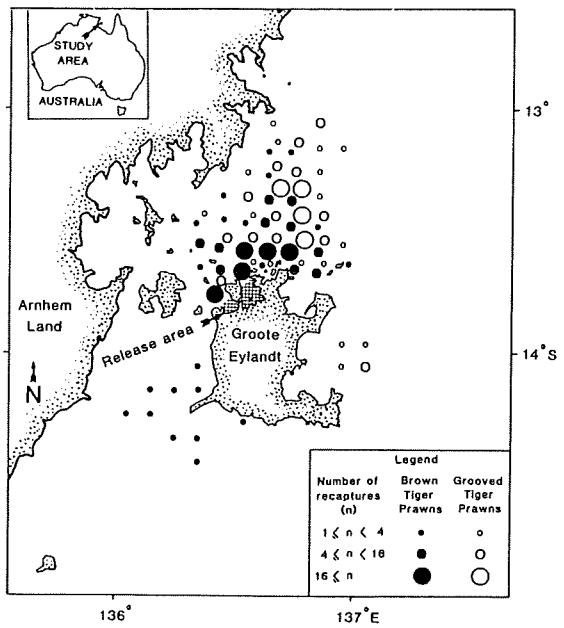


FIGURE 4 — Distribution of recaptures of brown and grooved tiger prawns from releases in Northwest Bay and Bartalumba Bay.

prawns had previously migrated north from nursery grounds in either Blue Mud Bay or from along the north coast of Groote Eylandt. However, from the distribution of recaptures (Figure 5), it would appear that the prawns do not necessarily continue with this northern movement. Rather they would seem equally likely to move north or south. Three recaptures were recorded near Bombard Shoal while four were recorded near Three Hummocks. Another significant feature of these releases was the percentage recaptured (40%), the highest we have recorded for tiger prawns. The releases did however coincide with the peak in fishing intensity (August) in this region.

Acknowledgements

The success of the tagging program has required the full support and co-operation of all sectors of the fishing industry as well as various research organisations. The tagging of prawns was completed with a great deal of assistance from the skipper (Steve Ivicic) and crew of the *FV Maxim* while the collection and processing of recaptures has been meticulously carried out by officers of Northern Territory Fisheries. The program was funded from the Fishing Industry Research Trust Account.

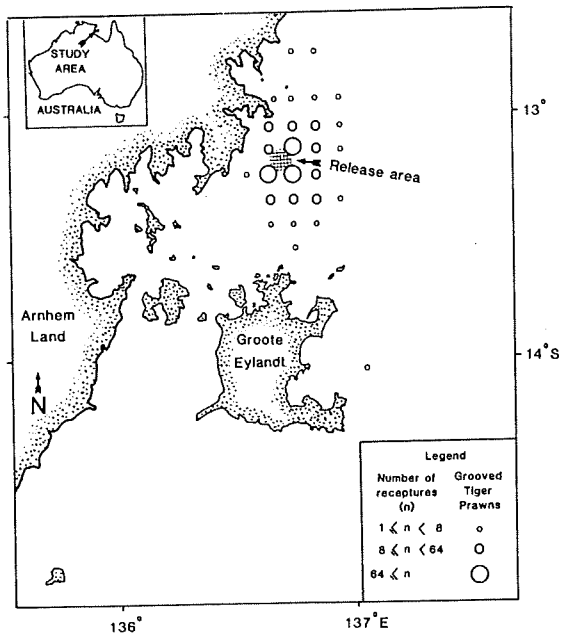


FIGURE 5 — Distribution of recaptures of grooved tiger prawns from releases in the area southeast of Cape Grey.

BANANA PRAWN SAMPLING 1985

Ian Somers
CSIRO Division of Fisheries Research
Cleveland

A report containing the results of the 1985 banana prawn preseason survey was distributed throughout the industry immediately prior to the fishing season. It is now history that the season opened on 6th April except for an area around the Sir Edward Pellew Group which was opened on 1st June as a result of action following cyclone *Sandy* which swept through this area on about the 23rd March.

A second phase in the sampling program was the monitoring of the size composition of banana prawns in the commercial catch at the commencement of fishing operations. The results from this phase have provided a means of assessing the accuracy and usefulness of the preseason survey results. The questions being addressed were:

- How accurate was the preseason estimate of best opening date for the southeastern Gulf?
- How good was the southeastern Gulf as a measure in relation to the best opening date for the whole fishery?
- Were there any trends in catchability which might permit more efficient selection of sampling times?

Accuracy of the southeastern Gulf assessment

The comparison between results from the two phases of the sampling program (Table 2) showed satisfactory agreement with respect to the estimates of banana prawn size composition and the corresponding opening dates. The forecast opening date (14/4/85) would have resulted in revenue within 1% of the estimated best date (24/4/85). The corresponding result from the actual opening date (6/4/85) was within 3% of the maximum possible.

The southeastern Gulf as a measure for the whole fishery

In order to assess the validity of using the southeastern Gulf region as a measure of the whole fishery, the size composition from all regions within the Declared Management Zone (DMZ) was monitored (Table 3). The recorded logbook catch was used to weight the results for each region so that an estimate of the size

composition for the whole DMZ could be obtained. The size composition was then analysed to calculate the best opening date for the whole fishery (4/5/85). With the Limmen Bight region excluded from this analysis, (cyclone *Sandy* passed through this area after the preseason sampling had been done) the resulting estimate of best opening date (24/4/85) was identical to that for the southeastern Gulf.

The situation with the Limmen Bight closure this year highlights the regional differences which can occur with respect to the size composition of the banana prawn recruitment and corresponding best opening dates for individual stocks. Had the Limmen Bight region been opened with the rest of the fishery, the resulting catch would have been worth some 35% less than that which was taken from the 1st June. With the added cost of processing, this figure can only be conservative. This leads us to ask two questions: Should the fishery be managed on an area by area basis? and; what is the future of preseason sampling?

TABLE 2: Comparison of size composition estimates of the 1985 banana prawn stocks of the southeastern Gulf of Carpentaria based on the preseason and within season surveys. The results from each survey have been projected to the opening day of the season (6/4/85.)

Commercial Grade (whole prawns -count/pound)	Estimated Size Composition (6/4/85 - percent by weight)	
	Preseason forecast	Within season estimate
U/8	0	0
9/12	14	12
13/15	31	23
16/20	45	42
21/25	9	19
26/30	1	3
31/35	0	1
36/40	0	0
41+	0	0
Average Count	16.3	17.5
Best Opening	14/4/85	24/4/85

TABLE 3: Results from the 1985 regional monitoring of banana prawn size composition from commercial catch samples.

Region	Fishing Locality	Number of samples	Average size (count/pound) 6 April	1 June	Best opening date
Weipa	Albatross Bay	52	16.1		
	Cape Keerweer	13	19.4		
	Regional total	65	16.7		2/4/85
Mitchell	Xmas Creek	18	16.3		
	Mitchell R.	1	19.1		
	Regional total	19	16.9		16/4/85
Southeastern Gulf	Bold Point	7	15.9		
	East of Sweers	52	18.1		
	Regional total	59	17.5		24/4/85
Mornington	West of Mornington I.	6	17.1		
	Regional total	6	17.1		17/4/85
Limmen Bight	Vanderlins	7	37.5	19.4	
	Regional total	7	37.5	19.4	28/6/85
Melville	Port Essington	4	23.2		
	Melville I.	4	18.8		
	Fog Bay	18	20.9		
	Regional total	26	21.4		19/5/85
DMZ	All grounds	182	28.3		4/5/85
DMZ	(excluding Vanderlins)	175	18.1		24/4/85

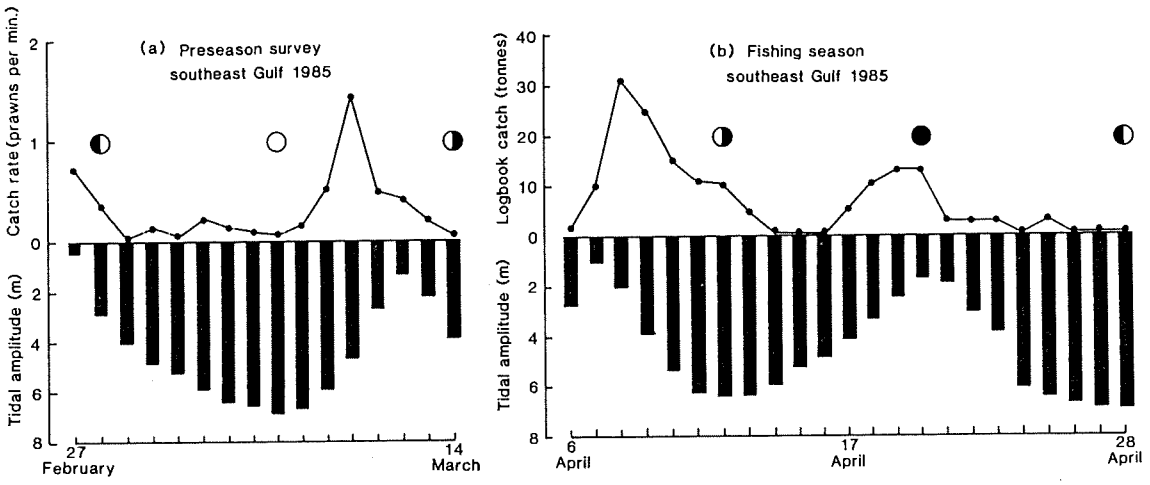


Figure 6(a) — Banana prawn catch rate and total tidal rise and fall for each day during the period 27/2/85 to 14/3/85.

(b) — Banana prawn catch and total tidal rise and fall for each day during the period 6/4/85 to 28/4/85.

Firstly, it is erroneous to think that preseason sampling has been responsible for the increase in the quality of the banana prawn catch that the industry has enjoyed in the last three years. This has simply been a result of the later opening dates — something which was suggested by the re-analysis of historical data on annual size composition of banana prawn stocks. Under the constraint of a common opening date for the whole fishery, preseason sampling can only provide a means of reducing the effect of year to year variability in the total size composition. As we have seen this year, the variability between areas is much greater than that for the whole fishery between years. This dampens the effectiveness of a flexible common opening date.

Secondly, it is also erroneous to think that the preseason sampling program was responsible for the extended closure in the Limmen Bight region. This could not have been the case as the survey was restricted to the southeastern Gulf. The necessary extension to the preseason program to accommodate regional closures would be both very expensive and a logistical nightmare.

At this stage, it is not clear what might finally evolve as the most appropriate means of ensuring that maximum revenue is obtained from the annual recruitment. However it would seem that, if regional variability is neglected, then a fixed opening date in mid-April would presently be more cost efficient than a flexible opening date determined through annual preseason sampling.

Trends in catchability

One aspect of the 1985 sampling program which was directed towards increasing the cost effectiveness of future surveys was the analysis of apparent changes in catchability of banana prawns in relation to moon and tides. Although the information collected from the preseason survey (Figure 6(a)) is insufficient to be definitive in statements regarding catchability, the logbook catch data from the first few weeks of the fishing season (Figure 6(b)) show a similar relationship between best catches and the period of minimum daily amplitude of rise and fall in tide. Although earlier years catch records still need to be analysed in a similar way, it would already appear that banana prawn sampling in the southeastern Gulf would be most efficient around the period of neap tides.

1986 PRESEASON WORKSHOP

The 1986 workshop is to be held in Cairns on a date yet to be finalised but sometime during both the DMZ and Queensland northeastern coast total closures. Notices will be circulated as soon as the date is settled.

CATCH STATISTICS

Log book records do not usually account for all the total landed figures which are compiled from processors monthly returns. If we assume however, that the log book records we do have are truly representative of the distribution of catch and effort across the entire DMZ we are able to estimate the proportion and hence the catch of each species in each region. Tables 4, 5 and 6 show the estimated total catch of banana, tiger and endeavour prawn in each of the statistical regions of the DMZ along with, in brackets, the average catch per day.

Note:

1. The catch per day figures are given in *kilograms* and all other figures are in *tonnes.*

2. The figures shown may change as further data is submitted and processed.

3. In Table 4, total landings and catch by region estimates include all banana prawns but the catch per day figure refers only to pure bananas.

TABLE 4: DMZ Banana Prawns

	1980	1981	1982	1983
Total landings	2681	5034	3046	1774
Catch/day fished	(325)	(514)	(450)	(313)
Catch by Region				
Weipa	481	579	942	434
	(397)	(554)	(653)	(433)
Mitchell River	171	602	36	106
	(206)	(401)	(165)	(300)
Karumba	570	1434	432	347
	(416)	(698)	(547)	(518)
Mornington	99	235	70	31
	(224)	(365)	(226)	(154)
Limmen Bight	147	188	357	72
	(300)	(400)	(667)	(278)
Groote	105	127	130	78
	(243)	(395)	(296)	(73)
Gove	41	107	29	41
	(222)	(375)	(196)	(173)
Arnhem	60	311	85	16
	(203)	(574)	(196)	(79)
Melville	1007	1396	871	626
	(335)	(491)	(369)	(286)

TABLE 5: DMZ Tiger Prawns.

	1980	1981	1982	1983
Total landings	4727	5118	4302	4727
Catch/day fished	(159)	(158)	(143)	(146)
Catch by Region				
Weipa	82	194	424	180
	(88)	(72)	(92)	(65)
Mitchell River	—	—	—	—
Karumba	694	553	508	675
	(142)	(159)	(150)	(171)
Mornington	82	404	527	566
	(158)	(210)	(171)	(195)
Limmen Bight	747	917	790	914
	(246)	(219)	(210)	(172)
Groote	2238	1936	1384	1631
	(162)	(175)	(142)	(143)
Gove	397	297	165	252
	(202)	(201)	(161)	(114)
Arnhem	58	18	9	9
	(211)	(131)	(99)	(114)
Melville	408	732	352	327
	(97)	(105)	(96)	(93)

TABLE 6: DMZ Endeavour Prawns.

	1980	1981	1982	1983
Total landings	1667	1760	1671	1133
Catch/day fished	(70)	(71)	(69)	(47)
Catch by Region				
Weipa	56	184	297	68
	(74)	(85)	(77)	(22)
Mitchell River	—	—	—	—
Karumba	237	145	130	189
	(67)	(58)	(58)	(64)
Mornington	26	104	142	104
	(70)	(73)	(57)	(37)
Limmen Bight	101	140	135	102
	(42)	(44)	(45)	(27)
Groote	719	442	444	323
	(63)	(51)	(55)	(38)
Gove	88	60	35	43
	(57)	(53)	(47)	(44)
Arnhem	6	3	1	2
	(35)	(46)	(17)	(26)
Melville	430	660	439	267
	(121)	(121)	(139)	(69)

FIRTA RESEARCH GRANTS

Among the 1985-86 Fishing Research Trust Account grants announced recently by the Minister for Primary Industry Mr. Kerin, were several of particular relevance to the northern prawn fishery and these are listed below:

- Investigations of the biology of tiger prawns in the western Gulf of Carpentaria (last year of this three year project north of Groote Eylandt).
  CSIRO $83 900

- Data and information service to the northern prawn fishery (fourth year)
  CSIRO $20 400

- Studies on the biology of, and fishery for, the red spot king prawn (second year)
  Queensland Department of Primary Industries $130 700

- A study of prawn nursery grounds and juvenile prawn populations in north Queensland (second year)
  Queensland Department of Primary Industries $41 400

- Tagging studies of the blue endeavour prawn (last year of this 2 year project around Groote Eylandt).
  N.T. Department of Ports and Fisheries $20 300

- Monitoring and assessment of management policies in the northern prawn fishery (first year)
  Bureau of Agricultural Economics $21 500

- Recruitment processes in commercially important prawns in the Gulf of Carpentaria (first year)
  CSIRO $250 000

FISHERIES OFFICER FOR TORRES STRAIT

The Australian Fisheries Service, Commonwealth Department of Primary Industry, is to base an officer permanently on Thursday Island and Mr. Peter Channells is expected to take up this appointment during October 1985. The appointment follows the ratification, earlier this year, of the Torres Strait Treaty between Australia and Papua New Guinea and this new position will provide:

1. a fisheries liaison officer to generally interact with fishermen and the community and government; and

2. a local contact for the collection of catch statistics in the Torres Strait fisheries. This project will include the implementation of a log book program and subsequent data analysis.

Peter will be based in the new Commonwealth office block — between the Grand Hotel and the customs building — on Thursday Island and he will be available to discuss any fisheries matters and to help with any enquiries. Peter said that he intends to have a high level of contact with fishermen in the field.

1986 PRESEASON WORKSHOP

The 1986 workshop is to be held in Cairns on a date yet to be finalised but sometime during both the DMZ and Queensland northeastern coast total closures. Notices will be circulated as soon as the date is settled.

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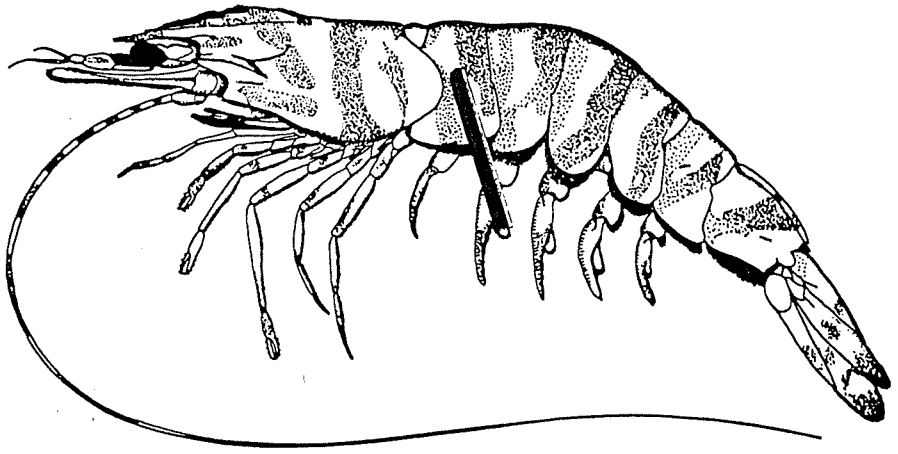
Note: Copies or reprints of most of these articles or publications are available from the authors or the organisations shown or through CSIRO at Cleveland.

NORTHERN PRAWN FISHERY INFORMATION NOTES

NUMBER 9 OCTOBER 1986



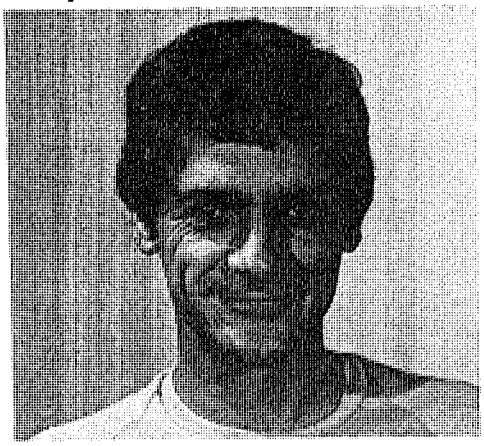
Compiled by Brian Taylor

Industry Liaison Officer

CSIRO Division of Fisheries Research

INDUSTRY LIAISON

Operating funds for the part-time position of Industry Liaison Officer have again been provided by FIRTA, which has supported this position since July 1982. I am sure that with your help I can again provide a useful service.



During 1981 meetings of the then NORPAC (Northern Prawn Fishery Advisory Committee), there was considerable discussion about ways in which communication of scientific and economic research results to industry could be improved. My appointment as Liaison Officer was, at least in part, as a result of these discussions. At subsequent NORPAC meetings and at the first pre-season prawn workshop (Karumba 1982), a list of information requirements was drawn up by industry. Where possible, these requirements were satisfied either via this position or directly from the organisations most involved. I have subsequently attempted to provide continuously updated information through a now well established communication network, but please bear in mind that not all information required is readily available.

In many issues of these *Information Notes* I have asked for your ideas and suggestions, particularly on the most useful format for statistical data derived from log books and on the best way to present information in these notes. This request is again repeated! In the article concerning the 1987 pre-season prawn workshop, I have also asked for your suggestions for agenda items and possible speakers. Perhaps you could consider these requests together! Both the *Information Notes* and the workshops are essentially for your benefit, and I would certainly like to see a greater industry input into these to ensure that we are providing a useful service. I should particularly like to hear from the sea-going sector. My contact here is, by necessity, somewhat limited.

As usual, I have updated the publication list at the end of these notes. During the year I have distributed many of the articles and reports listed, but if you have not seen some and are interested, then please let me know. I would also appreciate hearing from you if you are not receiving a continuous (albeit irregular) supply of written material.

BANANA PRAWN SAMPLING

INTRODUCTION

The opening of the 1986 prawn season in the Declared Management Zone (DMZ) was set by the Northern Prawn Fishery Management Committee (NORMAC) at April 7, after considerable discussion about the necessity for pre-season sampling. The opening day followed a total closure of four months (except for Joseph Bonaparte Gulf - 3.5 months), which had been in force for the first time in the history of the fishery. Pre-season sampling to estimate the date that would give maximum value of the prawns caught was not carried out this year. In-season sampling to assess the size composition of banana prawns actually caught in the first week or so of the season was again undertaken however. From these in-season samples we can calculate the optimum opening date and we can then check this against the predicted optimum opening date and/or against the actual opening date.

As we know the growth rate of banana prawns and as we have the measurements taken at the start of the season, we can calculate the date at which prawns from the various regions will reach an optimum value (given that we also know the current price structure). A 'weighting' or 'importance' value is allocated to each area according to estimates of the proportion of the total catch taken from that area, and an optimum opening date for the entire DMZ is then calculated.

1986 SAMPLING

As you might imagine, it is quite a logistical exercise to arrange observers and vessels to give us coverage of the entire DMZ. Firstly, observers and vessels need to be located. Owners and skippers must, of course, agree to help, berths must be available and observers must then be placed in the various ports ready to sail at some rather vague times. In 1986 however, we again managed to have observers at sea in all of the major producing areas and our thanks are extended to the owners and/or skippers of the vessels involved. Those participating are listed below along with the observers and their organisations.

VESSEL	SKIPPER	OBSERVER	ORGANISATION
Heather V F	Phil Harvey	Brian Taylor	CSIRO
Gove Scorpio	Shaun Perkinson	Ted Wassenberg	CSIRO
Solo 2	John Hearn	Irena Zagorskis	Contractor
Kingfisher	Garry Bisset	Irena Zagorskis	Contractor
Newfish 1	Colin Mailer	Peter Fearnside	Contractor
Solo 3	Murray Keegan	Peter McCormick	AFS
Taroona	Norm Hedditch	Margot Sachse	N T Fisheries
Point Moore	Ted Norton	Margot Sachse	N T Fisheries
Beachlands	John Harvey	Margot Sachse	N T Fisheries
Takari	Bill Fitti	Margot Sachse	N T Fisheries
Clipper Bird	Kurt Peterson	Stewart Tarrant	Qld Fisheries
Petanne	Peter Perry	Mike Dredge	Qld Fisheries

Our thanks are also extended to the quality control staff of KFV Fisheries who also provided numerous commercial catch samples.

1986 RESULTS

A total of 84 samples were taken from the major producing areas of the old DMZ (Cape York to Cape Ford, hence omitting the Kimberleys and Joseph Bonaparte Gulf). The range of sizes across all areas as at April 7, the actual opening date, was from 17 to 22 count per pound head on, the average count was 19 per pound (Table 1). The optimum opening date was calculated to be May 9. The range of opening dates with a resultant product value within 95% of the maximum was estimated to be April 12 to May 26. The actual opening date (April 7) resulted in an estimated loss of 7% against the optimum opening date (May 9) but as the actual landing figures are not yet available we are unable to calculate a dollar value for this.

TABLE 1: Banana prawn size data on opening day as calculated from commercial catch samples.

REGION	COUNT PER POUND (HEAD ON) BY YEAR		
	1984*	1985#	1986#
Weipa	20	16	17
Cape Keerweer	21	19	20
Xmas Creek	—	16	19
Mitchell River	—	19	20
Bold Point	19	16	19
East of Sweers	24	18	21
West of M'ton	22	17	—
Vanderlins	31	37	—
Port Essington	24	23	21
Melville Island	—	19	20
Fog Bay	26	21	22
DMZ average count	23	28	19
DMZ optimum opening date	May 19	May 4	May 9

* As at April 1st

As at April 7th

GENERAL DISCUSSION

For comparison and interest, size composition data from earlier years is also included in table 1. In 1985, sizes ranged from 16 count in the Weipa region to 37 count in the Vanderlin region and optimum opening dates ranged from April 2 to June 28. If data from the cyclone ravaged Vanderlin region is omitted, there is still a size range from 16 to 23 count and an optimum opening date range from April 2 to May 19. Data for 1984 also show a large variation.

If we accept that the *relative* value of the various commercial size grades has remained more or less constant over the years, we see that the optimum opening date each year is influenced mainly by the size of the prawns.

The large variation in the calculated optimum opening dates is also evident for the Karumba and Weipa regions for earlier years (Table 2). These data, along with the more recent data in table 1, illustrate the variation we may

expect from area to area within any particular year. The degree of spacial and temporal variation featured heavily in the NORMAC discussions about the necessity of pre-season sampling and the cost/benefit of 'fine tuning' the common opening date for all areas across the DMZ.

This does not, however, negate the need for in-season sampling. The annual variation in fact, makes regular in-season sampling to maintain a check on recruitment strength and timing in each area even more desirable.

TABLE 2: Optimum opening dates calculated from commercial catch samples.

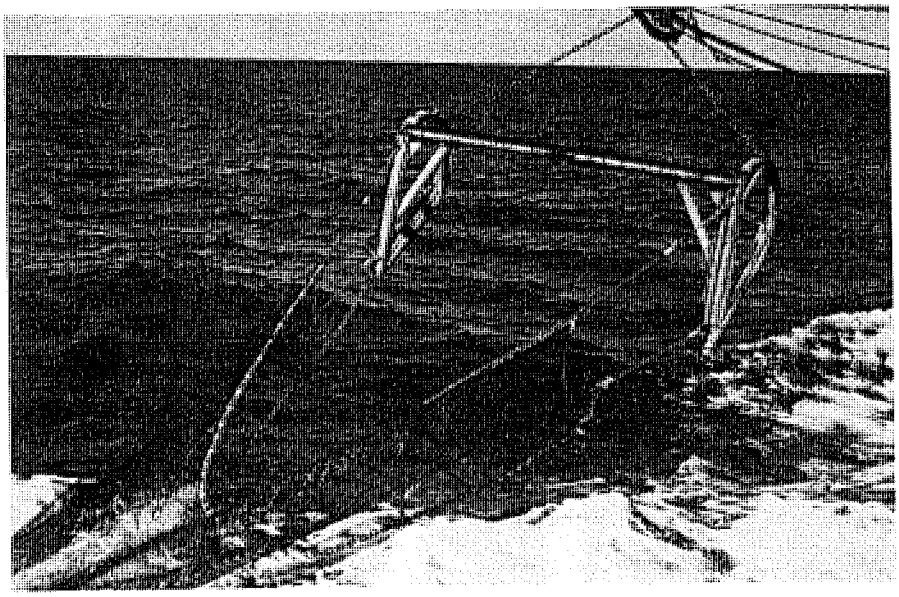
REGION	1974	1975	1976	1977	1978	1979
Weipa	12/3	26/3	7/4	7/4	8/4	N/A
Karumba	17/4	26/4	26/4	8/4	17/4	17/4

KFV DEEPWATER BANANA PRAWN SURVEY IN THE EASTERN GULF OF CARPENTARIA

Late in June 1986, KFV Fisheries started a short exploratory trawl survey in the deeper off-shore waters along the eastern side of the Gulf of Carpentaria. The objective of the survey was to test the theory that banana prawns *(P. merguiensis,* as distinct from the red-legged banana *P. indicus)* move into these off-shore areas during the seasonal closures earlier in the year. Funds were provided by the Fishing Development Trust Account (FDTA) and these notes are based on a report submitted to the FDTA by David Carter of KFV Fisheries.

Over the past few years the traditional fishing grounds between Weipa and the Staaten River have produced disappointing catches of banana prawns. In some years during the less restrictive 1970's, (closure areas and times have varied considerably over the history of this fishery) it was possible to catch banana prawns on these grounds as early as February and at a size not much smaller than that caught in April of this year. **What has happened to these 'early' prawns?** There has been considerable discussion among fishermen that perhaps the more restrictive closures now in force (both in area and time) have allowed the prawns to move through the traditional grounds and into deeper, off-shore waters where they have been lost to the commercial fishery. It was decided that it would be worthwhile proceeding with a survey to check this idea.

The two-week study began on June 25 1986, at a time coinciding with the best tides for banana prawns in this area.



VESSEL: 23 metre *KFV Goldsmith*
SKIPPER: Lou Pavlovich
CREW: David (Doc) O'Keefe, Joy Harvey and Anne McLean
OBSERVER: Brian Taylor (CSIRO)

The area surveyed was from about the Staaten River to north of Duyfken Point, 30 to 50 nautical miles off-shore and in waters up to 64 metres deep. All searching and sampling was based on the CSIRO 6 minute grid system and regular commercial procedures were followed in systematically searching during the day although try shots were carried out randomly as well as where there were signs of life. Limited sampling was also carried out at night. A 2.4 metre (8 foot) beam frame net was used for most sampling and shots were generally of ten minute duration.

A total of 197 shots over 132 grids was carried out although samples were not taken from all grids searched. Commercial species caught totalled 652 individuals and most were caught off Weipa. The grooved tiger prawn, *P. semisulcatus* and lesser quantities of both blue and red endeavour *(Metapenaeus endeavouri* and *M. ensis* respectively*)* predominated in the catch. No positive or even promising signs of banana prawns were seen and none were caught in any of the try shots.

David suggested in the report that further sampling in February might be the best way to verify these results and substantiate the conclusion that banana prawns do not migrate to the wider off-shore waters outside of the regular fishing grounds.

ARE WE LOSING BANANA PRAWNS *(Penaeus merguinensis)* DURING THE CLOSED SEASON?

As reported in the previous article, *KFV deepwater banana prawn survey in the eastern Gulf of Carpentaria,* banana prawns were caught on the grounds along the eastern Gulf as early as February in some years during the 1970's. Following the poor catches in this area in the past few years, it has been suggested that perhaps prawns are moving through the traditional grounds and into the deeper off-shore waters during the more extensive closed seasons we now have.

It is the CSIRO view that this is not the case. There are several reasons supporting this view, although no one reason by itself is conclusive.

1. In years of high, and therefore often early, rainfall, banana prawns are abundant and are widely distributed over the grounds. Rainfall during the 1970's was generally higher than so far recorded in the 1980's and we would therefore expect that prawns in the earlier decade would be more plentiful and more widely distributed.

2. Fishing intensity was less in the early 1970's than it is now and so the probability of prawns escaping fishermen to extend completely across their entire distribution was much greater. If prawns did move through the known grounds and into the deeper off-shore waters, we would have expected them to do this in the early 1970's. There is, however, no record of them being caught in the far off-shore areas.

3. Recoveries of tagged prawns released in earlier tagging experiments were all from on traditional grounds, and returns indicated a long-shore movement rather than an off-shore movement.

4. Plankton samples taken throughout the Gulf on regular cruises over almost two years in the mid 1970's showed that banana prawn larvae occurred predominantly in the more inshore areas. Since the larvae were only a matter of 2-3 days old their presence was a good indicator of the off-shore extent of mature prawns.

5. Systematic sampling by CSIRO was started in the Weipa area before the opening of the fishing season in 1986 and no sign of banana prawns was found in the more off-shore areas.

6. In other areas of the DMZ where regular adult sampling has taken place, (north of Groote Eylandt and Fog Bay), banana prawns have only been found in the more inshore areas.

7. The recent KFV survey gave no indication of any banana prawns off-shore.

The CSIRO sampling in the Weipa area will continue for three years and as the sampling stations extend well beyond the traditional banana prawn grounds, the results of this work will show, among other things, the monthly distribution of banana prawns in this area.

FISHING INDUSTRY RESEARCH TRUST ACCOUNT (FIRTA) PROJECTS

Listed below are some of the 1986-87 FIRTA projects that may be of interest to fishermen in northern areas.

ORGANISATION	TITLE OF PROJECT	GRANT
New Projects		
CSIRO Fisheries Research (Cleveland)	Productivity of tiger prawn nursery areas (FIRTA 86/78)	$51,100
CSIRO Fisheries Research (Hobart)	Northern shark tagging study (FIRTA 86/87)	$2,000
NT Ports and Fisheries	Assessment of status, composition and market potential of demersal trawl fish resources in northern Australian waters (FIRTA 86/49)	$44,000
Queensland DPI	Surveys of seagrass beds and juvenile prawn populations along the Qld coast — Bowen to Cairns; Karumba to C. York (FIRTA 86/108)	$59,000
Continuing projects		
CSIRO Fisheries Research (Cleveland)	Recruitment processes in commercially important prawn species (FIRTA 85/85)	$412,000
	Data and information service to the northern prawn fishery (FIRTA 82/12)	$21,000
CSIRO Fisheries Research (Perth)	Fisheries biology of scampi (FIRTA 85/82)	$77,300
Queensland DPI	Studies on the biology of and the fishery for redspot king prawns (FIRTA 84/20)	$88,200
	A cost model for the otter trawl fishery for prawns (FIRTA 85/25)	$45,700

If you would like any further information about these or any other FIRTA funded projects, or if you would like some help and advice about a proposal you may be formulating, please contact:

Dr. Mike Walker
Fishing Industry Research Committee
8/57 Labouchere Road
South Perth WA 6151
Phone (09) 474 1660

PRE-SEASON PRAWN WORKSHOP

The one day pre-season prawn workshops have been held annually for five years now. The first, organised by the Northern Fishing Companies Association (NFCA) was at Karumba in 1982. Subsequent workshops have been organised by the Industry Liaison Officer (CSIRO) in conjunction with NT Department of Ports and Fisheries and Queensland DPI. They have been held in Cairns (1983), Darwin (1984) and Cairns (1985 and 1986). Over this period, attendance has increased from 50 to about 140. There are, no doubt, several reasons for this increase and one is that the workshops are obviously regarded as worthwhile.

To help me maintain, and perhaps improve upon this level, I need your help. The following request will sound familiar, as at this time each year I remind you that the workshops are essentially for your benefit and you are therefore offered the opportunity to have a say in the selection of the agenda and in the choice of speakers. **If you have any suggestions, please let me know now.**

THE 1987 WORKSHOP IS TO BE HELD IN CAIRNS ON TUESDAY MARCH 3 AT THE PACIFIC INTERNATIONAL HOTEL. The agenda has not yet been settled but it is envisaged that biology and management discussions in a panel type forum will be a feature.

THE NORTH WEST SHELF DEEPWATER CRUSTACEAN FISHERY

BRUCE WALLNER, CSIRO, PERTH

THE FISHERY

Promising catches of scampi and deepwater prawns were made on the north west continental slope of Australia in 1982 by the CSIRO chartered research vessel *Soela*. Further exploratory trawling in 1983 by KFV's *Courageous*, and another survey by the *Soela* in 1984, determined that several species of deepwater crustaceans occurred in commercial abundance at depths between 300 and 500 metres. In March 1985, the Commonmwealth Department of Primary Industry released a development plan for the fishery to prevent the immediate over exploitation of this new resource. This entailed restricting trawling activity in the development area (Figure 1) by limiting the number of endorsed trawlers. At present, twelve endorsements are held and operated by five fishing companies. Six are valid for only part of the year so that fishing effort is staggered and maintained at a constrained level.

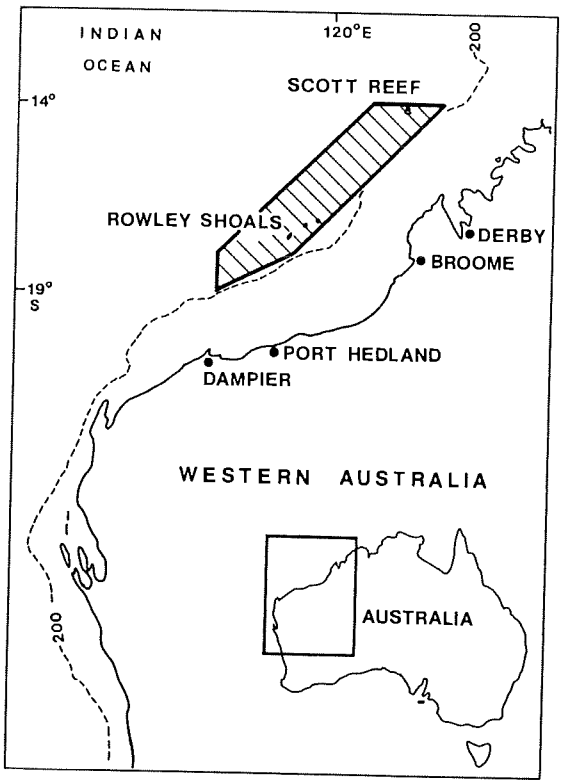


FIGURE 1:
Deepwater crustacean fishery development area.

Most of the vessels participating in this fishery are prawn trawlers from the Declared Management Zone and the gear and fishing methods initially developed were similar to those used in the northern prawn fishery. A range of gear from single stern-trawled rigs to more conventional triple otter trawls has since evolved in an effort to overcome the special problems associated with deepwater trawling.

To date, fishing effort has been seasonal as participating vessels have left the scampi grounds before April to fish the banana prawn season in the Gulf of Carpentaria, returning after July.

Three commercial scampi species of the genus *Metanephrops* are caught on the north west slope: *M. andamanicus, M. australiensis* and *M. boshmai.* During the last fishing season (April 1985 to April 1986), approximately 138 tonnes of scampi were caught in about 660 boat days of fishing affort. The average scampi catch rate for all boats was 12.9kg/hour although average catch rates for individual vessels varied between 3.0 and 17.0kg/hour depending upon the gear used. Each species inhabits different depth ranges (Figure 2). Fishing effort has been directed at the deeper grounds that yield the two larger species, *(M. andamanicus* and *M. australiensis).* The much smaller *M. boshmai,* from shallower water, is less marketable and has been exploited very little.

As well as scampi, over 169 tonnes of deepwater prawns were taken in the last season. Six commercially important species made up this catch: *Aristeomorpha foliacea* (red prawn), *Plesiopenaeus edwardsianus* (giant scarlet prawn), *Haliporoides sibogae* (royal red or pink prawn), *Aristeus virilis* (pink striped prawn), *Heterocarpus woodmasoni* (red carid prawn) and *Heterocarpus sibogae* (white carid prawn). Recent developments in international markets for some of these species has stimulated greater interest in the prawn component of the catch, which may comprise up to 80% of the catch biomass during daylight hours. This has prompted some operators to refine gear and techniques to concentrate on these prawn species which have produced average catch rates as high as 58kg/hour.

RESEARCH EFFORTS

The development of this fishery has prompted a FIRTA-funded research project by CSIRO with the following objectives:

- to obtain information on the size, mortality, growth rates and reproduction of the three commercial scampi species

- to document the catch and fishing effort by species and

- to refine yield estimates for the fishery

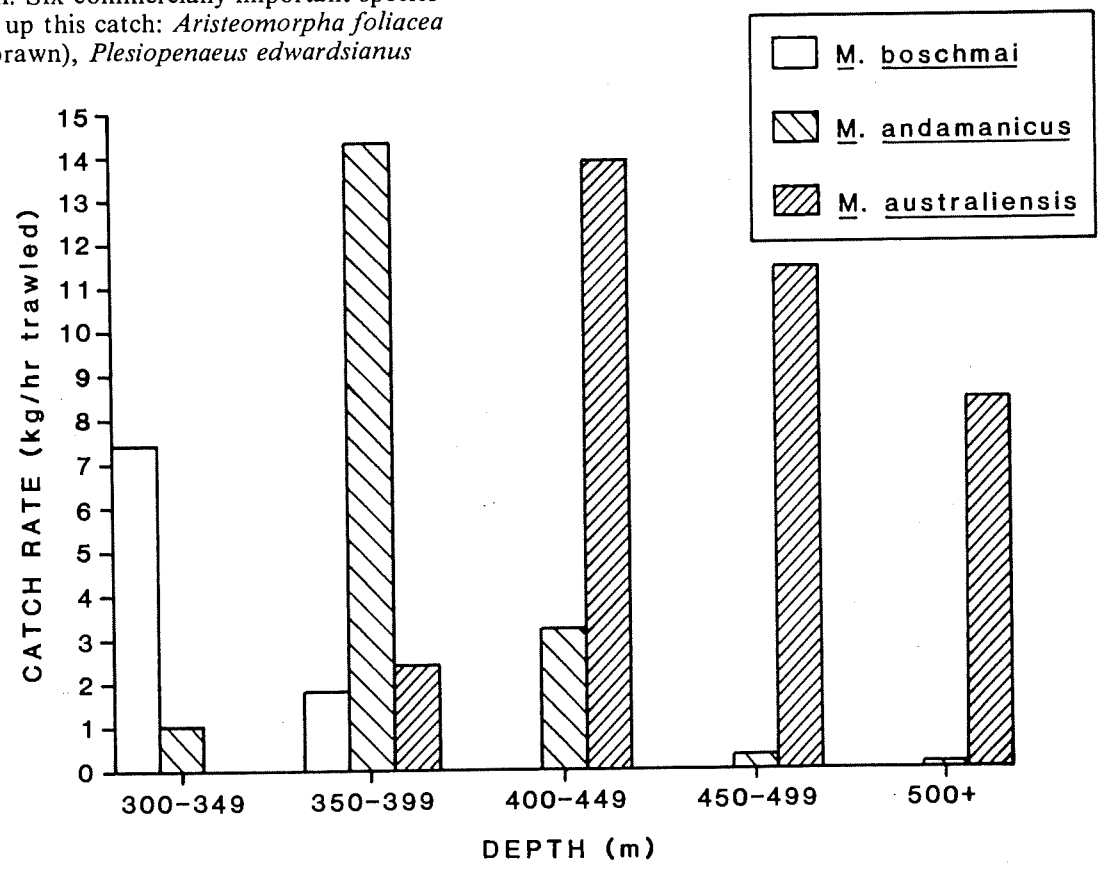


FIGURE 2: Catch rates of scampi *(Metanephrops)* by depth.

To achieve these objectives, the program is using two sources of information. Firstly, participating trawlers are required to complete and return a daily log book record of their fishing activity and catches. Analysis of these records is providing information on both daily and seasonal catch rates by species, area and depth. Secondly, a biologist aboard commercial trawlers is measuring samples of the catch to estimate growth and mortality. Scampi appear to be slow growing, taking as much as seven years to reach the size of the larger specimens caught (about 10/kg). Samples of females provide information of fecundity and the timing of reproduction in the different species.

This project is to be completed by July 1988 and will provide sound biological information upon which future management of the fishery can be based.

NORTHERN SHARK TAGGING

STEPHANIE DAVENPORT, CSIRO, HOBART

In the October 1984 *Information Notes,* Stephanie introduced the Northern Pelagic research program and gave some preliminary results. In this follow-up article, some of the more recent results from the shark tagging component of this project are presented and discussed.

BACKGROUND

Field work for the shark tagging project undertaken as part of the Northern Pelagic Fish Stock research program was completed in May 1985. The program was a FIRTA-supported, co-operative study: the participating organisations were CSIRO, Australian Fisheries Service and the Northern Territory, Queensland and Western Australian fisheries authorities. The objectives were to obtain information on the size, distribution, mortality, recruitment and yield potential of northern Australian pelagic fish stocks. Until recently, these stocks were fished by Taiwanese gill netters, which took approximately 9,000 tonnes annually. The developing Australian fishery takes up to 1,000 tonnes annually. The field study comprised a series of 12 cruises aboard the 21 metre commercial gill net vessel *Rachel* in waters off northern Australia between Napier Broome Bay and Cairns. Over 10,000 sharks and 100 mackerel were tagged.

RESULTS

To date, 376 tagged sharks have been recovered, providing information on stock structure, movements, growth and mortality. The two shark species of most interest are the black-tips *Carcharhinus tilstoni* (previously known as *C. limbatus* and *C. sorrah*). About

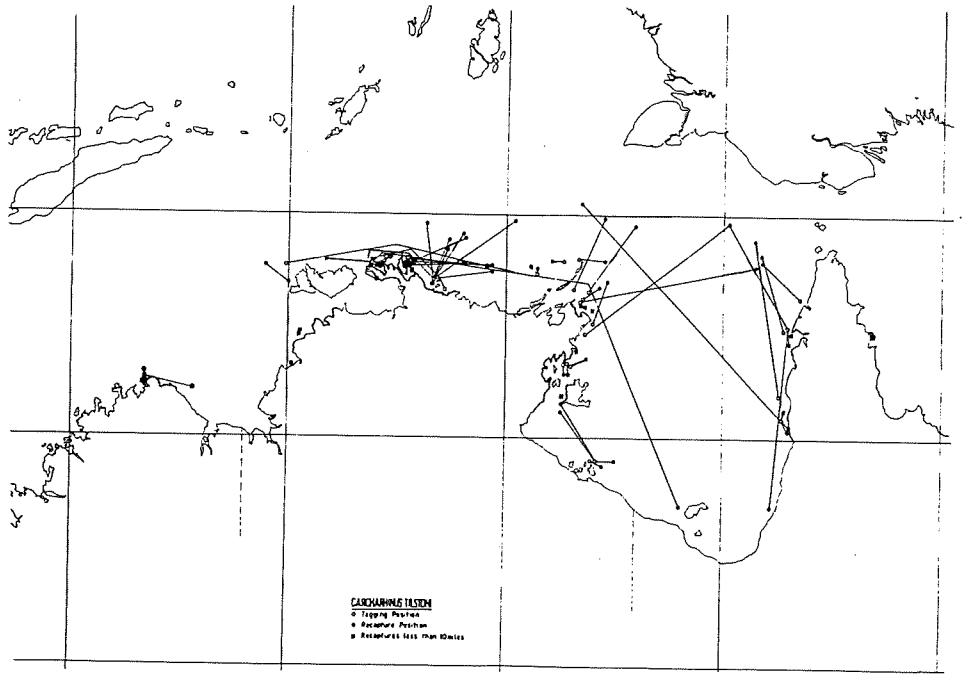


FIGURE 3: Shark tagging and recovery locations.

83% of the recovered *C. tilstoni* were caught more than 5km from the tagging location and had moved an average straight-line distance of 100km. Of the 63 recaptured *C. sorrah*, 79% had travelled more than 5km and the average distance travelled by this species was 127km. Some sharks had moved considerable distances: for example, one *C. tilstoni* tagged off Port Essington covered a straight- line distance of 1148km to Wellersley Island in the Gulf of Carpentaria in 77 days. The longest period at liberty was 813 days, during which time the shark, *C. tilstoni*, moved a straight-line distance of 65km. The map in figure 3 shows the release and recapture sites of some *C. tilstoni*.

Following the recent ban on gill nets longer than 2.5km and the resultant withdrawal of the Taiwanese gill net fleet from northern Australia, we now rely solely on Australian fishermen for the return of tagged sharks. If you should capture a tagged shark (or any other species), please retain the fish intact with the tag if this is at all possible, record the date and position of capture and return the fish to your local Fisheries Officer. The tags are easily recognised: they are red or yellow cattle ear tags and they are inserted in the dorsal fin.

A reward of $5.00 plus market value is offered for the return of the tagged fish. If it is not possible to retain the whole fish, the length should be measured as a straight-line distance from the tip of the snout to the fork of the tail as illustrated in the reward poster. The tag should then be returned with all recapture details.

Our thanks are extended to those people who have already provided valuable assistance by returning tagged sharks along with the relevant details, and we look forward to your continued co-operation.

GEAR RESEARCH

A report to FIRTA that recently came to my notice may be of interest, particularly to East Coast operators. It concerned a project comparing the engineering and catching performance of various types of trawl gear. The project compared the three variations of the Gundry nets used in the South Australian prawn fishery and the Florida Flyer, the Sandakan and the Sandakan-tongue nets used on the East Coast. In addition to the detailed FIRTA report, this project is also summarised in an article by Frank Chopin in the magazine *Focus*, (number 3) published by the Australian Maritime College. The paper is available from the college and requests should be directed to:

The Deputy Principal
Australian Maritime College
PO Box 986
Launceston
TAS 7250

NOTE — THE 1987 PRE-SEASON PRAWN WORKSHOP IS TO BE HELD IN CAIRNS ON MARCH 3 AT THE PACIFIC INTERNATIONAL HOTEL.

PUBLICATION LIST

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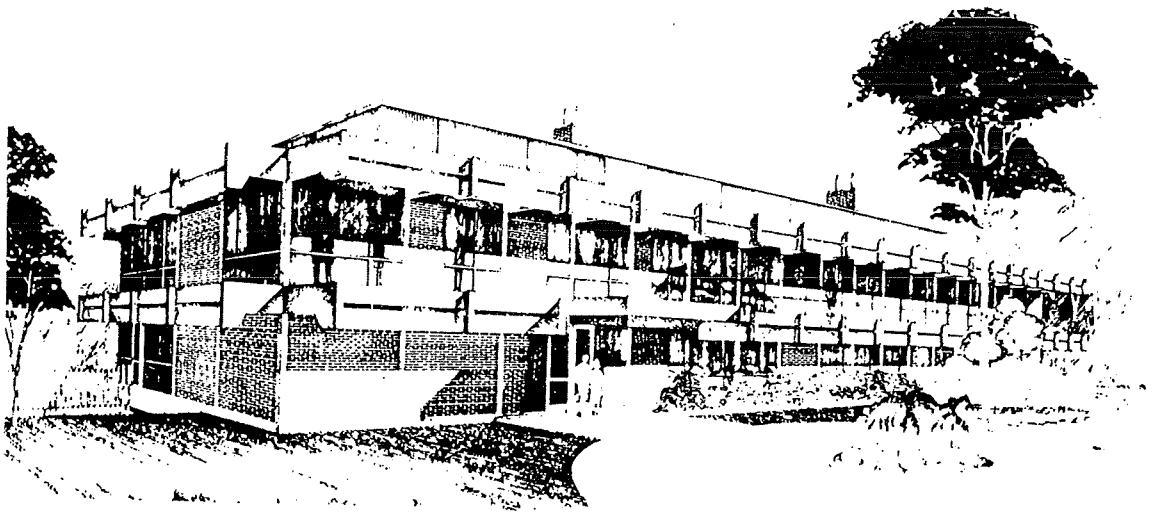

CSIRO MARINE LABORATORIES

233 Middle Street

Cleveland, Qld 4163

Telephone (07) 286 2022

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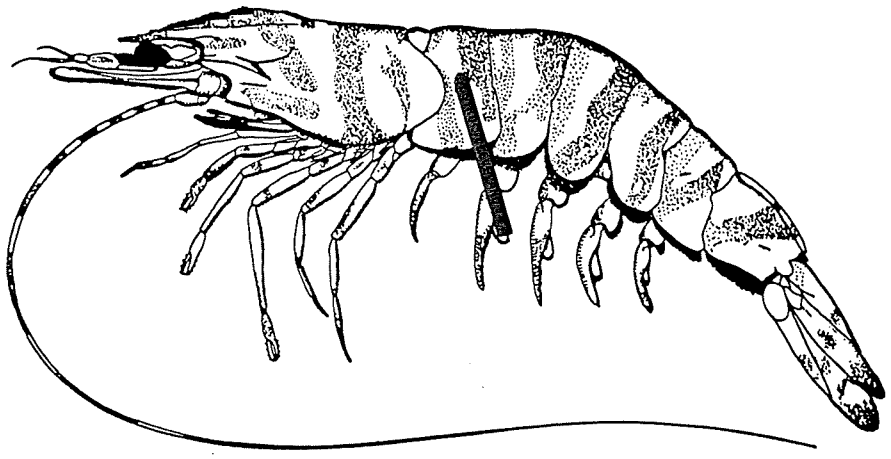


Compiled by Brian Taylor

Industry Liaison Officer

CSIRO Division of Fisheries Research

CHANGES IN FISHING EFFORT AND CATCHING POWER IN THE DMZ TIGER PRAWN FISHERY

RIK BUCKWORTH, NORTHERN TERRITORY DEPARTMENT OF PORTS AND FISHERIES

Annual fishing effort, in terms of nominal boat-days, has increased about 5-fold in the period since the early 1970's. This has been a result of increases in both the number of boats fishing and the average days fished per vessel each year (see Table 1). Today's fleet is also far more effective in fishing terms than that of the early days but just how much greater is this present catching power? In order to quantify the actual increase in "real" fishing effort, a study of changes in both fishing vessels and gear was undertaken so that nominal boat-days for each year might be standardised to 1970 equivalents.

TABLE 1: Nominal fishing effort in the DMZ tiger prawn fishery.

Year	Nominal effort (boat-days)	Number of boats	Days per boat
1970	5929	191	31
1971	7713	169	46
1972	8048	180	45
1973	7831	217	36
1974	3314	196	17
1975	5964	107	56
1976	6985	145	48
1977	11914	193	62
1978	18936	237	80
1979	18630	240	78
1980	32201	264	121
1981	34788	291	119
1982	36664	270	135
1983	38388	255	150
1984	35857	255	140
1985	30336	230	132

Source: CSIRO Division of Fisheries Research.

TABLE 2: Annual mean vessel and fishing gear characteristics for the DMZ tiger prawn fishery.

Year	Vessel length (m)	Engine power (kw)	Total headrope (fathoms)	Trawl speed (knots)	Swept area (fathoms x knots)
1970	21.1				
1971	22.5	130*			51.5#
1972	19.9				
1973	20.7				
1974	21.5				
1975	22.7				
1976	22.3				
1977	21.6				
1978	21.5				
1979	21.3	228.1	19.8	3.2	67.9
1980	20.1	279.0	22.0	3.3	77.4
1981	20.1	285.1	23.6	3.4	84.8
1982	21.2	283.1	24.4	3.3	83.2
1983	21.3	305.9	26.1	3.4	90.2
1984	21.5	336.1	28.7	3.3	95.1
1985	21.5	328.6	29.0	3.2	92.4
1986	21.7	335.9	30.1	3.4	98.0

Source: NT licence records (1970-78), NPF logbook gear sheets (1978-86).
* Source: Australian Fisheries Service.
\# Estimated from engine power-swept area relationship.

Surprisingly, the mean size of vessels has changed little since the early 1970's (see Table 2). The reason for this stems from the fact that many of the early vessels in the fishery were large Japanese trawlers operated by joint-venture companies. It seems that the departure of these larger vessels from the fishery was accompanied by an increase in the average size of Australian vessels. One characteristic which has changed noticeably, however, has been the average engine power which has increased from 130 kw in 1971 to 336 kw in 1986. This has allowed vessels to tow larger gear at an equivalent or even higher speed, thereby substantially increasing the area covered in a days fishing (swept area).

For the period 1979-86, it has been possible to calculate the increase in swept area directly from the data available on headrope length and trawl speed (44%, see Table 2). Because there was a high correlation between swept area and engine power over this period, engine power was used as a guide in earlier years when swept area could not be calculated directly. Estimated in this way, indications are that the swept area during a night's fishing in 1986 is almost double that of 1971. When this trend in increasing swept area is applied to the nominal effort, the real increase in fishing effort since 1970 has been about 10-fold rather than 5-fold (see Fig. 1).

Other technological improvements, such as the introduction of quad-gear, satellite navigators, coloured echo sounders and sonar, and Kort nozzles have also enhanced catching power. If these are also considered, it is clear that the increase in real fishing effort between 1970 and 1986 is probably even more than 10-fold.

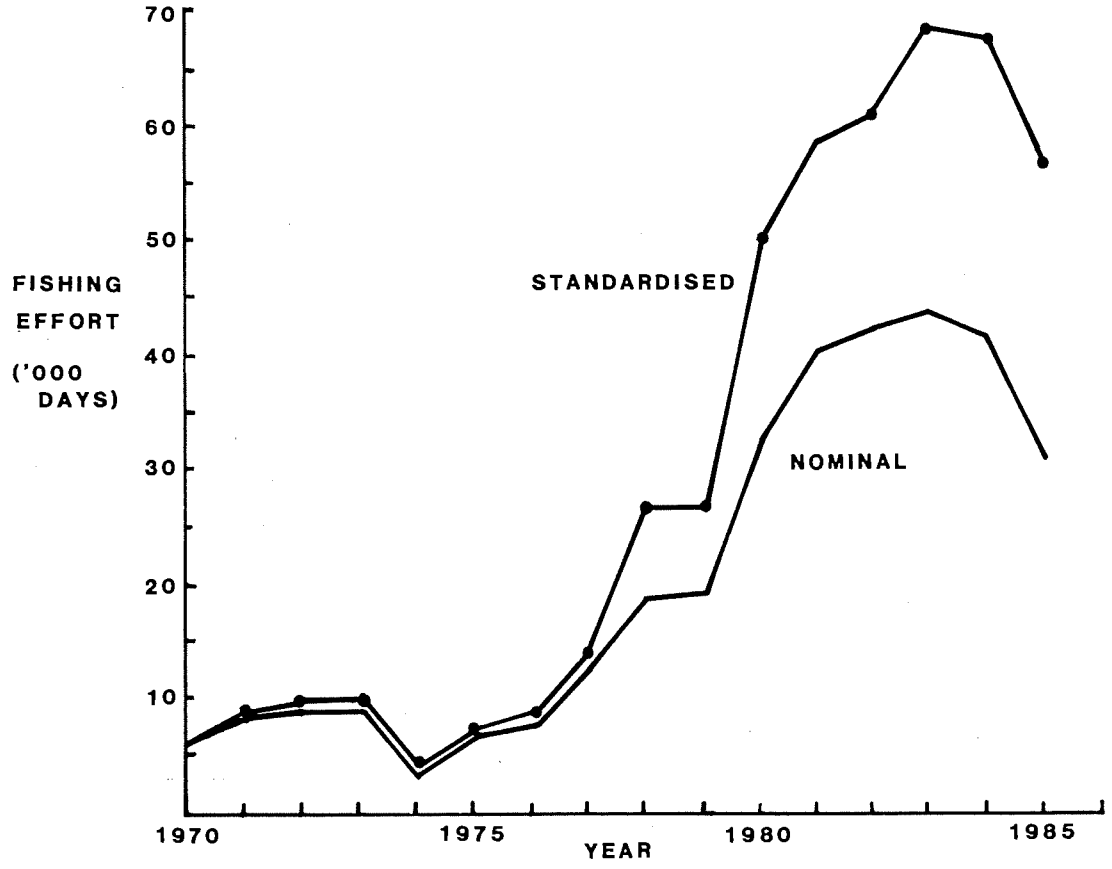


FIGURE 1: Nominal and effective (standardised to equivalent of 1970-boat-days) effort in the DMZ tiger prawn fishery.

THE STATUS OF TIGER PRAWN STOCKS IN THE WESTERN GULF OF CARPENTARIA

IAN SOMERS, CSIRO MARINE LABORATORIES, CLEVELAND

Resiliance to Fishing Pressure

Prawn fisheries are generally believed to be very resilient to fishing pressure. The main reason behind this belief is related to the very large number of eggs which are produced by each spawning female. A small change in the high natural mortality rate in the larval and juvenile stages can have a much larger effect on recruitment to a fishery than can the actual number of spawning females.

To demonstrate this, consider the hypothetical situation of a tiger prawn population before any commercial fishing (see Table 3): Suppose the recruitment of small prawns to the unfished population in January each year was 150 million individuals. With a drop in this population of 18% each month, the population would decline to about 30 million individuals by the time of the main effective spawning period (August-October). From what we know about reproduction, we would expect a population of this size to produce in the order of 15000 billion eggs. Of these, 99% do not survive through to the planktonic postlarval stage (the first month) and close to 99% of these survivors do not reach suitable nursery grounds (seagrass beds) because of unfavourable currents, winds, etc. Over the next three months on the nursery grounds, another 90% of the postlarval and juveniles will be lost to predition etc., leaving 150 million recruits to complete the cycle.

With the development of an intensive fishery on this population, the number of spawners might be reduced to half that of the hypothetical unfished population (i.e. 15 million rather than 30 million). With correspondingly fewer eggs being produced, some compensation in mortality rates occurs (or the Gulf prawn fishery would have long been extinct). It is possible that compensation may occur in the larval and juvenile stages through reduced competition for food, shelter etc. The important point to note is that a drop of as little as 1% in either larval or postlarval mortality would be sufficient to compensate for the 50% drop in egg production.

TABLE 3: Hypothetical tiger prawn life table for the western Gulf of Carpentaria prior to the establishment of a commercial fishery.

	First Generation			Second Generation		
Month	Stage	Number in each stage (million)	Mortality between stages (%)	Stage	Number in each stage (million)	Mortality between stages (%)
January	recruits	150	18			
February		122	18			
March		100	18			
April		82	18			
May		67	18			
June		55	18			
July		45	18			
August	spawners	37	18			
September	spawners	30	18	eggs	15000000	99
October	spawners	25	18	postlarvae[1]	150000	99
				postlarvae[2]	2140	80
November		20	18	juveniles	428	50
December		17	18	pre-recruits	214	30
January		14	18	recruits	150	18
February		11	18		122	18

1. Planktonic postlarvae having survived through the earlier larval stages.
2. Postlarvae which have settled on seagrass nursery areas.

Present Situation

In recent years, the degree of resilience of prawn fisheries (in particular tiger prawn fisheries) to fishing pressure has been increasingly questioned. Significant declines in tiger prawn stocks have recently been documented for fisheries in the Arabian Gulf (grooved tiger prawn) as well as Exmouth Gulf and Shark Bay in Western Australia (brown tiger prawn). In each of these fisheries, annual recruitment gradually dropped over years of heavy fishing pressure to levels of about 20% of that of early years.

Catches of tiger prawns in the western Gulf of Carpentaria, after reaching a peak of 2758 tonnes in 1980, have gradually declined to a 1985 catch of only 1427 tonnes (see Table 4). This decline followed a dramatic increase in fishing effort which occurred in the late 1970's (see article by Buckworth). Indications are that the 1986 catch was even less than that of 1985.

As we do not yet have a quantitative knowledge of the mechanisms which regulate survival at each of the pre-recruit stages in the life cycle, we must at this stage restrict analysis to the simple relationships between recruitment, fishing effort and spawning stock. However, with the level of recruitment so sensitive to small changes in pre-recruit mortality, relatively large natural fluctuations in annual recruitment must be expected. As a result, the relationship between spawning stock and subsequent recruitment will show a large degree of variability.

Theoretical Model

One way to understand the rather complicated way a natural population of prawns responds to being exploited is to develop simple theoretical models to describe the processes. The first of these involves the reduction in the number of spawning females as a result of increased fishing pressure. For a given level of fishing effort, the number of prawns which reach spawning age should be proportional to the number which recruit to the fishery. However, if the level of effort was to increase, more females will be caught before spawning, in which case the number of spawners would be less for the same recruitment level (see Fig 2).

TABLE 4: History of tiger prawn catch, effort and CPUE in the western Gulf of Carpentaria. Trawl survey results ((FV *Maxim*) and commercial catch sampling (NT Department of Ports and Fisheries) have been used to separate the information relating to the two species making up the tiger prawn catches. Although the splitting is based on only 18 months data, the separation of the two species in the fishery is thought to be stable because of their association with different sediment types. Effort is allocated to one species of the other dependent on which is predominant in the area. Because effort is calculated on a monthly basis using an extrapolitan technique, total annual effort may differ slightly from the sum of the effort on each species.

Year	Tiger Prawns			Brown Tiger Prawns			Grooved Tiger Prawns		
	Catch (tonnes)	Effort (days)	CPUE (kg/ day)	Catch (tonnes)	Effort (days)	CPUE (kg/ day)	Catch (tonnes)	Effort (days)	CPUE (kg/ day)
1970	558	3355	166	420	2769	151	137	611	224
1971	806	4106	196	496	2679	185	309	1461	211
1972	746	3513	212	573	2676	214	173	939	184
1973	1176	4370	269	780	2938	265	396	1431	276
1974	522	2019	258	306	1257	243	215	801	269
1975	443	2795	158	345	2166	159	98	638	153
1976	633	3570	177	401	2219	180	232	1369	169
1977	1741	6956	250	1119	4399	254	621	2557	243
1978	2243	10780	208	1319	6937	190	924	3843	240
1979	1722	8303	207	1121	5927	189	601	2378	252
1980	2758	16418	167	1635	10944	149	1123	5474	205
1981	2364	13274	178	1359	8574	158	1004	4700	213
1982	1766	12290	143	1144	8579	133	621	3710	167
1983	2270	13884	163	1221	8197	148	1049	5686	184
1984	1750	13123	133	877	7064	124	872	6059	143
1985	1427	10853	131	806	6402	125	620	4617	134

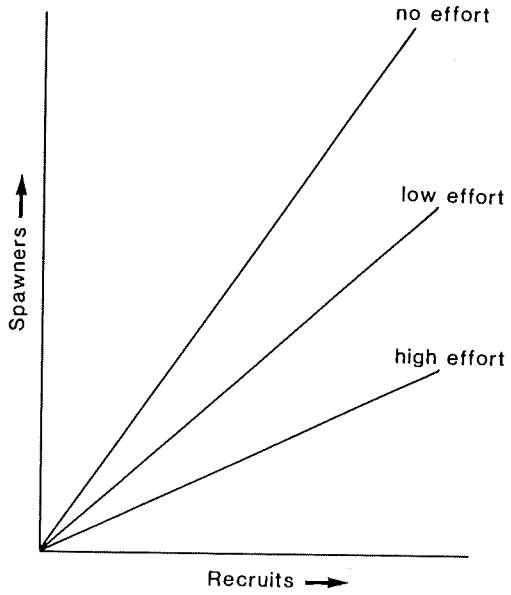


FIGURE 2: Conceptual relationship between the abundance of recruits, fishing effort and the subsequent abundance of spawners.

These surviving prawns, in turn, give rise to the next generation of recruits. Our conceptual model of the relationship between the size of the spawning population and that of subsequent recruitment is one where recruitment is zero with no spawning stock, where recruitment increases with increasing spawning stock, but where recruitment eventually levels out when the spawning stock is no longer the limiting factor (see Fig. 3). With sufficient levels of spawning stock, tiger prawn populations are generally thought to be largely regulated by the amount of available nursery ground (seagrass beds) and hence would conform to this type of model.

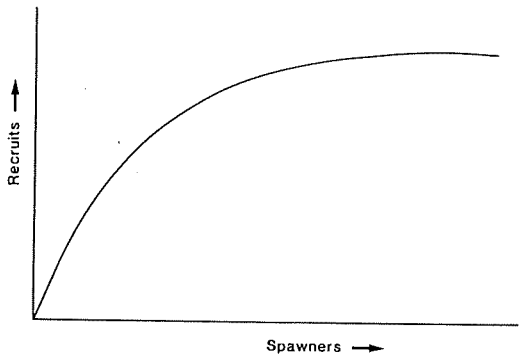


FIGURE 3: Conceptual relationship between the abundance of spawners and the subsequent abundance of recruits.

Combining two models (see Fig. 4) gives an appreciation of what constitutes recruitment overfishing and when management measures need to be introduced. The points at which the lines describing the recruit to spawner model cross over the curve describing the spawner to next recruit model, represent stable situations where the number of spawners balance the number of recruits and the population neither increases nor declines. At no fishing effort, the average spawning stock and recruitment remain high. With increasing fishing effort, both the number of spawners and the number of recruits move to a lower but stable level. This will occur in all fisheries. However, if the effort increases beyond a critical level, the line will not intersect the curve (high effort line of Fig. 4) and the population will simply collapse.

Methods of Analysis

To obtain suitable recruitment estimates for each of the two tiger species in the western Gulf of Carpentaria requires a knowledge of current levels of exploitation together with the history of fishing effort. Preliminary indications of 1985 exploitation levels are that around 50% of recruits are being caught. Exploitation levels for earlier years were estimated from the relative levels of fishing effort. Catch and effort for the individual species was estimated using logbook data, processing returns, and the results of CSIRO's trawl survey program in 1983/85 (see Table 4). Annual effort was standardised to make earlier boat-days equivalent to a 1985 boat-day; the effective increase in a nominal boat-day has been at least 100% over the period from 1970 to 1985 (see Buckworth article).

Annual recruitment of both tiger species in the western Gulf of Carpentaria has declined in recent years by about 50% (see Table 5). Recruitment of brown tiger prawns has decreased from about 110 million individuals in 1977 to around 50 million in 1985. Recruitment of grooved tiger prawns has decreased from around 60 million in 1980 to just over 30 million in 1985.

The effective spawning period for both species is in late winter and early spring (August, September, October) and the mean catch rate for these three months was chosen as a suitable measure of the relative size of the annual spawning stock (see Table 6).

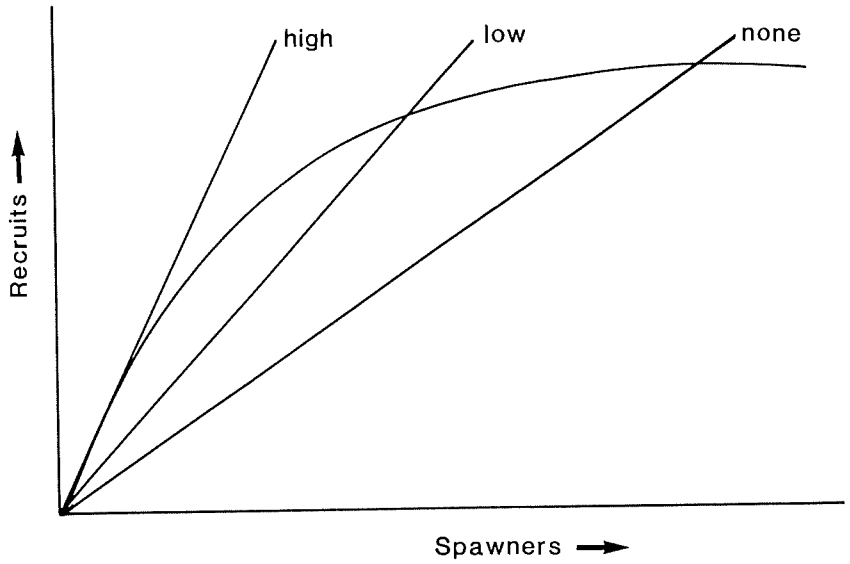


FIGURE 4: Conceptual stock-recruitment model under different levels of fishing effort (high, low and none).

Over the years 1970-1985, the average monthly fishing effort on brown tigers has dropped during the banana season (March) and immediately picked up as the banana season has drawn to a close (May) (see Fig. 5). Much of the effort is expended prior to August and hence before the effective spawning season. Effort on grooved tigers, however, has historically been later than that on brown tigers with most of the effort from August to November which may account for the fact that the decline in recruitment was initially in brown tiger prawns. However, in recent years there has been a re-direction of effort from brown to grooved tiger prawns (probably as recruitment declined on brown tigers). In 1984, 40% of the effort on grooved tiger prawns was expended before August compared to an average of 14% in earlier years.

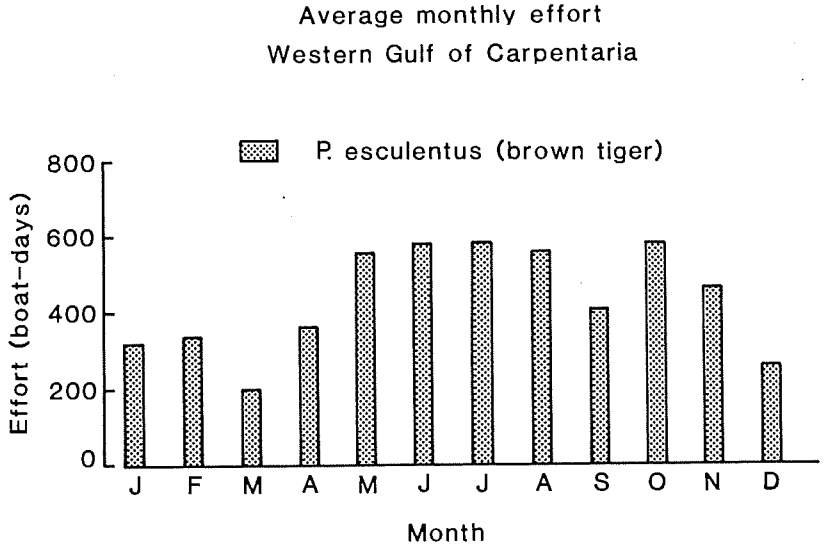


FIGURE 5: Monthly fishing effort (boat-days) on each of the tiger prawn species in the western Gulf of Carpentaria, averaged over the years 1970-1985.

TABLE 5: Estimates of effective effort, level of exploitation and recruitment for tiger prawns in the western Gulf of Carpentaria for the years 1970 to 1985. Effective effort has been standardised to 1985-boat-days assuming that there has been an increase of 100% in the effectiveness of a nominal boat day since 1970.

Year	Nominal effort (boat-days)	Effective effort (1985-boat-days)	Level of exploit-ation (%)	Number caught (million)	CPUE (thousand per 1985-boat-day)	Number of recruits (million)
Brown Tiger Prawns						
1970	2769	1384	17	13	10	78
1971	2679	1429	18	17	11	93
1972	2676	1516	19	19	12	99
1973	2938	1763	21	25	14	119
1974	1257	796	11	10	12	92
1975	2166	1444	18	11	8	64
1976	2219	1553	19	12	8	66
1977	4399	3226	33	36	11	110
1978	6937	5318	45	44	8	98
1979	5927	4741	42	36	7	86
1980	10944	9120	58	55	6	93
1981	8574	7430	53	45	6	84
1982	8579	7721	54	38	5	71
1983	8197	7650	54	41	5	76
1984	7064	6828	51	29	4	57
1985	6402	6402	50	26	4	53
Grooved Tiger Prawns						
1970	611	305	6	3	11	58
1971	1461	779	14	8	10	56
1972	939	532	10	5	9	48
1973	1431	859	15	11	13	72
1974	801	507	9	5	10	56
1975	638	425	8	2	5	29
1976	1369	958	17	5	6	34
1977	2557	1875	28	16	9	58
1978	3843	2946	38	24	8	61
1979	2378	1902	29	14	7	50
1980	5474	4561	49	30	6	61
1981	4700	4073	46	28	6	60
1982	3710	3339	41	17	5	42
1983	5686	5307	53	28	5	53
1984	6059	5857	55	27	4	49
1985	4617	4617	50	16	3	32

Thus for each species, the recruitment decline has followed a substantial increase in the level of pre-August (pre-spawning) fishing effort which reduced the size of the spawning stock.

Present Status of the Fishery

The data on the spawning stock, fishing effort and recruitment for the tiger prawns of the western Gulf of Carpentaria have been analysed with respect to our conceptual stock-recruitment model (see Figs. 6 and 7). For the recruitment to remain at a high level (i.e. in line with the high part of the curve), an appropriate limit on pre-August effort in the western Gulf should be around 3000 boat-days (2000 on brown tigers, 1000 on grooved tigers). On this basis, overfishing has been occurring on brown tigers since 1978 with pre-spawning effort reaching a peak in 1980 (5230 boat-days). For grooved tigers, overfishing would only be evident since 1983. Effort on tiger prawns in 1985 prior to August was around 4000 boat-days, which is the lowest that it has been since 1979.

TABLE 6: Annual recruitment, effort prior to August and index of spawning stock for the years 1970 to 1985. Effort has been standardised to 1985-boat-days and the measure of spawning stock abundance used is the mean CPUE (kg per 1985-boat-day) for the months August, September and October.

Year	Brown Tiger Prawns			Grooved Tiger Prawns		
	Number of recruits (million)	Spawning stock index (kg/boat-day)	Fishing effort pre-August (boat-days)	Number of recruits (million)	Spawning stock index (kg/boat-day)	Fishing effort pre-August (boat-days)
1970	78	280	622	58	449	60
1971	93	329	717	56	497	130
1972	99	274	1064	48	331	188
1973	119	416	1167	72	386	329
1974	92	485	418	56	458	93
1975	64	217	919	29	232	33
1976	66	296	1194	34	265	98
1977	110	385	1873	58	345	543
1978	98	262	3502	61	372	620
1979	86	307	2376	50	380	234
1980	93	202	5230	61	282	1212
1981	84	233	4077	60	311	1143
1982	71	157	4086	42	200	746
1983	76	199	4448	53	248	1430
1984	57	160	3472	49	154	2079
1985	53	170	3171	32	163	1082

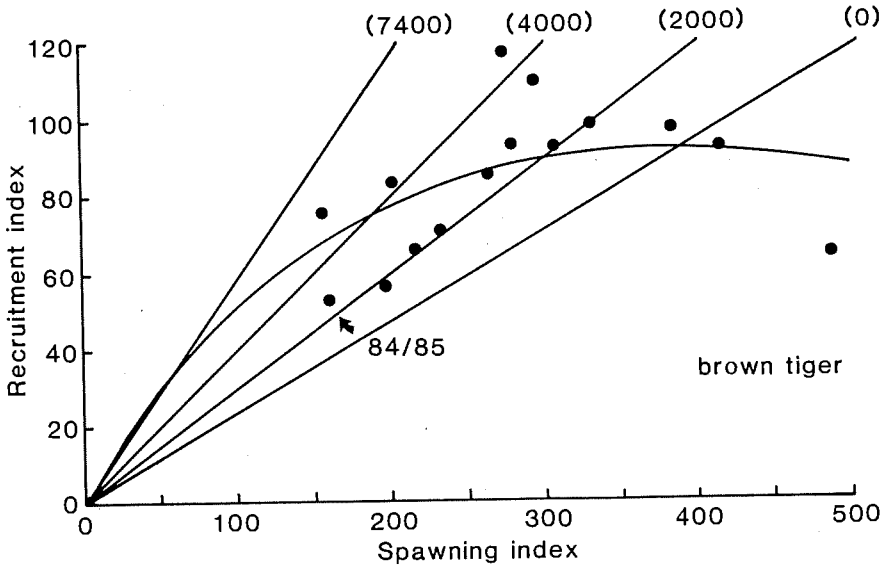


FIGURE 6: Stock-recruitment relationship for the brown tiger prawn in the western Gulf of Carpentaria. Numbers in brackets give the fishing effort in boat-days for each of the recruit to spawner lines.

The rate of recovery of the stocks is dependent on the degree of curtailment of fishing effort. A total ban on trawling before the spawning season would be expected to achieve the desired population levels in two to three generations (two to three years) if the conceptual model correctly describes the current situation.

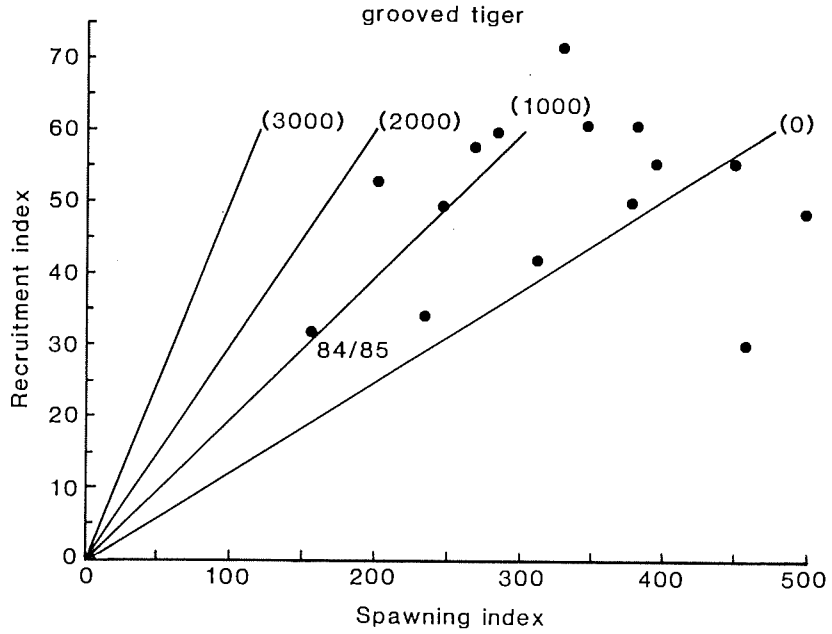


FIGURE 7: Stock-recruitment relationship for the grooved tiger prawn in the western Gulf of Carpentaria. Numbers in brackets give the fishing effort in boat-days for each of the recruit to spawner lines.

Comparison with Exmouth Gulf

To provide some wider perspective to the situation in the western Gulf of Carpentaria, it is interesting to compare the situation with that of Exmouth Gulf in Western Australia. The fishing intensity in Exmouth Gulf prior to recent restrictions was estimated as being the equivalent of each square metre of trawlable bottom being trawled more than four times per year. The comparable figure for the western Gulf of Carpentaria is just over twice per year. Whereas the tiger prawn recruitment decline in Exmouth Gulf was around 80%, the decline (so far) in the western Gulf has been around 50%. Monitoring of the tiger population in Exmouth Gulf since effort restrictions were imposed has shown the predicted increase in the size of the spawning population, indicating that prawn fisheries can bounce back with suitable management measures.

BIOLOGICAL ASPECTS OF MANAGEMENT OF THE DECLARED MANAGEMENT ZONE

BURKE HILL, CSIRO MARINE LABORATORIES, CLEVELAND

Although the management of prawn fisheries involves the use of non-biological means such as licence limitation and controls on the size of fishing vessels and gear, much of the management has a biological base. Until recently, it was thought that because prawns produce vast numbers of eggs — about 250,000 per female per month in the spawning season — it was unlikely that the number of spawning females could be reduced to the point where insufficient eggs would be produced to maintain the population at a reasonable level (see Somers article). It was considered that prawn fishing would become uneconomic before the number of adults had been reduced to the point where insufficient eggs would be produced. Increasing catching efficiency, coupled with factors such as extremely high prices, have changed the situation. Far more effort is being put into the Northern Prawn Fishery now as compared with even 5 years ago (see Buckworth article). The experience in Exmouth Gulf and now in the Northern Prawn Fishery (see Somers article) has caused a rapid change in thinking and consequently, in management techniques.

We now have to accept that heavy fishing pressure on the stock can lead to a dangerous decline in recruitment. The measures taken to rectify the situation in the Northern Prawn Fishery consist largely of reducing effort. This reduction is not however, aimed simply at reducing the total catch but rather at ensuring that as many prawns as possible survive to spawning age. After spawning, fishing pressure can theoretically be increased.

All the larger commercially fished Australian prawns have a similar life cycle (see Fig. 8). Unlike other crustaceans such as crabs and lobsters, female prawns do not carry their eggs attached to the body. Spawning occurs offshore where the eggs are released directly into the water to hatch into the first of many larval stages. The vast majority do not survive but are eaten by fish, jelly fish and other small predators.

Larvae reaching the nursery grounds settle out as post-larvae. Banana prawns settle in muddy mangrove areas whereas tiger prawns settle in seagrass beds. These nursery areas are critical for prawn populations and as they have been identified, many have been closed to trawling to protect both the habitat and the young prawns. These permanent nursery closures form the first level of biological management.

The young prawns grow rapidly and after a few months leave the nursery areas and move into deeper water. In the case of banana prawns, the mechanism which initiates this movement is associated with rainfall. The trigger starting tiger prawn movement is not known but the prawns appear to leave the seagrass when they reach a critical size. Once they leave the closed nursery area the prawns become vulnerable to fishing. They are at a small, uneconomic size at this stage and so closures were introduced to allow them to grow and reach maximum economic value. This introduces the second biological management tool — seasonal closures. The end of the closure period, i.e. the opening date of the fishing season, is dictated by three factors. These are the growth rate of prawns, the rate at which they are dying off and the export value of prawns at different sizes. Whilst the opening of the season is based upon banana prawns, the long closure also gives tiger prawns an opportunity to grow to an economic size.

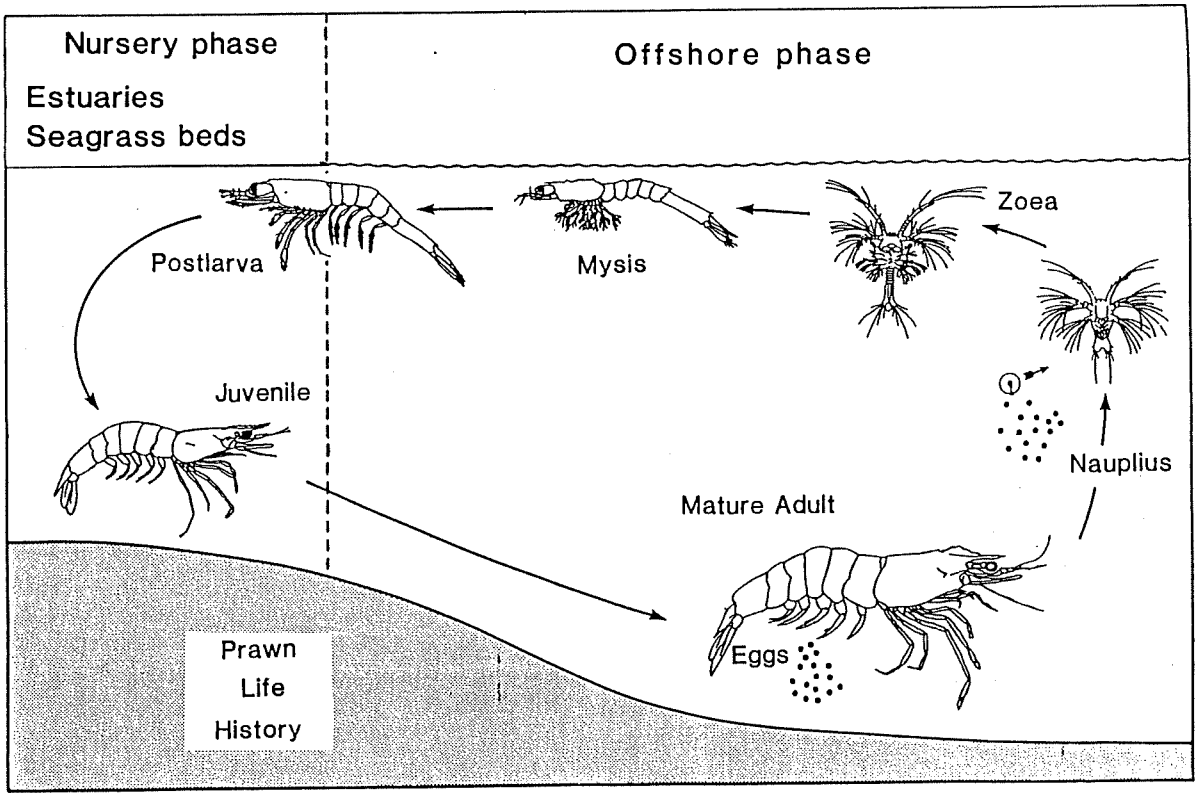


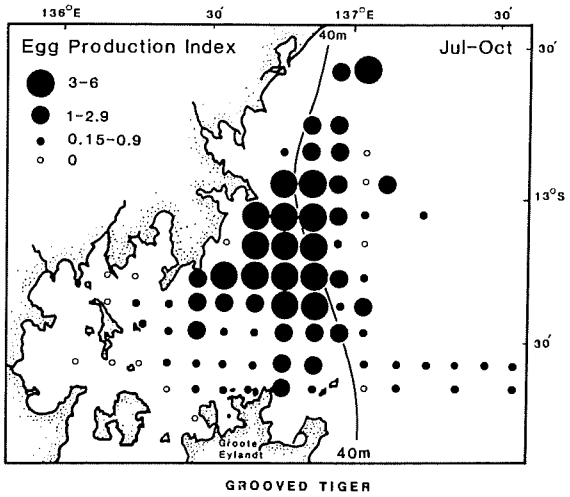
FIGURE 8: Generalised life history of northern commercial prawn species.

Because fishing pressure on tiger prawns is regarded as excessive, NORMAC decided additional protection was required to ensure that more prawns survived to spawning. A closure during the spawning season would serve no purpose if the prawns had already been caught. It was not feasible to close only the spawning grounds and leave the rest of the fishery open because the main fishing grounds are also the spawning grounds. This is illustrated by the situation north of Groote Eylandt where CSIRO studies have identified the spawning grounds for brown and grooved tigers (see Fig. 9). The only feasible alternative was to close the whole fishery before spawning commenced, hence the mid-season closure.

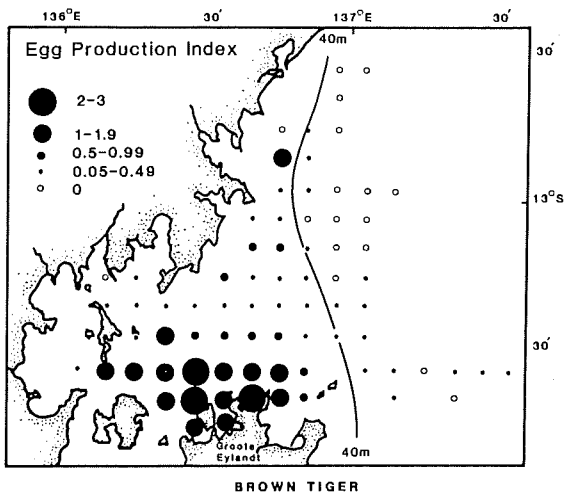
Identification of the spawning season was not easy. Examination of female brown tiger prawns showed prolonged spawning for most of the year. The grooved tiger prawn showed a marked August-October spawning season. Sampling of juveniles in the nursery areas and sub-adult recruits in the fishery showed that the most important spawning time for both tiger species in from August to October. The best time for the mid-season closure was therefore June/July. Banana prawns also spawn around August-October and so closing the fishery in July may also benefit the banana prawn populations.

Restrictions on daytime trawling arose from concern expressed by fishermen. There was no scientific information on the matter available as the effects of daytime trawling had not been investigated. There was however, data showing that the ratio of females to males in the remaining prawn population declined during the year as fishing intensity reached a peak. Fishermen suggested that daytime trawling yielded a higher proportion of females than males. As a result of this information, together with the overall state of the stock, NORMAC decided to take a conservative approach and ban daytime trawling before the spawning season.

Measures such as the mid-season closure, gear restrictions and the ban on daytime trawling are seen as being short-term measures to reduce effort. As the longer term measure of reducing the size of the fleet takes effect, it may be possible to remove the short-term measures. The main December-March closure will probably remain in place because of its economic benefit.



GROOVED TIGER



BROWN TIGER

FIGURE 9: Grooved and brown tiger prawn spawning areas north of Groote Eylandt.

HOW MANY PRAWNS ARE EATEN BY FISH?

STEVE BLABER, CSIRO MARINE LABORATORIES, CLEVELAND

It would seem that quite a substantial number of prawns are eaten by fish if preliminary results from a new CSIRO research program are confirmed! The Division of Fisheries Research at Cleveland has initiated a detailed investigation of the effect of fish predation on prawns with research centred on Albatross Bay and the Embley River estuary near Weipa. You may see Steve Blaber, John Salini, Dave Milton or Mick Haywood collecting samples from these areas.

The predation work is being tackled on two fronts. Firstly, commercial fish trawl nets are being used on the prawn grounds of Albatross Bay to catch fish which may eat adult prawns. The by-catch of fish from prawn trawling is not a good indication of the numbers or variety of fish in a particular area. Prawn nets are designed to catch prawns, not fish, and they do not capture many of the larger species. Secondly, gill and seine nets are being used inshore in the Embley River estuary to sample fish feeding on juvenile prawns before they move out to sea. The contents of large numbers of fish stomachs are being analysed to determine which species feed primarily on prawns, how many they eat and when they eat them. These data, coupled with other information from the sampling (quantities of fish present), will, it is hoped, allow the estimation of the actual numbers of prawns which are eaten by fish. Initial results show that fish eat at least as many adult prawns as are taken by fishermen, and probably considerably more! As the program proceeds, the research will be extended to the southeastern Gulf of Carpentaria and Groote Eylandt areas where it is planned to deploy the FRV *Soela*, CSIRO's chartered 54m stern trawler. In addition to providing the all-important information on prawn predators, the fish research program will also generate data on the overall fin-fish resources of the Gulf of Carpentaria.

Editors note — studies in the Kuwait prawn fishery during 1985 showed that:

* The grooved tiger prawn, *Penaeus semisulcatus* which also occurs in northern Australia is the dominant species in Kuwait and the annual yield varies from about 1500-3000 tonnes.

* Total prawn consumption by finfish was estimated to be about 6000 tonnes per year, 2 to 3 times the commercial landings by trawlers.

* On average, the prawns eaten by finfish were smaller than those caught by trawlers and therefore the number taken by finfish predators was far greater than that taken by commercial fishermen.

* Some of the top predators in Kuwait are similar to species found in northern Australia.

Source — *Kuwait's finfish catch three times more shrimp than its trawlers.* D. Pauly and C. P. Matthews. Naga, The ICLARM Quarterly, January 1986.

SPECIAL VOLUME OF THE AUSTRALIAN JOURNAL OF MARINE AND FRESHWATER RESEARCH

BURKE HILL, CSIRO MARINE LABORATORIES, CLEVELAND

The Australian Journal of Marine and Freshwater research is one of the scientific journals publishing among other things, fisheries related topics. A special volume on prawn research is to be published shortly. The cost is expected to be about $25 and enquiries should be directed to,

The Editor
Australian Journal of Marine and Freshwater Research
314 Albert Street
East Melbourne
Victoria 3002

Introduction to this Volume

The prawn fisheries of northern Australia are spread around 500km of coastline in some of the country's most isolated regions and were developed as recently as the late 1960's. The first major development followed surveys by CSIRO, the Queensland government and private enterprise from 1963 to 1965 in the south-eastern Gulf of Carpentaria (Munro 1983). The rapid expansion of the Gulf fishery in the early 1970's was based primarily on stocks of the banana prawn, *Peneaus merguiensis*. The complementary development of shore-based facilities and the construction and introduction of vessels designed for the remoteness of Australia's north stimulated the expansion of the fishery to include other species and regions. The late 1970's saw dramatic increases in the commercial importance of both the brown and the grooved tiger prawns *(P. esculentus* and *P. semisculcatus)* with major fisheries developing on Queensland's east coast, in the Torres Strait and in the Gulf of Carpentaria. The annual catch of prawns from Australia's northern fisheries is presently between 10000 and 14000 tonnes.

Prawn research in the region has largely reflected the changes in the commercial fishery. Initial emphasis on banana prawns led to several important papers dealing with the biology (see review by Rothlisberg et al. 1985) and population dynamics (Lucas et al. 1979). Research on banana prawns resulted in significant applications to management of the commercial fishery with models for predicting catches from rainfall data (Vance et al. 1985), for describing recruitment processes through each stage of the life cycle (Staples 1985) and for maximising the economic yield from the fishery (Somers 1985). Recent years have seen more emphasis on tiger prawn research following their increased importance in the commercial fishery. CSIRO and the fishery research agencies of Queensland and Northern Territory all initiated tiger prawn research programs in the early 1980's. Results of some of this work (eg. Buckworth 1985, Roberston et al. 1985 and Coles et al. 1985) have recently been published. Early in 1986 it became apparent that several additional papers were nearing completion and that it would be convenient if they were published together in one volume. The papers were not planned to give a continuous coverage of any one aspect of tiger prawn biology, but they do make a significant contribution to knowledge of the life cycle and ecology of these important penaeids.

List of Papers

Larval ecology of penaeids of the Gulf of Carpentaria, Australia, I. Assessing the reproductive activity of five species of *Penaeus* from the distribution and abundance of the zoeal stages. Rothlisberg, P. C., Jackson, C. J. and Pendrey, R. C.

Larval ecology of penaeids of the Gulf of Carpentaria, Australia. II. Hydrographic environment of *Penaeus merguiensis, P. esculentus, P. semisulcatus* and *P. latisulcatus* zoeae. Rothlisberg, P. C. and Jackson, C. J.

Comparative recruitment of the banana prawn, *Penaeus merguiensis,* in five estuaries of the south-eastern Gulf of Carpentaria, Australia. Staples, D. J. and Vance, D. J.

A study of the species composition and distribution of commercial prawns of Torres Strait, Australia. Somers, I. F., Poiner, I. and Harris, A.

Distribution and abundance of the tiger prawns *Penaeus esculentus* and *P. semisulcatus* in the north-western Gulf of Carpentaria, Australia. Somers, I. F., Crocos, P. J. and Hill, B. J.

Reproductive dynamics of the grooved tiger prawn, *Penaeus semisculcatus,* in the north-western Gulf of Carpentaria, Australia. Crocos, P. J.

Reproductive dynamics of the tiger prawn *Penaeus esculentus,* and a comparison with *P. semisulcatus* in the north-western Gulf of Carpentaria, Australia. Crocos, P. J.

Distribution of seagrass and associated juvenile commercial penaeid prawns in north-eastern Queensland waters. Coles, R. G., Lee Long, W. J., Squire, B. A., Squire, L. C. and Bibby, J. M.

Seagrass communities of the Gulf of Carpentaria, Australia. Poiner, I. R., Staples, D. J. and Kenyon, R.

Sediment type as a factor in the distribution of commercial prawn species in the western Gulf of Carpentaria, Australia. Somers, I. F.

Surficial sediments of the western Gulf of Carpentaria, Australia. Jones, M. R.

Natural diet of the tiger prawns *Penaeus esculentus* and *P. semisulcatus.* Wassenberg, T. J. and Hill, B. J.

Feeding behaviour of adult tiger prawns, *Penaeus esculentus* under laboratory conditions. Hill, B. J. and Wassenberg, T. J.

Outline of the Papers

The papers fall into three broad categories, life cycle, habitat and behaviour. The distribution of the zoeal (early planktonic stages) of the major commercial species of penaeids in the Gulf is described by Rothlisberg, Jackson and Pendrey. Because the time interval between spawning and completion of the zoeal stage is about a week, their presence is a good indication of where and when spawning has occurred. Spawning appears to be mainly coastal but there is no single spawning period since some species appear to spawn twice annually whereas others spawn only once each year.

The distribution of penaeid larvae with respect to ambient salinity and temperature is developed in the paper by Rothlisberg and Jackson as an indication of possible temperature and salinity optima. All four species of prawns investigated were found over a wide range of temperatures. Banana prawn larvae were found in higher temperatures and lower salinities than both tiger prawns or western king prawns. The endemic brown tiger prawn was found in the narrowest salinity range.

The two species of tiger prawns in the north-western Gulf of Carpentaria were the subject of a large scale trawl survey program, the results of which are described by Somers, Crocos and Hill. Juveniles of the two species utilize seagrass beds in shallow inshore waters as nursery areas before recruiting to the offshore fishery. There appears to be some slight difference in the spatial distribution of the juveniles of the two species but as they recruit to the offshore fishing grounds, the spatial separation becomes more noticeable. The green tiger moves further offshore than the brown tiger. Minor species differences were also found in the timing of recruitment to the offshore fishery.

A similar though smaller scale survey of the commercial species of prawns in the Torres Strait by Somers, Poiner and Harris showed that this fishery consists mainly of the brown tiger prawn, the endeavour prawn *(Metapenaeus endeavouri)* and the red spot king prawn *(P. longistylus).* Spatial differences in the species distributions were found to be associated with the distribution of different sediment types.

Previously published work on the recruitment of banana prawns in the Gulf of Carpentaria has dealt with only one estuary — the Norman River. In this volume, Staples and Vance have presented comparative data for five major estuaries around the south-eastern Gulf over one monsoon season. They show how catchment size affects river salinity and consequently the timing and extent of immigration into the rivers by postlarvae. Emigration to the offshore fishery in turn is influenced by rainfall, tide height and number of resident juveniles.

Two papers by Crocos detail the reproductive biology of the two species of tiger prawns in the north-western Gulf of Carpentaria. Crocos has used a population fecundity index to describe the dynamics of reproductive output based upon the abundance of females, the proportion of females spawning and fecundity according to size. He found quite distinct differences between the two species both with respect to areas where spawning occurred and with respect to seasonality of egg production. The brown tiger prawn tended to spawn over most of the year whereas the green tiger had a markedly seasonal pattern. It is interesting to note than the protracted spawning pattern in the brown tiger was not reflected in the recruitment pattern of juvenile tiger prawns in the same region as described by Somers, Crocos and Hill.

Two aspects of prawn habitat are covered — seagrasses which are of importance mainly to juvenile stages, and sediments which may affect juveniles but are definitely of importance to adults.

Coles, et al. demonstrate a clear relationship between seagrasses and the distribution of juvenile brown tigers and blue endeavours. A lesser known species, the red spot king prawn, has only recently become commercially important in Australian waters. Coles et al. report the finding of juveniles of this species in seagrass beds for the first time.

Poiner, Staples and Kenyon have mapped and classified seagrasses in over 900km^2 of seagrass habitat in the Gulf of Carpentaria — one of the largest extents of seagrass areas known anywhere in the tropics. They found 11 species and show that the seagrasses can be divided into intertidal and subtidal communities. The intertidal communities exhibited strong depth zoned species distributions. Most seagrass occurs along open coastlines — a reflection of the relatively low wave energy coastlines of the Gulf.

Several papers in this volume deal with the two tiger prawn species. The paper by Somers shows that as well as having different depth distributions, the two species prefer different sediment types. The grooved tiger prawn showed a preference for fine sediments (75% mud) whereas the brown tiger prawn was more abundant on coarser sediments. Sediment type was also found to be a significant factor in the spatial distribution of the other five species examined.

Since sediments appear to be of great importance in deciding the distribution of penaeids, the paper by Jones describing the origin and distribution of sediments in the western Gulf of Carpentaria is of especial interest and will be of value in interpreting the occurrence of penaeids in the region.

A different type of link to habitat is the nature of food eaten by penaeids. Wassenberg and Hill describe the diet of each of the tiger prawn species and show how this changes with the size of prawns. Dietary composition overlapped for both species caught in the same trawl but significant differences were found in average numbers of particular food items. Bivalves and gastropods were the most common items in the diets of all stages of both species. Hill and Wassenberg describe some of the feeding behaviour of the brown tiger prawn. This species feeds intermittently throughout the night and has clear preferences when offered choices. It becomes very active when deprived of food and Hill and Wassenberg suggest that this behaviour may result in this species spending less time in areas with little food than in those with an adequate supply.

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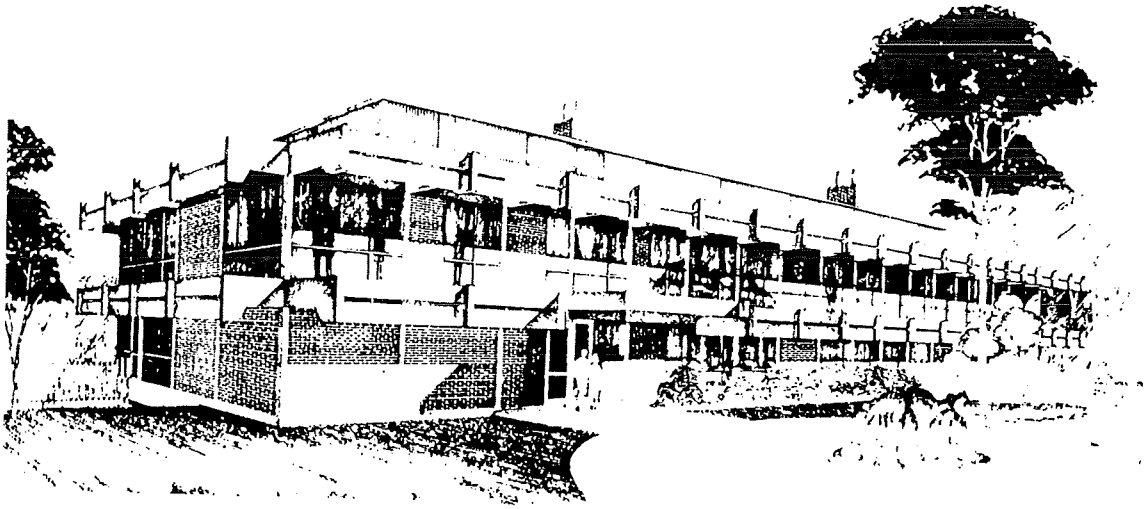

CSIRO MARINE LABORATORIES

233 Middle Street

Cleveland, Qld 4163

Telephone (07) 286 2022

NORTHERN PRAWN FISHERY INFORMATION NOTES

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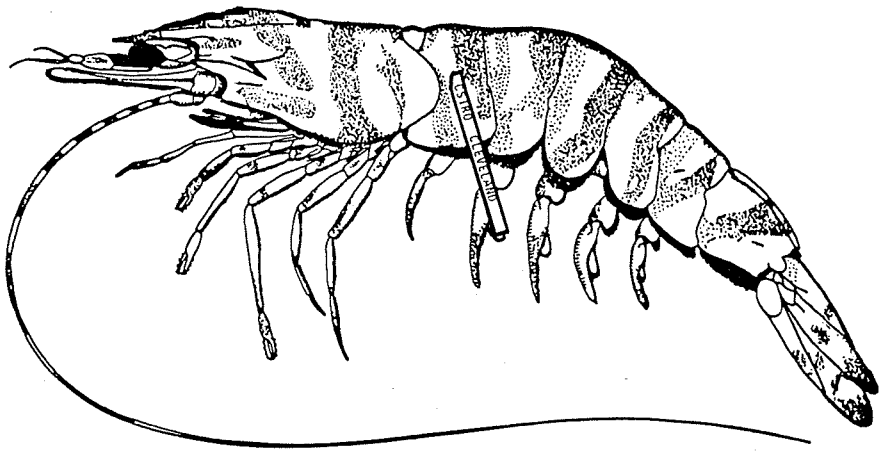


Compiled by Brian Taylor

Industry Liaison Officer

CSIRO Division of Fisheries Research

Industry Liaison

Operating funds for the liaison work have again been provided from the Fishing Industry Research Trust Account (FIRTA) for the financial year 1987-88. We had been warned that this funding might end after June of this year and although the new funding is only half of that requested, I am hopeful that with CSIRO support, I shall be able to maintain this service at a reasonable level. Two issues of these *Information Notes* are planned and the annual preseason workshop will definitely be continued. Travel is the other major cost associated with this position. Extensive travel has been a feature of the liaison work, as I have been able to collect and discuss data from reseachers and management and disseminate it personally. It has given me the opportunity to hear your views and ideas about this service and any other topical matters which is important if I am to provide a service of value to you. However, my travel now has to be severely curtailed. I would therefore appreciate your sending me ideas about the *Information Notes* and the preseason workshop through the the logbook agents, any other researchers in the field, or your NORMAC representative.

The 1988 preseason workshop will be held in Cairns. It will probably be held back to back with the next NORMAC meeting which, incidentally, will again begin with an open session for all interested parties. You will be kept informed about the date and the venue. The agenda will not be settled for a while yet but I am sure that the day will again prove to be both interesting and informative.

In view of the deliberations and action arising from NORMAC 12 (Darwin, October 1986) on effort reductions across the Northern Prawn Fishery, your attention is again drawn to several articles appearing in issue Number 10 (October 1986) of the *Information Notes*. Rik Buckworth from NT Fisheries detailed and discussed effort increases since 1970, Ian Somers from CSIRO discussed the status of tiger prawn stocks in the western Gulf of Carpentaria, and Burke Hill from CSIRO presented some selected aspects of biological research and management. These three papers summarised, in a clear and concise manner, a huge volume of data collected over many years of research and they represent an excellent coverage of the background to the current management regime. The next article in this issue is an expasion of some of the main points from these earlier articles and it should be read in conjunction with them.

In the last issue I included a list of articles to appear in a special edition of the Australian Journal of Marine and Freshwater Research which was being prepared. This edition, entitled, Biology of Penaeid Prawns in Northern Australia, is now available at a cost of $25 (including postage) from,

The Publications Sales Office
CSIRO
314 Albert Street
East Melbourne Victoria 3000

Tiger Prawns and Closures

Fishermen have known for some time that it has been increasingly hard to sustain high catch rates of tiger prawns in the Northern Prawn Fishery. There are, however, two species of tiger prawns caught but these are not identified in logbook records. Although we knew that tiger prawns were declining we did not know if it was the brown or the grooved tiger which was involved. As there are important biological differences between these, it was essential to sort the catch data so that appropriate management measures could be recommended.

Analysis of data collected by CSIRO during sampling in the area north of Groote Eylandt in late 1983, 1984 and early 1985 (FV *Maxim*) has shown that the catch can be split by species because there is a clear relationship between species and the nature of the bottom. Grooved tiger prawns are found mainly over fine, muddy substrates while the brown tigers prefer a coarser bottom. Results from an intensive survey of bottom type in the whole of the western Gulf allowed us to split the species according to fishermens logbook data recorded since 1970. This information was presented for the first time to both NORMAC and industry at meetings in Darwin in October 1986. The data showed that, in the western Gulf of Carpentaria, catch per unit effort of the brown tiger

had declined since 1978 and of the grooved tiger since 1981. It was further estimated that the number of sub-adult brown tigers entering the commercial fishery in this area in 1985 had decreased by about 50% since 1977, whilst recruitment of grooved tigers had declined by the same amount since 1980. Since the abundance of both species had declined and available evidence suggested that over-fishing may be the primary cause, both species required some form of protection.

Recommendations on both the time and area for closures are not arrived at simply even when the life histories are documented and understood. As well as the problems inherent with a spawning season spread over a period of time (see below), differences between species on the same fishing grounds, differences from region to region and differences from year to year must all be considered. Because of these complexities we cannot be too dogmatic about specific dates and boundaries for seasonal closures across the entire Northern Prawn Fishery. Furthermore, biological factors are not the only consideration and final decisions may well be a compromise between biological, economic and sociological factors.

However, to increase annual recruitment of sub adults to the resource it is first necessary to increase the number of prawns surviving to form the spawning stock. Obviously, if a prawn is caught before it spawns (and this means at any time before) then it will not contribute to the next generation. We must, then, reduce effort before spawning takes place. Protection during the spawning period alone will not achieve this increase as too many may have already been caught.

Although grooved tiger prawns have a rather short spawning season, brown tigers spawn over quite an extended period. The occurence of juvenile prawns in nursery areas, however, shows that the effective spawning period for both species is late winter and spring. Because the population spawns over a period of time and not instantaneously, each subsequent stage also occurs over a period of time and this must be taken into account. So generally,
Main spawning season --- late winter and spring
Juvenile nursery phase --- spring and early summer
Offshore recruitment --- summer and early autumn

If we consider the juveniles in the seagrass nursery areas as at the first stage of pre-spawning, we see that they (and their habitat) are already protected by permanent closures. Both these prawns and emigrating juveniles from the nurseries are also at least partially protected by seasonal closures. The recently declared seasonal closures around the Vanderlins and east of Mornington, reflect the increasing amount of information available on the occurence of juvenile prawns. Given that it was not practical to extend the main seasonal closure far enough to significantly reduce effort on the pre-spawning tiger population (cash flow !), the mid year closure was adopted instead. This 6 week closure should significantly reduce fishing effort on the pre-spawning resource and increase the probability of much larger numbers of both tiger species reaching the spawning season.

The ban on daylight trawling and the use of only 2 nets will also have a significant effect on the total effort in the general trawl fishery.

Post Cyclone Recolonisation of Seagrass Communities in the Western Gulf of Carpentaria

ROB KENYON
CSIRO, GROOTE EYLANDT

Four seagrass surveys have been carried out by CSIRO in the western Gulf of Carpentaria over the past few years. The first was in 1984 before cyclone *Sandy*, the next was immediately after *Sandy* in 1985, and the others were in 1986 and 1987. The first survey identified the extent and species composition of the seagrass beds in the western Gulf and the 1985 and 1986 surveys documented the extensive damage caused by *Sandy*. (see *Information Notes* No. 8, October 1985 and Information Sheet No. 1, February 1987). The most recent survey in April 1987, was the first to detect signs of recolonisation of the seagrasses in areas laid bare by the cyclone two years before.

These surveys play an important role in the continuing CSIRO studies examining the factors affecting the commercial catch of tiger prawns in the western Gulf of Carpentaria. Results to date have suggested that the removal of seagrass by cyclones may have a serious affect on prawn catches over the following few years.

During this latest survey, four sites in the study area (Figure 1) were sampled in detail for evidence of recolonisation. Sites 1 and 2 were selected because species for potential recolonisation were growing nearby; site 3 was physically distant from potential recolonising species; site 4 was previously unaffected by cyclonic disturbances. The seagrass species present, water depth, distance from shore and sediment type were recorded at each site and samples were taken to determine leaf area and shoot density. The coastline between these sites was also qualitatively examined but no samples were taken.

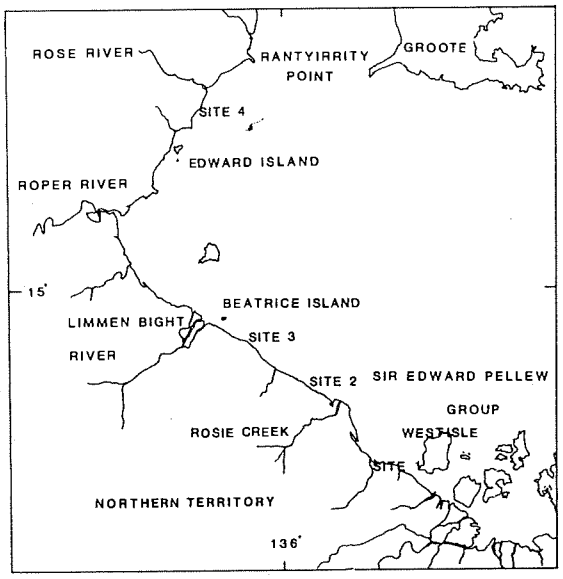


Figure 1. Map of the western Gulf of Carpentaria indicating the seagrass sampling sites.

Of the three damaged sites, recolonisation had only occurred on the two sites where potential seed stock was growing close by. At site 1, adjacent to the surviving seagrass protected by the Sir Edward Pellew Islands, only the shallow inshore beds were recolonised. At site 2, where seed stock remained, inshore beds were also revegetating. Recolonisation, however, was patchy and not uniformly distributed along the coast.

Site 3, an area physically distant from recolonising stock, is on the coast, south east of Beatrice Island. No evidence of regrowth in either inshore or offshore seagrass beds could be found. The qualitative examination of the coast between these three sites did not detect any signs of recolonisation either inshore or offshore.

It seems, then, that initial seagrass recolonisation following *Sandy* occurred between 1 and 2 years after the event and was restricted to a patchy inshore distribution in areas where recolonising stock was growing close by.

Site 4, a previously unaffected site , is between Edward Island and the Rose River. Two cyclones, *Irma* and *Jason*, passed through this area in 1987. After cyclone *Irma* in January, CSIRO staff carried out a short survey to assess damage caused by this low intensity cyclone. No evidence of damage was found and it was concluded that this was due to the small size and low intensity of *Irma*. Fifteen days later, cyclone *Jason* passed through the same area and as both size and intensity was about the same as *Irma*, it was assumed that no damage would be caused. During the annual survey some weeks later, however, considerable damage to the offshore seagrass was noted. Almost total leaf loss and rhizome burying had occurred although root systems were left intact and no washouts were evident. In the short period following the cyclone, however, some regrowth was noted. In contrast, the inshore seagrasses appeared completely unaffected by cyclone *Jason*.

In this case, two low intensity cyclones with similar windspeed had quite different affects. The damage resulting from *Jason* was also quite different from high intensity *Sandy* in 1985. During *Sandy*, shallow inshore beds were totally destroyed and offshore damage was characterised by washouts causing rhizome and root destruction.

A new phase in the seagrass work in the western Gulf began this year. The Fishing Industry Research Committee has approved funding for CSIRO to undertake a new project over the next

three years and there will be three main aspects to this work.

1. Continuation of the current survey work, with an expasion of effort in the Groote Eylandt area to complement survey results. This extra work will involve growth and reproductive studies of selected seagrass species important in the recolonisation process.
2. Annual surveys of the juvenile prawn populations in the four previously listed study sites to document changes occuring in the prawn communities. Particular attention will be paid to changes in the numbers of both tiger and endeavour prawns as revegetation occurs and as the composition of the seagrass community changes with time.
3. Detailed examination and analysis of log book records from the Limmen Bight area to detect any emerging trends in catch following *Sandy*. This cyclone caused a 41% reduction in the tiger prawn nursery habitat in this area. It is hypothesized that habitat destruction will lead to a reduction in juvenile recruitment and hence to a reduction in the number of adults. If so, this will be reflected in commercial catch records. Verification of any such trend would demonstrate a direct link between the destruction of nursery habitat and catch fluctuations in the fishery.

Diurnal Changes in Sex Composition of Tiger Prawn Catches

DARRYL GREY AND RIK BUCKWORTH
NT FISHERIES, DARWIN

The Northern Territory Fisheries Division is conducting a series of trawl surveys on the tiger prawn grounds between Groote Eylandt and Cape Grey to determine if there are any differences in the sex composition of replicate catches made during the day and night.

The ban on daylight trawling between Cape York and Cape Ford was introduced because industry thought a much higher proportion of female tiger prawns were taken during daylight trawling. The fishery is facing reduced catches and increased operating costs, including surveillance costs to enforce such a ban, and it is important that the effectiveness of any management measures be evaluated so that they are used to maximum advantage. Unfortunately, the actual data available were not adequate to evaluate such a measure, although it was quite clear that it would be beneficial in reducing fishing effort.

Four survey cruises have already been completed (May, June, July and August) and another will be completed during September. It is anticipated that the results will be available to industry before the start of the 1988 season.

Movement Patterns of Grooved Tiger Prawns in the Gulf of Carpentaria

IAN SOMERS and PETER CROCOS
CSIRO, CLEVELAND

Introduction

Until recently, our knowledge of the movements of tiger prawns in the Gulf of Carpentaria has been based almost solely on tag-recapture studies. The two tiger prawn species caught commercially in the Gulf, the brown tiger (*Penaeus esculentus*) and the grooved tiger (*Penaeus semisulcatus*), have each been the subject of tagging experiments. Studies in the western Gulf, where brown and grooved tiger prawn species co-exist, have demonstrated different movement patterns for each species. Brown tiger prawns released in shallow (less than 20 m deep) inshore waters were subsequently recaptured offshore in waters from 20 to 30m deep and generally on a sandy-mud substrate. Grooved tiger prawns released in the same inshore waters were recaptured further offshore in depths of between 30 and 45m and on muddy substrates (see *Northern Prawn Fishery Information Notes*, No 8, 1985 and *Australian Fisheries*, July 1982).

One of the main problems with interpreting movement patterns from tag-recapture studies is that tagged prawns are recaptured in areas that are fished. For brown tiger prawns, this is not a problem, because the commercial fishing grounds go well beyond the offshore limit of their distribution. However, grooved tiger prawns were recaptured out to the eastern boundary of the commercial fishing grounds in the western Gulf (about 45m depth) suggesting that perhaps these prawns may move further out.

An opportunity to test whether grooved tiger prawns moved further offshore arose in March 1982 when a CSIRO oceanographic research vessel (RV *Sprightly*) carried out hydrographic and seismic work between Weipa and Groote Eylandt. It proved possible to do some trawling in the western half of the Gulf during this cruise. Grooved tiger prawns were found beyond the eastern limits of the fishing grounds, but only to a depth of about 50m. More recent studies involving regular sampling over a longer term, have shed more light on the movements of grooved tiger prawns in the Gulf.

Northwest Gulf of Carpentaria (1983-85)

One of the primary aims of the FIRTA funded CSIRO tiger prawn project in the northwestern Gulf of Carpentaria was to each of the two tiger prawn species throughout a complete generation. The study began with the spring spawning of 1983 and ran until March 1985, by which time this generation of prawns had all but disappeared from the catches.

The grooved tiger prawn, like the brown tiger prawn, uses inshore seagrass beds as a juvenile nursery area. During the study in the northwestern Gulf, juvenile grooved tiger prawns were most abundant in the nursery areas in the spring and summer months (September to February). They began moving offshore as early as November and continued throughout the summer and autumn months (until May). In February, the greatest catches were still in depths of less than 20m but some individuals were caught as deep as 40m. The population continued to disperse further offshore in the winter months. By June and July the greatest catches were in depths greater than 40m, with good catches still being made at the deepest extremity of the survey area (about 55m).

By August, the pattern began to reverse. Catches in the deepest parts of the survey area (more than 50m) began to decline, while catches in depths of between 30 and 40m began to increase once again. During the spawning season (roughly August to October), this same trend continued, with greatest catches in 30 to 40m. This period and depth zone also corresponded to the highest catch rates in the commercial fishery as well as the highest levels of fishing effort. The increased catches could not be attributed to further recruitment from shallow, inshore waters but are thought to be a result of inshore movement of the prawns from deeper waters. By October, grooved tiger prawns were largely absent from the deepest areas (more than 50m) and by November were absent from depths more than 40m. The remnants of the population continued to be commercially fished during November and early December, in depths between 25 and 40m.

Northeast Gulf of Carpentaria (1986-87)

Another FIRTA funded CSIRO prawn project is presently being carried out in the Albatross Bay region of the Gulf. Although the main objective is to study the recruitment processes of banana prawns (*P. merguiensis*), the population of tiger prawns (mainly grooved tiger prawns) is also being monitored. A series of trawl stations have been established throughout Albatross Bay to a depth of about 45m and are sampled once every four weeks. The study area thus covers the main commercial fishing grounds in this region.

Large numbers of small grooved tiger prawns began appearing in survey catches at inshore trawl stations in November 1986. Catches increased over the summer months until February 1987, after which time the numbers began to decline rapidly - even though the area was closed to commercial fishing until mid-April.

To test the hypothesis that the grooved tiger prawns were moving further offshore than the traditional fishing grounds, additional trawl stations out to a depth of over 60m were sampled in May and July ,1987. Grooved tiger prawns were caught at most of the offshore trawl stations on both cruises. The catches at stations beyond the offshore limits of the commercial fishery were actually greater than those within Albatross Bay.

It is anticipated that the grooved tiger prawn population will return to shallower water (30 to 40m) during the spawning season from August onward. Further offshore cruises are planned over the coming months to monitor their movements.

What factors might be influencing the pattern of movement?

Penaeid prawn species usually have a planktonic larval phase, followed by an inshore juvenile phase, followed by a movement to offshore spawning grounds. Grooved tiger prawns seem to follow this general pattern to a certain extent. The species has reportedly been caught in other parts of the world at depths of 130m, so it should be of no surprise that it was found in the deepest parts of the Gulf of Carpentaria in winter. Why then, does the Gulf population apparently move back into shallower water (30 to 40m) in spring?

To answer this question, we must first consider the shape and water conditions of the Gulf. The Gulf is shaped like to a saucer; over 300 km wide but with a maximum depth of less than 70m. The water in the shallow perimeter (less than 40m deep) is well mixed throughout the year, probably by tides and winds. The water temperature ranges from about 23 deg.C in winter to about 31 deg.C in summer. As the water temperatures begin to increase in spring, the resulting change in water density produces a layer of warm water over the cooler water below (called a thermocline) at between 30 and 40m. By mid-summer, water temperatures at 50m can be as low as 24 deg.C while those at the surface can be over 30 deg.C. Early in autumn (around February or March), the thermocline breaks down and the whole water column becomes well mixed. (It is presently thought that this mixing is associated with the peak tides at this time of the year. This will be examined in a forthcoming research cruise by the RV *Franklin* early in 1988). The waters remain well mixed throughout the winter, but the thermocline forms again in spring.

Our current hypothesis is that it is the colder water below about 40m that starts this movement of grooved tiger prawns back to shallower water. Although no direct evidence has been obtained from tagging studies on this phenomenon, it seems to be the most logical hypothesis.

Our understanding of the seasonal movement of grooved tiger prawns is summarised in Figure 2. This shows the distribution of prawns and the hydrography in summer (February), winter (July) and spring (October), along a cross section of the Gulf (roughly between Groote Eylandt and Albatross Bay). The next step in testing this hypothesis will be to tag and release grooved tiger prawns in the winter months in waters offshore from the commercial fishing ground and to see if tagged individuals are recaptured back in shallower water in spring and summer.

What are the implications if the movement pattern is as suggested?

The most obvious implication from the fisherman's point of view is that tiger prawns may be more abundant in waters deeper than those presently being fished - at least in winter time. The problem here is that the deeper waters of the Gulf represent a vast increase in the area occupied by the prawn population and the potential catch rates may not be commercially viable. In practice it will mean that, because of the present seasonal closures (mid-December to mid-April, and mid-June to the end of July), the grooved tiger prawns will not be subject to fishing pressure before they have dispersed into the deeper waters of the Gulf. Because the fishery concentrates on banana prawns in April and May, there will effectively be little or no fishing pressure on the population before the spawning season. The second opening to the fishing season (the beginning of August) coincides with the migration of the population to shallower water during the spawning season. Furthermore, because of this migration, there is a continuing input of large prawns to the commercially fished population which helps keep the catch rates high.

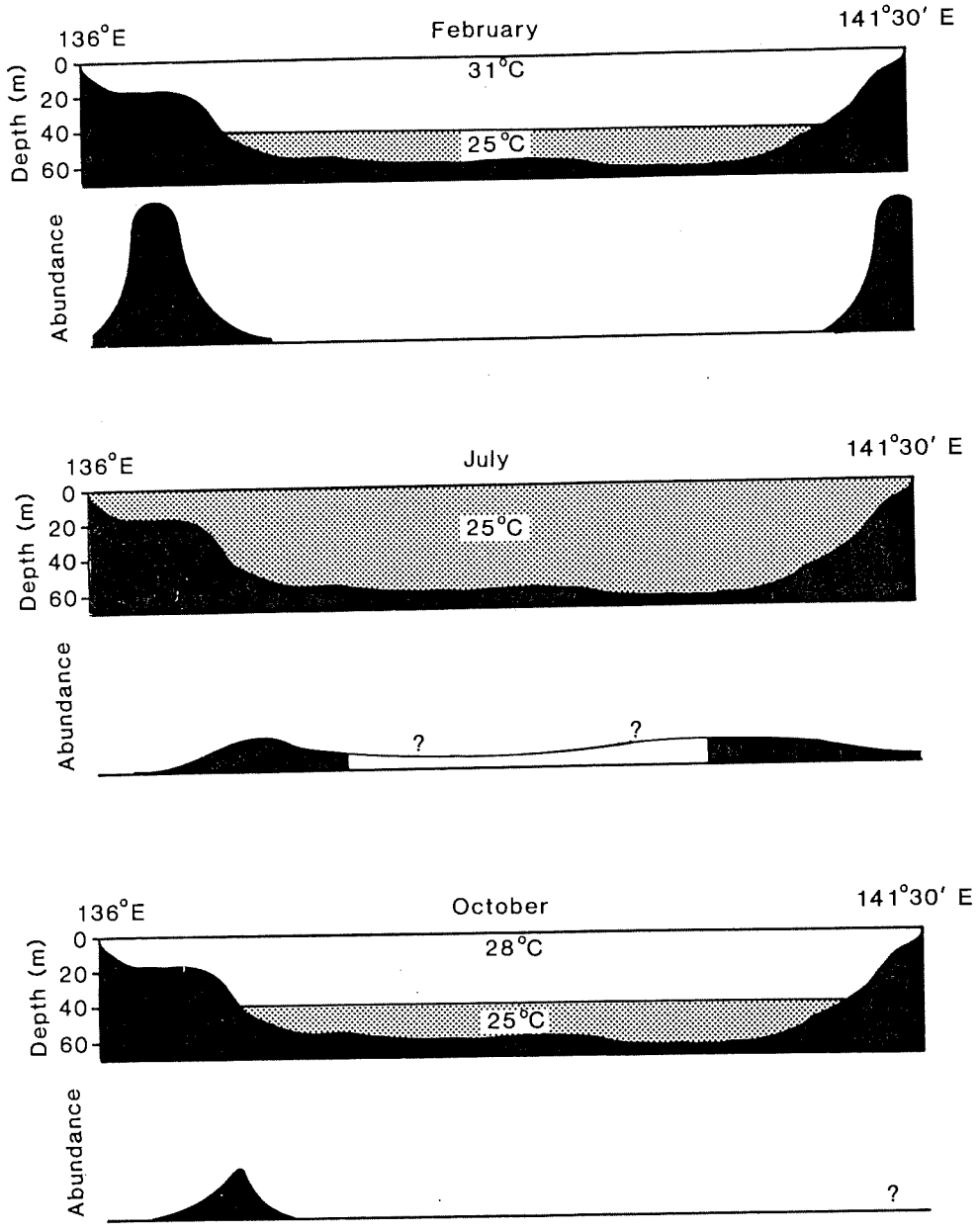


Figure 2. Stylised cross section of the Gulf of Carpentaria at about 13 degrees S showing the summer (February), winter (July) and spring (October) patterns of grooved tiger prawn distribution together with the corresponding hydrographic regime. In February, the greatest abundance of prawns is in the shallow inshore areas (around 20m), with virtually none in depths below the prevailing themocline. In July, the whole water column is completely mixed and the prawns are distributed well offshore in depths beyond those generally fished by the commercial fleet. In October, the thermocline has begun to reform and the prawns aggregate in depths just above the boundary layer (30 to 40m).

Torres Strait Prawn Tagging a Success

DR REG WATSON
QUEENSLAND FISHERIES, CAIRNS

A prawn tagging program was conducted by the Fisheries Research Branch of the Queensland Department of Primary Industries in the Torres Strait during January and February this year as part of an ongoing study of the commercial prawn species in these waters. A team lead by Dr Reg Watson tagged and released over 19,000 brown tiger prawns at two sites in the Warrior Reef area. A biologist from Papua New Guinea, Ms Ursula Kolkolo, also participated in the program. Prawns were marked by numbered blue plastic streamer tags so their growth rates, survival and migration could be studied.

Tagged prawns were released at two locations from the research vessel *Gwendoline May* . One release site was west of the Warrior Reefs, in an area closed to trawling at industry request because of the catches of juvenile prawns. It was believed, but had not been shown, that at least some of the smaller prawns from this area migrated into the fishery to the east. The other tagging area was near Pearce Cay, east of Warrior Reef and just to the north of the Papua New Guinea jurisdiction line.

It was expected that about 5% of the tagged prawns would be recovered. To date, over 1,700 or about 9% have been returned by fishermen. Preliminary analysis has shown that several hundred prawns moved easterly for distances up to 50 nautical miles into the fishery from the closed area to the west of Warrior Reef. These migrations confirm that prawns protected by the closure do indeed make a contribution to the fishery. Prawns tagged near Pearce Cay moved generally south-east although many tagged during February were caught shortly after release.

A $2 reward is given for every tagged prawn returned. Participating fishermen have received letters acknowledging their contribution to the program and listing the growth rates, migration speeds, distances and direction of movement of their returns. Two newsletters with articles on the general results from this program have been distributed among Torres Strait fishermen. Dr Watson is still keen to receive further returns. These should be returned, together with information on the time and place of recapture, to

Northern Fisheries Research Centre
Cnr. Aumuller and Tingira Streets
Portsmith, Cairns 4870

The results of the tagging will be published in the *Queensland Fisherman* later in 1987.

In addition to the tagging study, the Queensland Fisheries Research Branch is continuing monthly surveys of juvenile and adult prawns which began in January, 1986. The information is being analysed, and details on the size, species and movements of prawn stocks will soon be available to fishermen. Another prawn tagging program is planned for February or March of 1988.

Prawn Fishery By-Catch Study

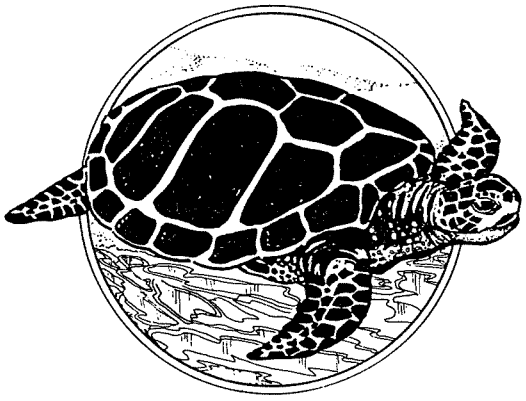
RIK BUCKWORTH AND DARRYL GREY
NT FISHERIES, DARWIN

It has been estimated that the tiger prawn component of the Northern Prawn Fishery discards about 40,000 tonnes of by-catch each year. A small proportion (squid, bugs, scallops and larger fish) is already used but there is little doubt that more could be utilised profitably. An assessment of the potential for marketing other species is therefore highly desirable. The first step it is to establish the species composition, how much of each species or species group is taken, and how this varies with area and with season. For this reason, NT Fisheries with the assistance of the NT Museum, initiated a program to assess the quantity and species composition of trawler by-catch from the Northern Prawn Fishery. Existing information will be used

as well as on-board monitoring of commercial catches, including the appraisal of by-catch handling procedures.

A technical assistant, Mr Russell Willing has begun the task of data collection and specimen identification. It is hoped that a scientist will be appointed to the program shortly.

Marine Turtle Tagging



The Western Australian Department of Conservation and Land Management has recently initiated a study of turtles nesting on the north and north western coast of Western Australia. Titanium metal tags (Figure 3) have been attached to the trailing edge of one or both of the fore-flippers of adult turtles of four of the six species known in Australia. As these turtles will probably move across at least some areas of the Northern Prawn Fishery your help and cooperation are requested. If you should sight one of these, please record

: on which flipper(s) the tag is attached
: tag number(s)
: date of capture
: time of capture
: location of capture
: circumstance of capture
: your name and address
: general comments

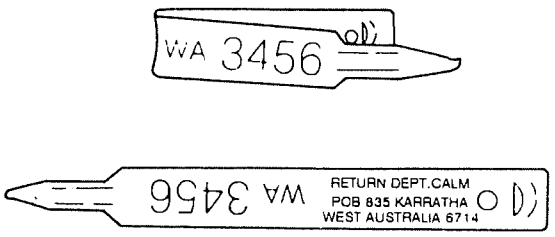


Figure 3. Marine Turtle Tag

If the turtle is alive, the tag(s) should be left intact and the animal released as soon as possible. If dead, the tag(s) can be removed and returned with the information required, but a note indicating that the turtle was dead should be included. Please forward this information to

CALM
P.O. Box 835
Karratha
WA 6714

Tagging work began in the spring of 1986, and just under 1,000 turtles were tagged and released. Tagging will start again in the spring of 1987. The aim of this part of the survey is to study survival and long term movements. Eggs and hatchlings are known to have a very high mortality rate, but individuals that do survive are long lived and may move large distances. Previous studies have indicated a connection between populations in Australia and Indonesia as well as showing some long migrations within Australian waters. For example, a female green turtle tagged in 1986 moved from the Lacepede Islands off the Kimberley coast to Croker Island (some 1500 kms) between 21 November when it was marked, and 6 April, when it was recaptured.

If you are interested in recording more general observations and information on turtle biology and ecology, please contact,

Dr Bob Prince
W.A. Wildlife Research Centre
P.O. Box 51
Wannaroo, WA 6026
Phone (09) 405 5115

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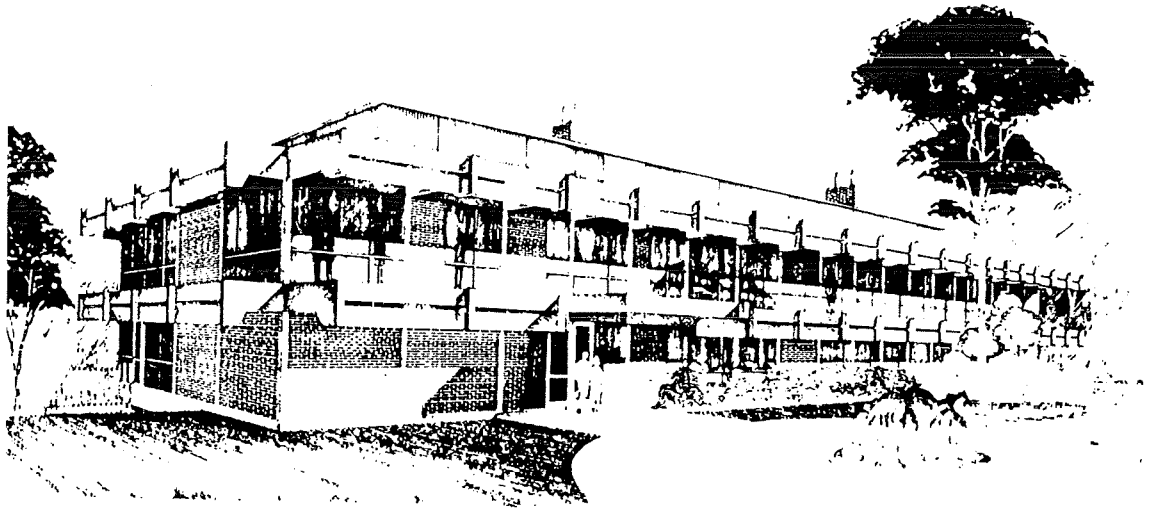
Prawn tagging in Torres Strait. March 1987.

13th NORMAC meeting opens its doors to industry . April 1987.



CSIRO MARINE LABORATORIES

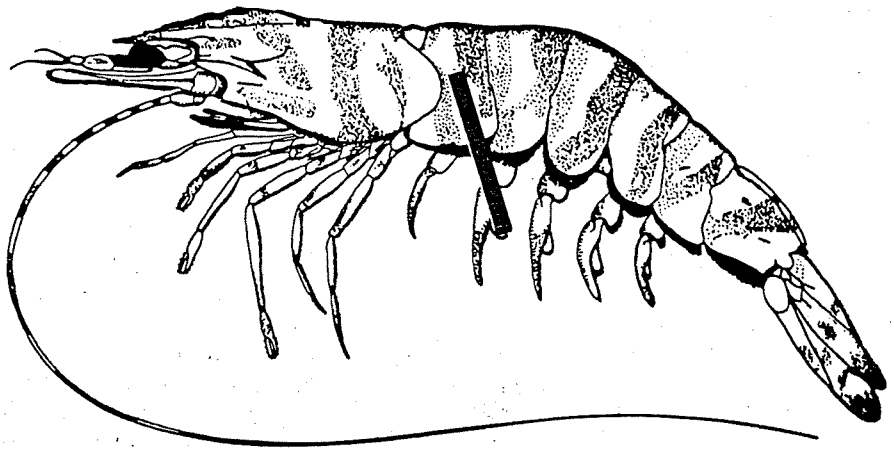
233 Middle Street

Cleveland, Qld 4163

Telephone (07) 286 2022

NORTHERN PRAWN FISHERY INFORMATION NOTES

NUMBER 12 FEBRUARY 1988



Compiled by Brian Taylor

Industry Liaison Officer

CSIRO Division of Fisheries Research

Industry Liaison

CSIRO has continued to support the liaison work in the northern prawn fishery, and NORMAC recently agreed to cover some of the future costs from the research levies collected from industry. As a result, the liaison work will no longer be dependent on grants from FIRTA, who have provided funding since the start of 1982-83.

I mentioned in the October 1987 *Information Notes* that funding for 1987-88 had, however, been severely reduced . Travel has consequently been drastically curtailed and general contact, particularly with fishermen, has been reduced accordingly. Nonetheless, I have been able to produce two issues of the *Information Notes*; I trust my lack of personal contact with you is not reflected in the choice of articles appearing in these issues. I also hope that you will find my choice of agenda items for the 1988 preseason prawn workshop of interest. This year's workshop is being generously sponsored by Trinity Petroleum Services Pty Ltd, Cairns and is being held at the Pacific International Hotel in Cairns on February 16th.

About 125 people attended the 1987 workshop. Of these, about a third were fisheries researchers and managers from government, 20% were known to be fishermen and another third were from fishing companies. I don't know how many of the fishing company people were actually practising fishermen, but I do hope, that as this year's workshop will be held during both northern and east coast closures, more fishermen will attend. These workshops really do offer the opportunity for all involved in the industry to learn more about recent research and other topical activities. The success of the workshop is enhanced through audience participation in the discussion periods so please take the opportunity to question the speakers or to make your comments.

CSIRO Research in the Gulf of Carpentaria - A Progress Report

A wealth of knowledge about the major prawn species has been accumulated over the past decade or so, but with changing circumstances in the fishery, new questions require answers. The current CSIRO project, which began in early 1986, is examining rates of growth and survival, and the factors controlling these rates at each stage in the life history of the major species. Both natural ecological and human influences are being studied. Of particular interest at the moment is the effect of the recent management measures aimed at increasing the spawning populations of tiger prawns.

Although CSIRO can only intensively sample one area at any time, it is essential that changes in the adult population throughout the entire northern prawn fishery be monitored. Your contribution in providing comprehensive and accurate log book information is vital to this program. (See also Ian Somers' article in these notes, "Northern Prawn Fishery Catch Composition"). Furthermore, both the log book data and our own sampling must be long-term, firstly to avoid bias from atypical seasons, and secondly to detect any long-term trends. The climate in the Gulf of Carpentaria, for example, is influenced by the Southern Oscillation (El Nino effect), which varies over a 3-5 year time scale, and so climatic factors could well bias data if sampling were done for only 1 or 2 years. Without log book data over many years, the trends in tiger prawn catch-per-unit-effort could not have been analysed and it would have been far more difficult to make rational management decisions.

Most of the CSIRO field work is being done around Weipa and Groote Eylandt, and field stations have been established at Evans Landing and Bartalumba Bay. Small power boats are used for inshore and estuarine sampling, and the chartered trawler FV *Jacqueline D* is used for regular offshore sampling.

Adult Ecology

Field sampling is carried out from the *Jacqueline D* in and around Albatross Bay. Each lunar month, about 29 trawl stations are sampled to establish the

distribution and abundance of each species, their size and their reproductive stage. Sampling started in March 1986. The second year of sampling has provided comparative data, from which differences in relative abundance and in the timing of spawning peaks has been observed. The grooved tiger has been the most abundant species over any 12 month period during this sampling time, while banana prawns were most abundant in March of both 1986 and 1987. As expected, there was an extremely sharp decline in the number of banana prawns after the opening of the season each year . Very few of the original population survived to the following September-October, the important spawning season for banana prawns.

Water temperatures and salinities are taken at each sampling station and during November 1987, a thermocline with a 3°C temperature drop was noted at a depth of 25 metres. As mentioned in the October 1987 *Information Notes*, water temperature may well be one of the factors influencing the movement of the grooved tiger prawn. Two longer transects to 70 nautical miles offshore were recently added to the sampling regime so that the extreme offshore distribution of grooved tigers in this area could be plotted.

Larval Ecology

Routine larval sampling is carried out from the *Jacqueline D* on the same cruises as the adult prawn sampling. Various sized nets and towing techniques are used to collect samples from throughout the entire water column. As was the case with adults, grooved tigers were the most abundant larvae, with peaks in August of both 1986 and 1987. The number of banana prawn larvae peaked in March of both years, whilst a small secondary peak was also observed in September 1986. Red-tailed endeavour prawn larvae have been found in small numbers on most cruises throughout the year, but larvae of the blue-tailed endeavour have rarely been caught.

Early larval stages are only a couple of days old, and as our samples are taken more or less at the same time as the adult samples, a direct comparison between larval abundance and estimates of egg production from ripe females can be made for each species. Spawning seasons and areas can be determined and the success or otherwise of spawning can be monitored. Evidence is accumulating that some spawnings are a complete failure.

The availability of food and the effect of tides and currents on larval movement obviously influence survival. Information on the seasonal abundance of species of phytoplankton (planktonic plant life) on which prawn larvae feed is therefore being collected. Inshore water currents are being measured with land based radar to provide more information on how prawn larvae find their way into the estuary system. This last project is being undertaken in conjunction with James Cook University .

Juvenile Ecology

Resident CSIRO staff at Weipa (Mick Haywood) and Groote Eylandt (Rob Kenyon) are assisted by staff from Cleveland when samples are taken from the inshore nursery grounds. Small beam trawls are used on established stations over various habitats in both areas, and in the Weipa estuary, set nets are also used to monitor migration from the nursery areas out into Albatross Bay.

In the Weipa estuary, marked seasonal differences in the abundance of juveniles of both tiger prawn species have been noted from that of five years ago when similar sampling was carried out. The seasonal distribution of banana prawns, however, was similar to that of 1981-82, with the largest juvenile population found from March through to June. Rainfall seems to be less important in prompting emigration of juvenile bananas from this area than is the case in more southerly parts of the Gulf of Carpentaria.

In the Groote Eylandt area, ten regular beam trawl stations have been established along the north coast of the island and in Blue Mud Bay. In the two years of sampling, the number of juvenile tiger prawns caught each season at each station has been remarkably consistent. We now have data on juvenile prawn abundance at some sites for four years; so far these numbers do not match up with the large decline seen in adults offshore. The factors prompting offshore migration and affecting juvenile mortality are being investigated further to try to explain this apparent anomaly.

Predation

Fin-fish predators of prawns are being studied on both the commercial grounds and the inshore nursery grounds at Weipa. The work initially involves identifying predators and ascertaining the species of prawns eaten. The project will eventually attempt to estimate the impact of these predators on the prawn populations.

Gill and seine nets have been used to sample fish on the prawn nursery grounds of the Weipa estuary system and the stomach contents of over 3000 fish have so far been examined. The main inshore predators have been shown to be barramundi, queenfish and threadfin salmon.

Fish trawls with both 100 mm and 50 mm codend mesh have been towed by the *Jacqueline D* for sampling fish on the commercial prawn grounds of Albatross Bay. (As pointed out in the February 1987 *Information Notes*, prawn trawls are designed to catch prawns not fish). Four offshore cruises have been completed and over 5000 stomachs of fish from these grounds have been examined. The major predators in this area are sharks and trevally.

The abundance and diet of predators varies with season and with area, and hence estimates of predation at each stage of the prawn life history require much more field data, which will be collected as the study progresses.

Do Changes in Water Temperature Affect Prawn Catches?

Burke Hill
CSIRO, Cleveland

Fishermen operating in temperate areas of Australia such as Moreton Bay, know that prawn catches drop during the winter time. Part of this drop is due to a decrease in the number of prawns available because of fishing mortality, natural mortality and migrations, and part is due to lower temperatures. Are the seasonal differences in temperatures in tropical areas such as the Gulf of Carpentaria large enough to affect catches in these regions? To answer this question we need to know something of the biology of prawns.

Most species of prawns bury in the substrate during the day. They bury whenever they are exposed to light. Some species are very sensitive to light; king prawns, for example, bury on moonlit nights. Tiger prawns show a very clear response to light, usually remaining buried during daylight. However, young prawns are less sensitive to light and often emerge during the day.

Although tiger prawns don't bury very deeply (their eyes are nearly always exposed), they are not usually caught by trawling when they are buried. As a result, tiger prawns are more catchable at night when they emerge and are walking around, than they are during the day when most are buried.

Anything that changes the length of time prawns spend buried or emerged will change their catchability. For example, if the water is muddy, less light can penetrate and prawns may spend more time emerged and will be more catchable.

At the CSIRO Marine Laboratories at Cleveland, there are excellent facilities for testing the effect of various factors on the behaviour of prawns. So far, experiments on the effect of temperature have been carried out on both the brown and grooved tiger prawns. Prawns have been kept singly in 2 m diameter tanks in a laboratory in which light and temperature can be controlled. The tanks are lit by white light in the day and by red light at night. Red light does not penetrate seawater well, and so very little is normally present in the sea. Consequently, most marine animals have poor vision in red light and when the tanks are lit by red light at night, the prawns act as if it were dark. They can then be observed with television cameras that are highly sensitive to red light . Time-lapse recorders are used for continuous monitoring, as they allow a 12 hour recording to be played back and analysed in about 10 minutes.

Results from experiments on brown tiger prawns and grooved tiger prawns were almost identical.

Temperatures above 27°C did not affect emergence, but when they dropped below 26°C, they did. At 22°C, prawns spent about 40% less time on the substrate surface at night than they did at 27°C. Temperatures below 22°C are uncommon in deeper waters in the Gulf of Carpentaria, but are typical in winter in areas such as Moreton Bay. At a temperature of 18°C, emergence is down to about 30% of that at 26°C. If we assume that catchability is affected to exactly the same extent as emergence, then a drop in temperature of 5-10°C would cause a decrease in catch of about 40-75%.

The decrease in the catch of tiger prawns in the Gulf of Carpentaria in June-July is part but not wholly, caused by a drop in temperature. Other causes, such as the depletion of the population by fishing and by predation, also contribute. In the case of grooved tigers, the offshore migration into deeper water (described by Ian Somers in the October 1987 *Northern Prawn Fishery Information Notes*) results in fewer prawns being available for capture on the trawl grounds at this time.

Northern Prawn Fishery Catch Composition

Ian Somers
CSIRO, Cleveland

Throughout the history of the northern prawn fishery, scientific organisations have enjoyed a considerable degree of cooperation from the fishing industry in obtaining basic commercial catch and effort data. Evidence of this is the large body of logbook data spanning some eighteen years. However, one of the problems with the fishery data has been that the commercial species groups are each made up of more than one species. For example, the tiger prawn group includes the brown tiger and the grooved tiger species. This has created difficulties in assessing stocks in the fishery and has underlined the need for supplementary information on the species composition of each of the commercial groups.

To obtain this information, CSIRO has once again turned to the fishing industry for assistance. In March this year, we will be conducting a short training course at the CSIRO Cleveland Laboratory for a small group of people from the fishing industry. The course will cover species identification and sampling techniques as well as showing participants what other research we are doing. As the catch composition data can be collected without disrupting normal fishing activities, we expect that the participants will soon be providing us with valuable information about the individual species.

NORMAC has enthusiastically supported the project and has granted funds obtained from the research levies to meet the travel and accommodation costs of participants in the scheme, as well as providing some compensation for the additional work while at sea. The number of participants in the first year will be limited to ten, most of whom will be sea-going staff already involved in quality-control catch assessments on behalf of the various fishing companies.

The results of the project will be publicised in future editions of the *Information Notes.*

Productivity of Seagrass Beds

David Moriarty
CSIRO, Cleveland

Detailed studies of the productivity of some of the seagrass beds around Groote Eylandt and Weipa have been carried out by CSIRO over the past eighteen months. The productivity in seagrass beds is generally very high, with primary productivity (the production of plant material) being roughly equivalent to sugar cane on the land. As with agriculture there is marked seasonal variation: summer productivity is about five times greater than that in winter.

Seagrass beds with high primary productivity have been found to support dense populations of juvenile prawns. Bacteria play an important role in these systems: juvenile and adolescent prawns feed on many of the small animals (worms, bivalves, snails, brittle stars, other crustaceans) that rely on bacteria as a food source.

Another important aspect of bacterial activity is nitrogen fixation. Nitrogen is an important nutrient, which, when lacking, is often found to limit productivity in the sea. It is certainly essential to the growth of seagrass. Bacteria are the only organisms that can convert nitrogen gas dissolved in water or in the atmosphere to ammonia or other chemical forms, which can then be used to make protein. These bacteria are very active in seagrass beds which they depend on for the organic matter they decompose to supply them with the energy needed to fix atmospheric nitrogen.

Besides providing sites in which the prawns find shelter and food then, seagrasses have a major role in assisting the bacterial fixation of nitrogen thus ultimately supplying the protein needed by juvenile prawns.

Historic Catch and Effort Data in the NE Queensland Trawl Fishery

Yvette Beurteaux
Queensland Fisheries, Cairns

In a project funded by the Queensland Fish Management Authority, the Queensland Government's Northern Fisheries Research Centre in Cairns is collating historic catch and effort data for the northern sector (Townsville to Cape York) of the east coast prawn fishery.

Catch and effort data form a basis for the effective management of all fisheries, but this type of information has not been readily available for the east coast prawn fishery. However, several sources of this data have been identified. Analysis of berthage records for the port of Cairns and aerial surveillance sightings of trawlers show that the use of north-eastern trawl grounds increased 34% between 1983 and 1986, with over 20% of the whole east coast fleet operating out of Cairns at some time during 1986.

Trawler length and licence type, skipper (employee or owner) and the use of mothership and fuel barge facilities were all shown to influence fishing effort (days at sea). Cairns-based trawlers licensed to fish only on the east coast spent an average of 206 days at sea in each year from 1983 to 1986. Those licensed to fish on the east coast and in the northern prawn fishery spent an average of 214 days at sea in 1983, increasing to 253 days in 1986.

Aerial surveillance sightings have shown that the annual fishing effort expended by the trawl fleet on major north-eastern trawl grounds (Princess Charlotte Bay and Cape Flattery) has remained fairly constant from 1983 to 1986. Most of the 34% increase in total fishing effort for the north-eastern region was accounted for by increased activity adjacent to Cairns and expansion of trawl grounds north of Lloyd Bay.

Catch data are still being collated. Once analysed, these data will show the effect of the trends in fishing effort we have already identified. Interested north-eastern trawlermen have been asked for access to their personal logbooks so we can verify primary data sources and ensure the accuracy of findings. If you can help, Yvette Beurteaux at the Queensland Fisheries Laboratories, Aumuller Street, Cairns would be pleased to hear from you.

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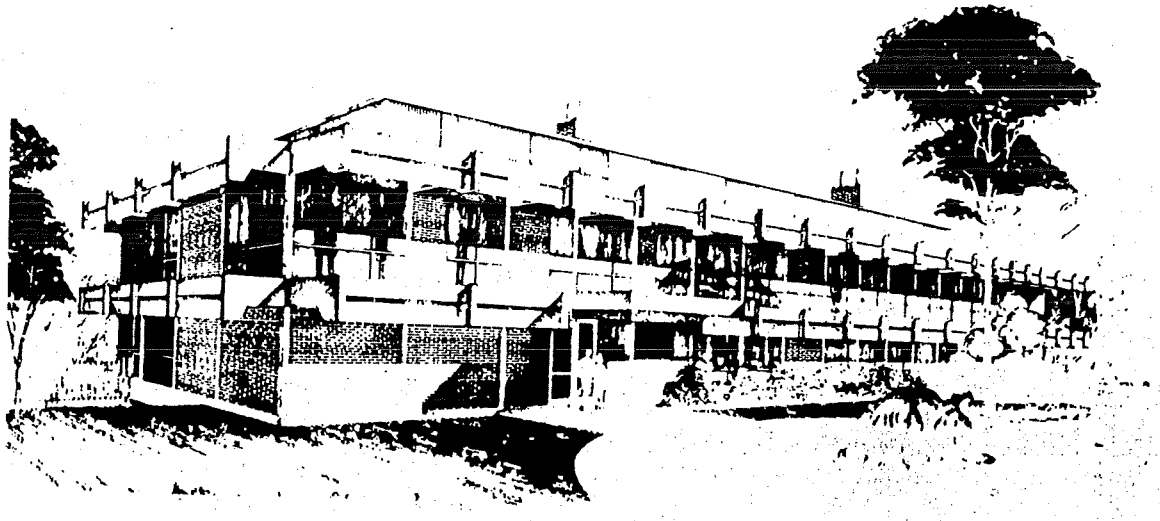


CSIRO MARINE LABORATORIES

233 Middle Street

Cleveland, Qld 4163

Telephone (07) 286 2022

CSIRO
Marine Laboratories
INFORMATION SHEET
No. 2 February 1987

CSIRO prawn research and the Cleveland Regional Laboratories

Brian Taylor
Division of Fisheries Research

CSIRO Marine Laboratories
PO Box 120, Cleveland, Qld 4163

Introduction

CSIRO has been involved in research in the northern prawn fishery for many years. In the early 1960s, Mr Ian Munro of the CSIRO Division of Fisheries led a joint industry and government survey of the south-eastern parts of the Gulf of Carpentaria. Field work was carried out from a temporary base-station at Karumba. The potential for a commercial banana prawn fishery was demonstrated, and a daylight fishery directed at this species soon developed.

Cleveland laboratories (1984)

Three main objectives have been set for this new project:

1. To identify the main causes that significantly affect growth and mortality at each of the major stages in the life history of prawns (larval, postlarval, juvenile, sub-adult and spawning stages).

2. To establish a long-term sampling program of juvenile prawns to determine the extent to which the above factors may limit the fishable stock of prawns.

3. To develop quantitative models of recruitment in the three major commercially important species (brown tiger, grooved tiger and banana prawn) to describe the stock-recruitment relationship of each species.

This is a closely integrated project, which is perhaps most easily understood if we consider the staff groupings along with the generalised life-history diagram. The major field-work component will be carried out by four groups, each studying a specific stage of the prawn's life cycle: the larval, juvenile and adult ecology groups and the reproductive biology group. Another project to study fish predation of both juvenile and adult prawns in their respective habitats has also recently been established. Field stations have been set up at Groote Eylandt and Weipa and inshore sampling has begun in both of these areas. A chartered trawler is used to take regular lunar monthly samples both inshore and offshore in the Weipa area.

Laboratory studies will support field work and vice versa. The physiology, behavioural, seagrass and bacterial productivity groups, in particular, are involved in laboratory work. These groups study prawns at all stages and hence all ages. Large new aquarium tanks for some of these experimental studies have recently been installed at Cleveland.

Information on research results

Information on the current project will be made available to fishery managers working in the northern prawn fishery, to industry generally, to the scientific community and to any other interested parties. CSIRO Division of Fisheries Research is represented on the Northern Prawn Fishery Management Committee (NORMAC), and a representative from the Cleveland laboratory reports directly to this committee. Industry generally is kept informed through written material in appropriate magazines, through the Preseason Prawn Workshop and through personal contact with the northern prawn fishery liaison officer and other field staff. Presentations at seminars and publication of data in scientific journals and books serve the scientific community and, from time to time, general information leaflets and talks are prepared for other interested groups.

Further information

This leaflet has presented a general outline of the Cleveland laboratories and the associated work program. If you are interested in further details, please contact Brian Taylor

Industry Liaison Officer
CSIRO Marine Laboratories
PO Box 120
Cleveland, Qld 4163

Plankton nets

CSIRO DIVISION OF FISHERIES RESEARCH
information service

PRAWNS

Commercial quantities of the banana prawn (*Penaeus merguiensis*) were first located in the Gulf of Carpentaria during a 1963-65 survey carried out by the then CSIRO Division of Fisheries and Oceanography, the then Queensland Department of Harbours and Marine, the Commonwealth Department of Primary Industry and the fishing company Craig Mostyn and Co Pty Ltd. A fishery was soon started and development was spectacular. By 1971 vessel numbers had risen to about 300, a fishery for tiger and endeavour prawns was being developed and grounds extending throughout the Gulf were being exploited. During the 1970's large freezer vessels designed specifically for trawling in the north began replacing the smaller, original east coast style "wet" vessels. At the same time, fishing grounds were extended outside the Gulf and across northern Australia. In 1977 the fishery was declared limited entry so that only specially endorsed vessels could fish in the declared management zone (DMZ).

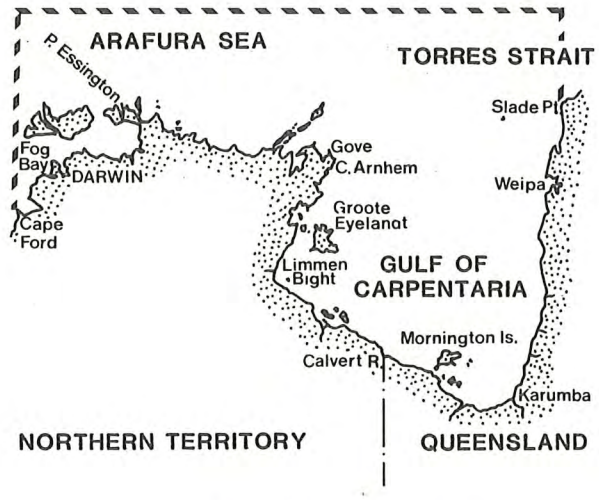


Fig.1 Declared Management Zone

As well as providing biological data for consideration by management authorities, CSIRO prawn research (which is carried out from the Marine Laboratories at Cleveland, Brisbane) also provides industry with more general information. Although the research now covers several species it was previously directed mainly at banana prawns. This component of the northern prawn fishery is characterised by large fluctuations in annual landings and this has given rise to concern as to the stability of the resource.

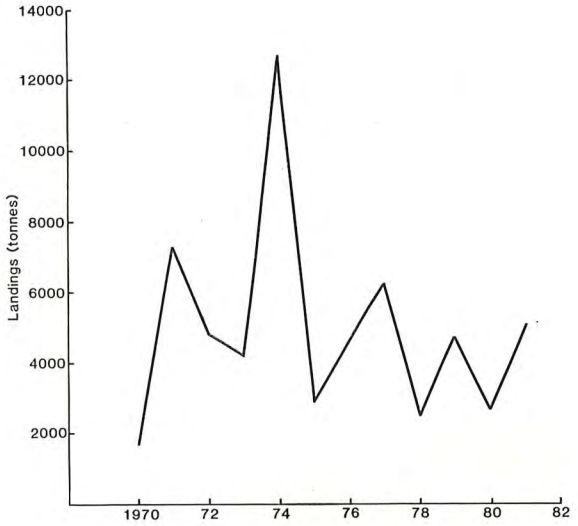


Fig.2 DMZ banana prawn landings

The banana prawn fishery has been shown to have been fully exploited since about 1971 and fishing effort (measured in boat days) has remained more or less constant for the past 10 years. Banana prawns are relatively short-lived and so the resource is essentially renewed annually. Fluctuations in landings are therefore an indicaor of the variation in the size of the resource from year to year.

This predictive model has explained about 50% of catch variance. The effect of factors such as temperature and prevailing winds is also being examined and it is possible that in some areas the year to year variation in the commercial catch may be more closely related to differences in larval recruitment into the inshore nursery areas.

These notes have summarised only some of the results of CSIRO's banana prawn research project. Further enquiries should be directed to:

Brian Taylor
Industry Liaison Officer
CSIRO Marine Laboratories
233 Middle Street
Cleveland Qld 4163
Phone: (07) 2862022

September 1982

CSIRO
Marine Laboratories
INFORMATION SHEET
No. 1 February 1987

Seagrass and cyclones in the western Gulf of Carpentaria

Rob Kenyon and Ian Poiner
CSIRO Division of Fisheries Research

CSIRO Marine Laboratories
PO Box 120
Cleveland, Qld 4163

Introduction

In April 1984, the CSIRO Division of Fisheries Research surveyed the seagrass communities between the Sir Edward Pellew Group of islands and a point to the north of Rantyirrity Point in the western Gulf of Carpentaria. Previous work had demonstrated that seagrass beds are an essential habitat for juvenile tiger and endeavour prawns and this survey was designed to identify any such nursery grounds.

Tiger prawn in seagrass

Seagrass bed

Discussion

The centre of 'Sandy' passed 60 km south of the Rose River. Despite destructive winds in the area, the healthy seagrass remaining suggests that the velocity of the wind was not enough to cause damage. It would seem, then, that in respect to seagrass, the destruction swathe of a cyclone is a relatively narrow region near the centre. For a cyclone to destroy large areas of seagrass it would have to travel parallel to the coast for quite some distance. If it neared the coast and crossed immediately, then disturbance would probably be restricted to a small area each side of the point at which the coast was crossed.

Other CSIRO research has shown that the post-larvae of both tiger and endeavour prawns settle only in the shallowest of the inshore seagrass beds, and not in the deeper-water beds. The destruction of these close inshore beds is therefore particularly disturbing.

Post-cyclone survey 2

A second post-cyclone survey was carried out in April 1986 to observe and record the rate of recovery of the seagrass beds. The entire area from West Island to north of Rantyirrity Point was again examined. A dramatic longer-term effect was found: the impacted beds between West Island and the Limmen Bight River have now been completely removed (all 183 km^2), presumably by the scouring of the few remaining shallow inshore beds and the smothering of the deeper-water beds by the fine mud recorded before.

The complete destruction of these beds represents an estimated 14% reduction of the entire Gulf of Carpentaria seagrass beds and a decrease of 41% in the seagrasses of the Limmen Bight region. It would seem intuitive that a reduction in seagrass area would lead to a reduction in prawn numbers, and although the exact relationship between nursery areas and adjacent commercial fisheries is unclear, this cyclone may well have had a significant effect on the tiger prawn fishery in this area.

Catch reports for 1986 have so far certainly indicated an extremely low abundance of both tiger and endeavour prawns, but as these low catches have occurred across all of northern Australia, we can hardly attribute this to destruction of seagrass in the Limmen Bight area. It may be some time before we know the full effects of the cyclone, as we have yet to collect current catch and effort data from processors and fishermen in this region.

Further information

For further details about this work please contact the authors direct or

Brian Taylor, Industry Liaison Officer
CSIRO Marine Laboratories,
PO Box 120, Cleveland, Qld 4163

Early results reveal value of tiger prawn tagging in Gulf of Carpentaria

With the help of commercial fishermen, biologists are increasing their knowledge of tiger prawn stocks in the Gulf of Carpentaria, knowledge that will be used in management of the fishery. Here biologists I. F. Somers, G. P. Kirkwood, B. R. Taylor (CSIRO Division of Fisheries Research) and N. Carroll (Fisheries Division, NT Department of Primary Production) detail some of the early results from tagging experiments in the Gulf.

WHEN the prawn fishery of the Gulf of Carpentaria commenced in the late 1960s it was based mainly on the banana prawn. However in recent years this has changed because of the large increase in fishing effort for other species, mainly tiger prawns. Tiger prawn catches now constitute the major part of the annual landings from the fishery. Despite the importance of tiger prawns to the fishery, there has been very little research into either the biology of the species or the extent of the resource.

As part of a preliminary research program on tiger prawns, scientific and technical staff from CSIRO, Northern Territory Fisheries Division and Queensland Fisheries Service tagged and released 20 000 tiger prawns in the western Gulf of Carpentaria near Groote Eylandt in 1981. To date almost 3 000 tagged prawns have been recaptured.

The tagging experiments had three main aims:

- estimate tiger prawn growth rates;
- study tiger prawn migration patterns; and
- estimate mortality rates in the fishery under different levels of fishing effort, and thereby estimate the current level of exploitation.

The tagging experiments were in two parts. The first tagging cruise was completed in February 1981, using the commercial fishing vessel *Xanadu J*, skippered by Marcus Westlake. The second was completed in June 1981 using two vessels — *Faysea-G* skippered by Jeff Hutley, and *Mable-K* skippered by Warwick Smyth.

The first series of experiments was at a time of the year when fishing effort was concentrated on banana prawns in the eastern Gulf, with minimum fishing effort on tiger prawns. This potentially allowed the tagged tiger prawns a longer time at liberty before recapture and thus was likely to provide better information on growth rates and migration patterns. The second series in June was timed to coincide with the increased fishing effort on tiger prawns (highest around July and August). In this way fishing mortality estimates could be made from experiments conducted during periods of different fishing intensities.

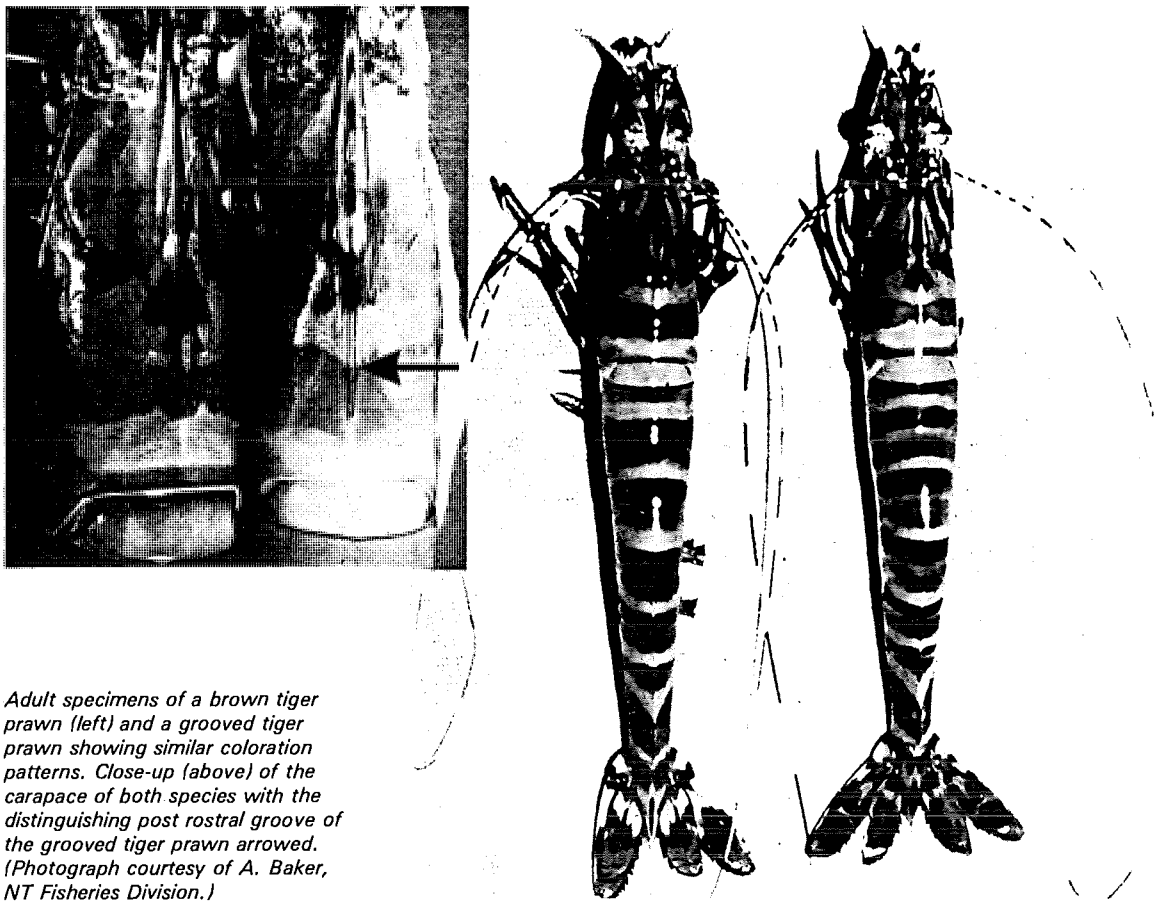
There are two species of prawns commonly referred to as 'tiger prawns' in the Gulf of Carpentaria. They are the brown and the grooved tiger prawn.

The brown tiger prawn (*Penaeus esculentus* Haswell) has only ever been recorded in Australian prawn fisheries. It is caught in northern waters from Shark Bay on the west coast to Moreton Bay on the east coast.

The grooved tiger prawn (*Penaeus semisulcatus* de Haan) sometimes referred to as the green tiger prawn, has a wider distribution than the brown tiger prawn. Although it does not extend as far south as the brown tiger prawn in Australia's northern prawn fisheries, this species is a major component of prawn fisheries of New Guinea, Indonesia, India, the Persian Gulf and East Africa.

The two species have very similar color patterns and are not easily distinguished. (Commercial fishermen record catches of both species grouped as tiger prawns.) The simplest way to separate the two species is to look for the very small groove in the ridge at the rearmost part of the rostrum of the grooved tiger prawn (see photograph). It also seems the grooved tiger prawn is more vulnerable than the brown tiger prawn to the infestation of a crustacean parasite (bopyrid isopod) that attaches itself to the gills of the prawn. Its presence is seen as a swelling on the side of the prawn's carapace. During the tagging period about 15 per cent of grooved tiger prawns carried the parasite but none of the brown tigers.

To obtain undamaged prawns suitable for tagging, trawls were kept to about 30 minutes. Once on board, the live prawns were immediately transferred to holding tanks with circulating seawater. The size, sex and species of each prawn was recorded alongside the number of the tag. The tagged prawn was then placed in a release cage in a separate holding tank before release. With the vessel stationary the release cages, each holding up to 200 prawns, were lowered to the bottom and the prawns set free.



Adult specimens of a brown tiger prawn (left) and a grooved tiger prawn showing similar coloration patterns. Close-up (above) of the carapace of both species with the distinguishing post rostral groove of the grooved tiger prawn arrowed. (Photograph courtesy of A. Baker, NT Fisheries Division.)

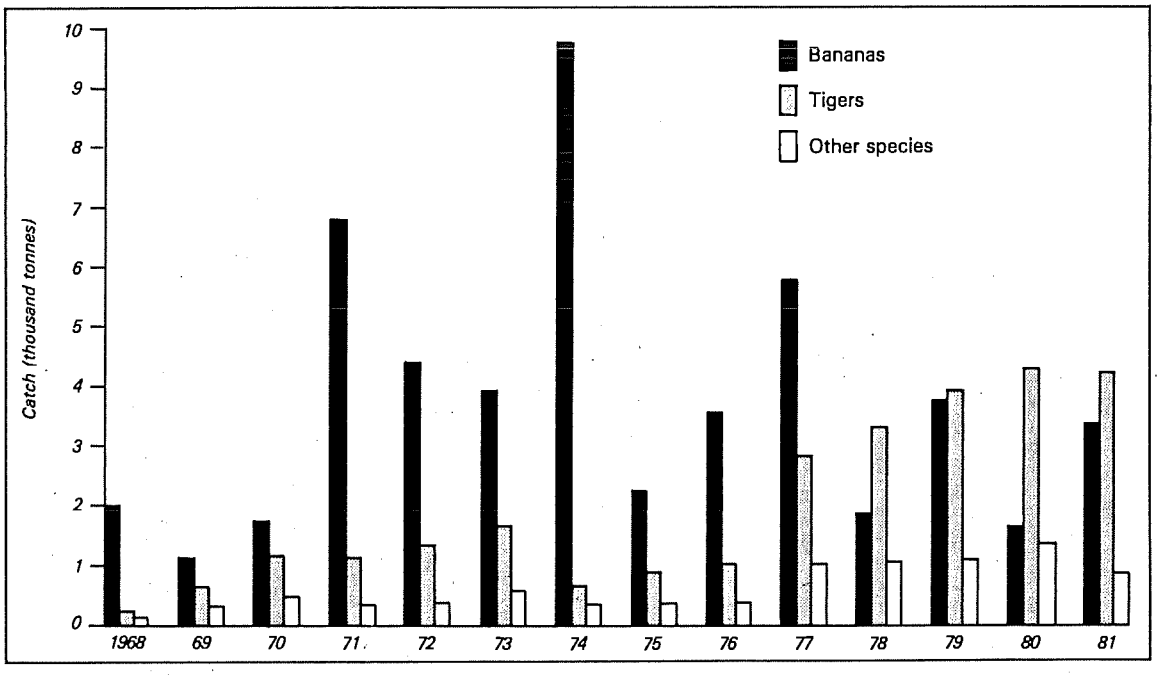


Figure 1: *Annual prawn catches from the Gulf of Carpentaria for the years 1968 to 1981, showing the variation in banana prawn catches but steadily increasing tiger prawn catches.*

Migration patterns

In general the movement of tagged prawns was as fishermen would expect from shallow to deeper water. The main release area for the experiments in February was around the entrance to Blue Mud Bay in depths between 20 and 25 metres. Within six months, recaptures of these prawns were mainly in depths of 30 to 45 metres.

Of more interest, however, was the different general direction of movement shown by the two species from these releases. Recaptures of grooved tiger prawns were widely distributed north-east of the release area, with at least eight recaptures north of Cape Grey, more than 100 kilometres from the release area. In contrast, brown tiger prawns were recaptured east and south of the release area (see Figure 2).

During the series of experiments conducted in June 1981, tagged prawns were released in two main areas. One area was basically the same as for the February series, north of Groote Eylandt, while the other was south of the island. The average size of prawns released was larger than in the February experiments and, as might be expected, the patterns of movement slightly different. In the case of the releases north of Groote Eylandt, the prawns did not seem to move as far and the overlap in the distribution of each species seemed to be greater than in the earlier experiment.

The prawns tagged in June, south of Groote Eylandt, were mainly brown tigers. These showed much less movement than those to the north of the island, with only a gradual dispersal and shift to marginally deeper water. Of the grooved tiger prawns released in this area, five of the 70 recovered were recaptured to the north of Groote Eylandt, suggesting some intermixing of stocks throughout the region (see Figure 3).

Although we have a large amount of recapture information, tagged prawns can not be recaptured from areas in which there is no fishing effort. The full analysis of migration patterns can only be undertaken when the pattern of fishing effort is taken into account. This will be possible when all of the relevant fishermen's logbook information has been collected and processed.

Growth rates

Because prawns were measured individually before release and because fishermen were very cooperative in returning the recaptured prawns and tags, it has been possible to measure rates of growth for both males and

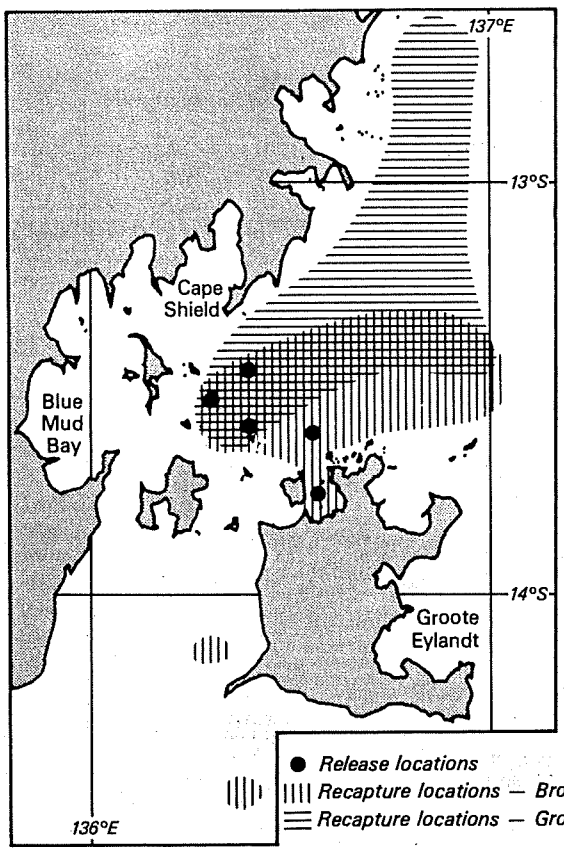


Figure 2: The tagging area around Groote Eylandt in the Gulf of Carpentaria, with the release and recapture areas for prawns released in February 1981.

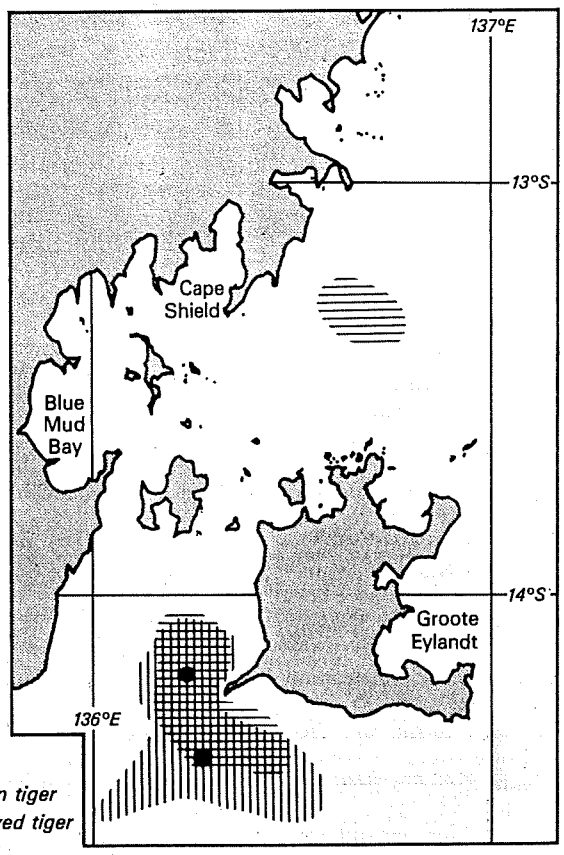


Figure 3: This map shows the location of release and area of recapture for prawns released in June 1981 in the tagging area south of Groote Eylandt.

females of each tiger prawn species.

As with most prawns, the females grew faster and to a larger maximum size. But more significant was the marked difference between the species. The rate of growth is faster and the maximum size attained is larger for the grooved tiger prawn than for the brown. This can be demonstrated easily by applying the growth models obtained from the tagging experiments to a hypothetical situation where prawns of each sex and each species are the same size (equivalent to 150 prawns a kilogram) in December of any year. The sizes that each prawn would attain over the subsequent year are given in the table.

A knowledge of these rates of growth is important when assessing the effects of closing areas (temporarily or permanently) on total yields.

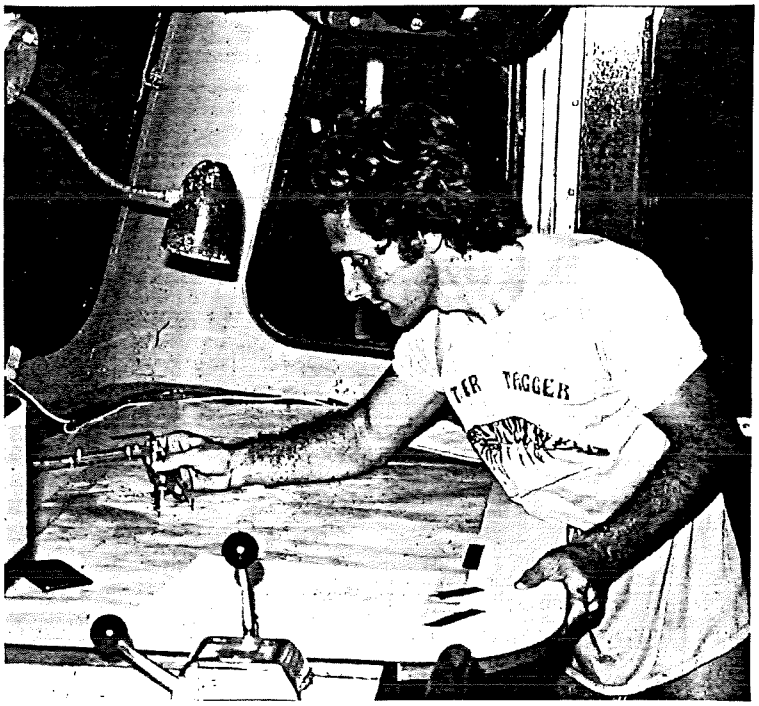
Mortality rates

Estimates of mortality rates are based on the rate of decline over time in the number of tags returned. However, because the numbers returned must first be adjusted according to the varying level of fishing effort, such an analysis must await final collection and processing of all the relevant logbook information.

Fishing industry role

The success of prawn-tagging experiments depends heavily on the degree of interest and co-operation by the fishing industry. The amount of useful information obtained is greatest when recaptured tagged prawns, together with the relevant details regarding time and place of recapture, are returned directly from fishing vessels.

Previous tagging experiments in the Gulf have not been as successful because most of the prawns recaptured were not found until they had reached a processing plant. Although tag returns from processing plants are still important in estimating mortality rates, without accurate information on date and location of recapture they add nothing to our knowledge of growth and migration of the species.



Jeff Hutley, skipper of Faysea-G, *recording the vessel position during the release of a batch of tagged prawns.*

Growth of tiger prawns over one year. Size is given in terms of the number of prawns to the kilogram

	Brown tiger prawn		*Grooved tiger prawn*	
	Male	*Female*	*Male*	*Female*
December	150	150	150	150
February	95	62	73	61
April	52	38	48	35
June	41	29	37	24
August	35	23	31	18
October	32	20	28	15
December	29	18	26	13

In this present series of experiments there has been a marked improvement in data quality, with almost 90 per cent of recaptures coming directly from the fishing fleet.

Two contributing factors are the use of blue streamer tags, which seem to be more noticeable than red tags previously used, and an increase in the amount of on-board processing of the commercial catch.

An equally important contribution by fishermen to the research project is the completion of logbook records. As mentioned earlier, the pattern of tagged prawn recaptures is not meaningful unless the pattern of fishing effort is taken into account. The fact that no tagged prawns were recaptured in any area may simply be a result of no fishing effort there at that time.

We hope that fishermen have gained an appreciation of the importance of fishing effort data to the experiments. By continuing to maintain accurate logbooks they can help provide a more precise and detailed understanding of the fishery.

1987 PRESEASON WORKSHOP BANANA PRAWN CATCH/RAINFALL

Area	10 Year Averages			1985-86			1986-87			
	Sept to January Rain(mm)	Sept to February Rain(mm)	1975-84 Catch (Tonnes)	Sept to February Rain(mm)	Predicted Catch (Tonnes)	Actual Catch (Tonnes)	Sept to January Rain(mm)	Predicted Catch (Tonnes)	Sept to February Rain(mm)	Predicted Catch (Tonnes)
WEIPA	964	1421	657	1134		566*	696		1449	
MITCHELL RIVER	594	982	406	947		358	458		686	
KARUMBA	363	636	971	550	791 (373-1210)	320	388	973 (569-1378)	573	881 (481-1260)
MORNINGTON ISLAND	587	959	267	784	173 (0-386	12	432	218 (4-432)	676	151 (0-373)
LIMMIN BIGHT	346	673	292	355	128 (0-422)	31	199	121 (0-346)	587	262 (51-472)
GROOTE EYLANDT	591	909	114	427		42	646		1296	

*Incomplete estimates

1988 PRESEASON WORKSHOP

BANANA PRAWN CATCH/RAINFALL

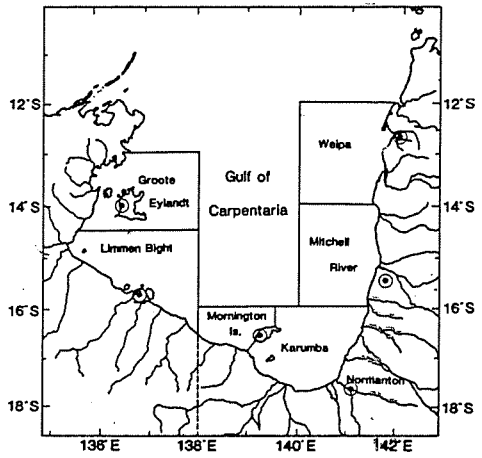
	10 Year Averages		1986-87		1987-88	
Area	Sept. to January Rain (mm)	1977-86 Catch (tonnes)	Sept. to January Rain (mm)	Estimated catch (tonnes)	Sept. to January Rain (mm)	Predicted Catch + Range (tonnes)
Weipa	917	670	696	778	961	
Mitchell River	569	320	348	691	365	
Karumba	365	868	388	440	272	831 (348-1316)
Mornington Island	555	240	432	73	622	362 (166-558)
Limmen Bight	317	352	199	274	343	258 (107-410)
Groote Eylandt	574	144	646	116	287	

Predictions based on rainfall are only made for the Karumba, Mornington Island and Limmen Bight regions.

GULF OF CARPENTARIA

BANANA PRAWN CATCH/RAINFALL, 11 MARCH, 1988.

Area	10 Year Averages			1986-87			1987-88			
	Sept. to January Rain (mm)	Sept. to February Rain (mm)	1977-86 Catch (Tonnes)	Sept. to January Rain(mm)	Sept. to February Rain (mm)	Estimated Catch (Tonnes)	Sept. to January Rain(mm)	Predicted Catch (Tonnes)	Sept.to February Rain(mm)	Predicted catch (Tonnes)
Weipa	917	1361	670	696	1514	778	961		1278	
Mitchell River	569	908	320	458	728	691	365		546	
Karumba	365	539	868	388	547	440	272	831 (348-1316)	443	678 (166-1190)
Mornington Island	555	808	240	432	917	73	622	362 (166-558)	840	224 (4-444)
Limmen Bight	317	615	352	199	587	274	343	258 (107-410)	556	206 (27-439)
Groote Eylandt	574	849	144	646	1297	116	308		505	



1988 RAINFALL + BANANA CATCH PREDICTION

= SEPTEMBER TO MARCH

	10 year average rain	1987 rain	1988 rain	CATCH PREDICTION
NEIPA	1689mm	1821mm	1464mm	670 tonnes
MITCHELL RIVER	1098mm	872 mm	585mm	320 tonnes
KARUMBA	667 mm	593 mm	472	425 (0-923)
MORNINGTON ISLAND	1057mm	929mm	992	63 (0-339)
LIMMEN BIGHT	898 mm	597mm	668mm	0 (0-100)
GROOTE EYLANDT	1111 mm	1370 mm	531 mm	144 tonnes

PROF. FISHERMEN AUG 1983

Banana Prawn Survey

The most intriguing aspect of a pilot banana prawn survey in Gulf waters off Weipa conducted by a joint CSIRO — Industry group is the incredible speed with which the results have been published and distributed.

Within a month of the six day survey beginning March 3 the results of this and a later 17-22 March sampling were on our desk, courtesy of David Carter of K.F.V. Fisheries in Townsville.

It is worth noting that the CSIRO Fisheries Division were continually taken to task at the Archer, Senate Fishing Industry Inquiry.

Many witnesses appearing before this lengthy inquiry were critical of the CSIRO's efforts in Gulf waters. Some claimed to have not seen any published results from early work on the banana fishery since the mid 1970's and an industry-wide failure to provide log book data of fishing effort was said to result from the feeling that nothing would be done with it.

Page — 18 P.F.

Banana prawn research was 'wound down' at the end of the 1970's so that the accumulated field data could be analysed properly according to Fisheries Research chief Dr Garth Murphy.

He believes fishermen can't always see the results of research because applied regulations tend to make them 'invisible'.

Draconian restrictions on banana prawn fishing were an example he offered of field results that went against fishing restrictions placed by others.

Regardless, the joint effort stems from an initiative by the Northern Fishing Companies Association and a Federal offer of $55,000 to send 6 prawn vessels out in a pre-season sampling of 3,770 prawns. Participants found it 'encouraging' that forecasted figures agreed closely with trawl results.

Tribute is paid to the level of co-operation between skippers and crew; industry and Government in this initial effort. More precise closures of certain nursery areas could result.

Prawning a little "too early"

This year's banana prawn season is starting three weeks too soon for best returns, according to results of the just-completed pre-season CSIRO survey.

The survey report says analysis of the "size composition data, the current market value by size grades and the expected levels of fishing effort", the '84 season should open on April 23 to ensure the "maximum export revenue" from prawn catches.

But the '84 banana season got underway on April 1.

The following is reproduced from the CSIRO survey report, available from CSIRO, 233 Middle Street, Cleveland, Qld 4163:

SUMMARY

The 1984 banana prawn preseason survey was carried out during the six days from 3/3/84 until 8/3/84. The survey covered the main banana prawn fishing grounds in the Gulf of Carpentaria and also included Port Essington and Fog Bay to the west. The primary aim of the survey was to assess the size composition of the banana prawn stocks early in March and thus enable calculation of the best date on which to open the fishing season.

During the survey, 3840 banana prawns were measured and the average size was 22.9 count per pound. Analysis of the size composition data, the current market value by size grades and the expected levels of fishing effort has suggested that the opening date in 1984 which would result in maximum export revenue from the prawns caught, is 23rd April.

The opening date has already been set at 1st April and the anticipated average size of prawns on that day is 18.5 count per pound.

ACKNOWLEDGEMENTS

This survey could not have been carried out without major assistance from the fishing industry as well as the cooperation of the skippers and crew. The ten trawlers were provided at no cost to the survey, while the Northern Fishing Companies Association contributed directly to the costs of the CSIRO observers.

BACKGROUND

Banana prawn research carried out by CSIRO in the eastern Gulf of Carpentaria has shown that there has been marked variability from year to year and from area to area with respect to the size composition of banana prawn stocks.

A knowledge of this size composition prior to the fishing season would enable a more flexible setting of the opening date and thus provide maximum returns for the prawns available in that year.

With a great deal of assistance from the fishing industry, a study was undertaken in Weipa in March and April 1983 with the aim of measuring the size composition of the banana prawn population prior to the fishing season.

The success of that study led to a more widescale program for 1984 in which it was decided the survey would cover all the major banana prawn fishing grounds within the current closure in the DMZ.

This report provides a description of the procedures adopted for this study together with results relevant to the 1984 fishing season.

PROCEDURES

Although banana prawns are caught throughout the fishing grounds of the DMZ, the major portion of the annual catch comes from 10 small isolated regions within this area. The aim of this study was to assess the size composition and relative level of recruitment within each of these 10 regions.

Togetherness

Getting amateurs together with commercial fishermen to improve their relations is an important reason for the forming of a new Recreational Fishing Advisory Committee, according to State DPI Minister Neil Turner.

But QCFO has only one member on the nine-man committee announced last month.

The job of putting the case for the free-paying commercial fishermen will fall to QCFO Deputy Chairman Peter Conaty.

He'll be the "loner", across the committee table from — DPI Director-General Dr Graham Alexander (Chairman), DPI Fisheries biologist Mr B. Pollock (Secretary), QFMA Chairman Mr Dave Mitchell, DPI Dairying and Fisheries Director Mr J. Miller, Boating and Fisheries Patrol boss Mr G. Price — plus Dr Peter Saenger, Dr Terry Russell and Mr Graham Roberts-Thomson, all representing the Queensland Amateur Fishing Council.

Everything's done by numbers these days!

BAE survey

The Bureau of Agricultural Economics have started field interviews with selected fishermen in Tasmania, Victoria and South Australia to gather data for an economic survey of the Australian southern rock lobster fishery.

The Minister for Primary Industry, Mr John Kerin, said the survey would be to assess the overall economic conditions experienced by rock lobster fishermen and to examine the effects of preser management policies in the fishery. The project h been funded in part by the Fishing Industry Rese Trust Account.

The survey would cover the financial years 1 to 1982-83. Information would be collected and returns, capital investment, labour use boat size, engine power and other matters the profitability of the fishery.

TO: NORTHERN FISHING OPERATORS
FM: CSIRO CLEVELAND

16 MARCH 1987

PHOTOCOPY ONLY

MONTHLY TRAWL SURVEYS ARE BEING CARRIED OUT IN WEIPA REGION AS PART OF CURRENT CSIRO/FIRTA PRAWN RESEARCH PROGRAM. THE SIZE COMPOSITION OF THE BANANA PRAWN CATCH FROM THE MARCH SURVEY IS GIVEN BELOW. RESULTS FROM THE NEXT SURVEY WILL BE PROVIDED AFTER ITS COMPLETION IN EARLY APRIL.

									AV.SIZE (NO/LB)
GRADE	9/12	13/15	16/20	21/25	26/30	31/35	36/40	41+	
PERCENT	6	12	37	27	11	4	1	2	21.1

WITH NO FURTHER RECRUITMENT OF SMALLER PRAWNS, THE ANTICIPATED SIZE COMPOSITION AT THE BEGINNING OF THE FISHING SEASON (MID-APRIL) WOULD BE:

									AV.SIZE (NO/LB)
GRADE	9/12	13/15	16/20	21/25	26/30	31/35	36/40	41+	
PERCENT	16	41	37	5	1				15.4

IN PREVIOUS YEARS, THE AVERAGE SIZE OF BANANA PRAWNS AT WEIPA HAS GENERALLY BEEN LARGER THAN THAT FOR THE FISHERY AS A WHOLE.

RAINFALL (SEPTEMBER TO FEBRUARY) IS GIVEN BELOW FOR EACH OF THE STATISTICAL REGIONS IN THE GULF. CATCH PREDICTIONS BASED ON THESE DATA ARE GIVEN FOR THE SOUTHERN REGIONS.

REGION	RAINFALL(MM) (10 YEAR AV)	RAINFALL(MM) (SEPT-FEB)	PREDICTED CATCH (TONNES)
WEIPA	1421	1449	
MITCHELL	982	686	
KARUMBA	636	573	881
MORNINGTON	959	676	151
LIMMEN BIGHT	673	587	262
GROOTE	909	1296	

...

PLEASE ADVISE YOUR FACSIMILE NUMBER IF CONNECTED.

....

CSIRO AA42240

RAPTIS AA48438
87-04-07 1228 BT
CALL CONN GA

PHOTOCOPY ONLY

CSIRO AA42240

TO: NORTHERN FISHING OPERATORS

FROM: CSIRO - CLEVELAND

7TH APRIL 1987

MONTHLY TRAWL SURVEYS ARE BEING CARRIED OUT IN WEIPA REGION AS PART OF CURRENT CSIRO/FIRTA PRAWN RESEARCH PROGRAM. THE SIZE COMPOSITION (% BY WEIGHT) OF THE BANANA PRAWN CATCH FROM THE SURVEYS IN EARLY MARCH AND EARLY APRIL ARE PROVIDED FOR YOUR INFORMATION.

SURVEY	COMMERICAL GRADE						AVERAGE SIZE		
DATE	9/12	13/15	16/20	21/25	26/30	31/35	36/40	41+	(NO/LB
1/3/87	6	12	37	27	11	4	1	2	21.1
1/4/87	19	21	33	15	6	3	2	2	18.8

WITH NO FURTHER RECRUITMENT OF SMALLER PRAWNS, JTHE ANTICIPATED SIZE COMPOSITION AT THE BEGINNING OF THE FISHING SEASON (MID-APRIL) WOULD BE:

						AVERAGE SIZE		
9/12	13/15	16/20	21/25	26/30	31/35	36/40	41+	(NO/LB)
22	21	33	15	6	3	2	2	16.5

RAINFALL (SEPTEMBER TO MARCH) IS GIVEN BELOW FOR EACH OF THE STATISTICAL REGIONS IN THE GULF.

REGION	RAINFALL (MM) (10 YEAR AVERAGE)	RAINFALL (MM) (SEPTEM,BER TO MARCH)
WEIPA	1721	1671
MITCHELL	1139	730
KARUMBA	708	616
MORNINGTON	1129	679
LIMMEN BT	934	597
GROOTE	1140	1259**

APPENDIX B.

Gulf of Carpentaria prawn fishery is complex and intriguing. Australian Fisheries, June 1977.	8 pp.
Northern prawn fishermen - pray for rain. Australian Fisheries, December 1980.	2 pp.
Young banana prawns seem unaffected by heavy Gulf fishing - so far. Australian Fisheries, November 1981.	4 pp.
Water movements and the transport of prawn larvae in the Gulf of Carpentaria. CSIRO Research Report 1979-1981.	9 pp.
Banana prawn catch prediction. CSIRO Research Report 1979-1981.	11 pp.
Tiger prawn tagging program in Gulf of Carpentaria. Australian Fisheries, March 1981.	3 pp.
Studies identify Indian banana prawn in northern catches. Australian Fisheries, April 1982.	3 pp.
A guide to the Australian Penaeid prawns. NT Department of Primary Production, 1983. (Proforma order forms).	2 pp.
Breeding biology of banana prawns in the Gulf of Carpentaria. Australian Fisheries, November 1983.	3 pp.
Preseason Gulf prawn sampling survey. Australian Fisheries, March 1983.	1 p.
Industry and researchers join in Gulf preseason survey. Australian Fisheries, April 1983.	1 p.
Gulf prawn prediction trials start. QFCO Newsletter, March 1983	1 p.
What happens to banana prawns?	7 pp.
How marine life copes with a lead smelter. Ecos 36, 1983.	6 pp.
Banana prawn catches in the Gulf of Carpentaria - trends and predictions. Australian Fisheries, June 1983.	4 pp.
Banana prawn preseason survey. CSIRO, 1983, 1984, 1985.	58 pp.
Programme and abstract for second Australian national prawn seminar. CSIRO, 1984.	74 pp.
Atlas of operational, environmental and biological data from the Gulf of Carpentaria prawn survey, 1963-65. CSIRO 1984.	
Part 1. Introduction	24 pp.
Part 2. Survey operations	115 pp.
Part 3. Physical and chemical environment	83 pp.

The biology of tiger prawns in the western Gulf of Carpentaria. CSIRO Research Report 1981-1984.	5 pp.
Torres Strait Research. CSIRO Research Report 1981-1984.	10 pp.
Pre-season survey of banana prawns. Australian Fisheries, April 1984.	2 pp.
Second Australian national prawn seminar. CSIRO, 1985.	368 pp.
Biology of commercial prawn species in the Torres Strait. QDPI Information leaflet. 1986.	1 p.
Biology of penaeid prawns in northern Australia. CSIRO, 1987. (Both the book and proforma order forms.)	190 pp.
A new CSIRO/industry commercial catch sampling program. CSIRO, 1988.	4 PP.
Research on the fishery for red spot king prawns. QDPI leaflet. No date.	4 pp.
NT study backs up fishermen's views on juvenile prawn areas. Australian Fisheries, December 1983.	4 pp.
1984 banana prawn season set to be a testing time. Australian Fisheries, April 1984.	2 pp.
An assessment of the 1985 Queensland east coast prawn trawling closure. QDPI, 1985.	20 pp.
Northern Prawn News. Australian Fisheries Service. Nos. 1-5, 1987.	36 pp.
Assessment of management policies in the northern prawn fishery. Australian Bureau of Agriculture and Resource Economics, 1988.	10 pp.
Northern Prawn Fishery information booklet. Australian Fisheries Service, March 1988.	53 pp.
Various ministerial press releases re closure areas and times and other management and administrative matters.	
Environmental monitoring - climate of Karumba and hydrology of the Norman River estuary, south-east Gulf of Carpentaria - CSIRO 1983.	32 pp.
Estuaries - their ecological importance. Department of Agriculture NSW, 1985.	7 pp.
Mangroves, NSW Department of Agriculture, 1985.	15 pp.
El Nino, and prospects for drought prediction. Ecos, Spring 1986.	7 pp.

Mangroves. QDPI leaflet, 1986.	2 pp.
NSW wetlands maps aid estuarine management. Australian Fisheries, July 1986.	4 pp.
Pollution - a big killer of inshore fish. The Queensland Fishermen, April 1987.	3 pp.
Seagrasses: A brief look at their ecology and biology. QDPI leaflet, 1987.	4 pp.
Our coastal wetlands. QDPI, 1987.	12 pp.
The importance of mangrove forests. Ascent, August 1987.	1 p.
Various articles from this special issue on inshore habitat, ecology and fisheries. Australian Fisheries, January 1981.	80 pp.
Our vulnerable estuaries. NSW State Fisheries leaflet. No date.	16 pp.
The Northern prawn fishery. A statistical summary. Australian Fisheries Service, 1981, 82, 83, 84 and 85.	Various up to 82 pp
Various landing and export statistics for each year.	
Fishery statistics relating to the DMZ of the Australian NPF 1968-1979. CSIRO, 1981.	16 pp.
Prawns - Australia's most valuable fisheries product. Australian Fisheries, April 1984.	6 pp.
Control of blackspot in prawns. Australian Fisheries, July 1976.	3 pp.
Prawns fresh and frozen. CSIRO Consumer Service, March 1976.	7 pp.
Australian Crustaceans. CSIRO Consumer Service, November 1976.	2 pp.
Seafoods - buying, freezing and preparation. CSIRO Consumer Service, November, 1976.	4 pp.
Fish from Australian water. CSIRO Consumer Service, November 1976.	4 pp.
Australian Molluscs. CSIRO Consumer Service, November 1976.	4 pp.
How much sulphur dioxide in the prawn dip? Australian Fisheries, February 1976.	2 pp.
Quality control needed all along the line. Australian Fisheries, January 1980.	2 pp.

Cost of controlling 'blackspot' repaid in better prawn prices. Australian Fisheries, January 1980.	4 pp.
Quality - how it is affected. QCFO Newsletter, April 1980.	2 pp.
Handling fish - US conference looks at the basics and beyond. Australian Fisheries, March 1982.	4 pp.
Preserved prawns pose marketing problem. Australian Fisheries, July 1986.	2 pp.
Room for improvement in fish freezing procedures. Australian Fisheries, January 1983.	3 pp.
Storage of frozen fish - a blind spot. Infofish Marketing Digest, 1/87.	1 p.
Blackspot occurrence in lobsters and shrimp. Infofish Marketing Digest, 1/87.	2 pp.
Weight loss in cold stores. Infofish International, 6/87.	3 pp.
Freezers - making the right choice. Infofish International, 3/88.	3 pp.
Australian prawn trawling gear. Australian Fisherieries Paper 1969.	15 pp.
Net mending and patching. Australian Fisheries Paper 1970.	15 pp.
Knots for nets. QCFO Newsletter, July 1979.	5 pp.
US-designed prawn trawls may take Australian species. Australian Fisheries, November 1981.	1 p.
Steel boards seem set to save money. Australian Fisheries, November 1981.	1 p.
How to make and use a tiger prawn grader. Australian Fisheries, August 1982.	5 pp.
Northern prawn fishery - boats, gear and methods. Australian Fisheries, April 1982.	7 pp.
Northern prawn fishery - gear, boats and methods. Australian Fisheries, February 1972.	9 pp.
Flume tank ready at Australian Maritime College. Australian Fisheries, December 1983.	2 pp.
Hydro-Mounta doors save fuel, boost trawl speed. Australian Fisheries, December 1983.	1 p.
Flume tank proves popular at Australian Maritine College - Australian Fisheries, January 1985.	3 pp.

Fishing gear technology : prawn trawls. Australian Maritime College, 1985.	13 pp.
Fuel consumption reduction and increasing the efficiency of fishing vessels. Commercial Marine Design Pty. Ltd., 1985.	38 pp.
Fuel-saving trawl doors. Australian Fisheries, January 1986.	1 p.
Tidal and non-tidal circulation in Gulf of Carpentaria. Australian Fisheries, September 1979.	3 pp.
Tide Stream Atlas - Gulf of Carpentaria. CSIRO, 1981.	22 pp.
Prediction model for Carpentaria currents developed. Australian Fisheries, December 1982.	2 pp.
The east Australian current. CSIRO Information sheet, June 1987.	4 pp.
New logbook for northern prawners. Australian Fisheries, June 1983.	2 pp.
Management of the Spencer Gulf prawn fishery. SAFIC, July 1985.	6 pp.
Marine turtle tagging. Department of Conservation and Land Management WA. 1986.	1 p.
Impact of aquaculture on Australian prawning industry. Australian Fisheries, April 1986.	4 pp.
Changes in commercial prawns during the 1985-86 Queensland east coast closure. QDPI, 1987.	20 pp.
Effort trends in the north-east coast prawn trawl fishery. QDPI, 1988.	24 pp.
From scampi to deepwater prawns: developments in the North West Shelf deepwater trawl fishery. Australian Fisheries, September 1988.	4 pp.
Trawled mud crabs in the Gulf of Carpentaria. CSIRO (Proforma leaflets).	2 pp.

This totals over 100 articles and reports, in turn totalling over 1600 pages.

APPENDIX C.

1985 Preseason Prawn Workshop

By BRIAN TAYLOR

The fourth annual workshop, organised and conducted by the CSIRO Division of Fisheries Research and the Fisheries Research Branch of the Queensland Department of Primary Industries was held in Cairns on March 19th, 1985 and attracted some 120 participants from all sectors of industry and government.

In his opening address, the Mayor of Cairns and Chairman of the Cairns Port Authority, Alderman Ron Davis, referred to the role of the workshop as providing a further means of communication in this widely dispersed fishery and said that he was delighted to see the level of interaction and co-operation between all involved. He added that the agenda indicated a diverse and interesting day and that active participation from the floor was encouraged to ensure that everyone would benefit.

The opening session commenced with a summary of 1984 **preliminary** statistics presented by Mr David Wesney (Australian Fisheries Service). Mr Wesney told the meeting that the total 1984 northern prawn fishery (NPF) – Bowen to Cape Londonderry – landings of 10,269 tonnes were down about 10% from the previous year whilst landings from that part of the NPF known as the declared managed zone (DMZ) – Cape York to Cape Ford – were down about 4% to 7,594 tonnes.

He added that while banana prawn landings were up considerably, tiger prawn landings were down. The total number of vessels operating in the NPF continued to decline and the number operating in the DMZ increased marginally. Mr Wesney then went on to present a situation report concerning the seven point management plan now operating in the DMZ with particular regard to the boat replacement and voluntary buy back arrangements and extension of the DMZ area.

Dr Derek Staples (CSIRO Division of Fisheries Research) led the biological presentations with a discussion of the relationship between rainfall and banana prawn catches in the Gulf of Carpentaria. He said that as this year's rainfall was down on the previous year so too were predicted catches in the southern Gulf where a positive correlation has been shown to exist.

He also pointed out that in the northern Gulf, where historically no relationship between catch and rainfall has been found, catches have also continued to decline over the past few years.

Mr Darryl Grey (NT Department of Ports and Fisheries) then outlined a banana prawn tagging program being carried out in Fog Bay in NT. Although still underway at the time, some 4,000 prawns had been tagged and released. Mr Grey urged all operators to co-operate by returning all recovered tagged prawns with as much data as possible regarding recapture.

The objectives and initial results from 1985 banana prawn preseason sampling were given by Mr Ian Somers (CSIRO Division of Fisheries Research) and recommendations concerning.the opening of the 1985 season were given. (The actual decision regarding the opening date was made at the Northern Prawn Fishery Management Committee (NORMAC) meeting the next day.) Mr Somers pointed out that the industry co-operation was also required during the second sampling phase of this program when commercial catch sampling, to validate the projections, would take place.

In a move away from management and biological reports, Mr John Stratton (KFV Fisheries) discussed the impact of the increasingly high fuel cost component in fleet operations and concisely illustrated the current fuel pricing structure and freight subsidy arrangements. He called on all vessel operators to support a case being prepared for submission to government requesting that the part of fuel taxes contributing to the bicentenary road works program be reviewed in light of the peculiar position of the fishing industry in this regard.

Mr Phil Helmore (Commercial Marine Design Pty Ltd) followed on with a paper discussing the potential for reducing fuel consumption and increasing efficiency. Mr Helmore first made the point that as fuel costs were not a major consideration a few years ago, many vessels and much of the gear used today incorporate design features which are no longer appropriate.

He then went on to discuss the effects that hull design (above and below the waterline), attachments such as keel coolers and transducers, and propellers may have on fuel consumption. The importance of keeping all below water sections free of fouling was also stressed. Machinery and onboard layout and practices were discussed and Mr Helmore said that improved design and minimal use of stabilisers and often a less heavy hand on the throttle would achieve an instant reduction in fuel consumption.

He said that whilst actually trawling, however, the greater proportion of total resistance through the water is created by the fishing gear, and in particular by the boards, and many alternative board designs were suggested.

Mr Frank Chopin (Australian Maritime College) continued this discussion with a talk on the engineering efficiency and both laboratory and field testing of various trawl gear designs. Mr Chopin illustrated with video film the use and value of flume tank testing of gear models and discussed some of the problems which can, and do, arise during sea trials using commercial sized gear. He also pointed out that the College was conducting short course programs for fishermen and that the flume tank could be made available on a contractual basis.

In another complete change of subject, Mr Cornelius Mock presented an impromptu but most enlightening review of prawn aquaculture developments in the western hemisphere. Mr Mock is from the US National Marine Fisheries Service and is well known for his work and experience in the aquaculture field. He had just arrived in Australia at the invitation of the Raptis organisation. The present and potential impact of cultivated prawns on world markets were among the points discussed.

Mr Mike Dredge (Queensland Department of Primary Industries) followed with a review of a survey of the red spot king fishery off the Queensland east coast. Mr Dredge pointed out that the fishing occurs within declared marine parks and close communication with the Great Barrier Reef Marine Park Authority was, and is essential for development of this fishery.

Mr Darryl Grey again addressed the workshop and summarised his department's research program on the general trawl fishery in the Groote Eylandt area. He said that studies of the biology of the blue tailed endeavour prawn (including some tagging work) had been a feature of this work.

The role of the Queensland Fishing Industry Training Committee (QFITC) was explained by the Committee's Executive Officer Mr Dick Lee. He said the Committee aimed to satisfy the training needs of all sectors of the industry and pointed out some of the problems arising in providing this service over such a large area. Mr Lee also listed many of the training courses which were presently available through QFITC and other organisations.

A study of nursery grounds on the Queensland north eastern coast was then described by Mr Robert Coles (Queensland Department of Primary Industries) who said that the immediate aim of the survey was to locate and define the geographic boundaries of nursery grounds and to collect data on the times that juvenile prawns of the various species occupy these grounds.

Mr Coles was followed by Mr Warren Lee Long (also Queensland Department of Primary Industries) who described similar studies from a more extensive project around Mornington Island in the Gulf of Carpentaria. The immediate benefits from studies of nursery grounds in relation to closures was then discussed.

Dr Bill Dall (CSIRO Division of Fisheries Research) concluded the presentations for the day with his address 'Why biological research?'. He said that if sound management, to ensure the viability of the resource, was required then a complete understanding of the dynamics of that resource was essential. In addition to the collection of log book and other data direct from industry, this research also required other long term and perhaps seemingly academic studies of parameters critical to stock assessment and exploitation.

The benefits of shorter term projects were also further discussed. Dr Dall said that it was essential that communication between industry and researchers be maintained to ensure a co-operative relationship and he welcomed any positive suggestions.

0830	Commence Registration	
0845	Introduction	Queensland Fish Management Authority (David Mitchell)
0855	Present Management Situation	Australian Fisheries Service (David Wesney)
0955	The Impact of Aquaculture	Northern Fishing Companies Association (David Carter)
1015	Survey of the Usage of Coastal Radio Services	Coopers and Lybrand W D Scott - Consultants for OTC - (Warren Baker)
1030	MORNING TEA	
1100	Trends in Tiger Prawn Catch Per Unit Effort	CSIRO (Ian Somers)
1120	Nursery Area Studies	Queensland Fisheries (Rob Coles)
1140	Endeavour Prawn Studies	N.T. Fisheries (Rik Buckworth)
1200	The Scampi Fishery - Introduction	Australian Fisheries Service (Rusty Branford)
1205	The Scampi Fishery - Operational and Marketing Aspects	K.F.V. Fisheries (Qld) Pty Ltd (Alex Robertson)
1220	The Scampi Fishery - Data Collection and Processing	CSIRO (Bruce Wallner)
1235	LUNCH	
1345	East Coast Deepwater Crustacea Survey	CSIRO (Burke Hill)
1355	The Weather and the Weather Bureau	Bureau of Meteorology (Geoff Love)
1455	N.P.F. Management	E.C. and Gulf Endorsed Fishermen (Lyall Price)
1515	The National Fishing Industry Council	N.F.I.C. Deputy Chairman (Dale Bryan)
1530	AFTERNOON TEA	
1600	Banana Prawn Preseason Surveys	CSIRO (Ian Somers)
1615	Banana Prawn Research in Fog Bay	N.T. Fisheries (Rik Buckworth)
1635	Research in Torres Strait	Queensland Fisheries (Reg Watson)
1655	Closing Remarks	

* **Times indicated include discussion time.**

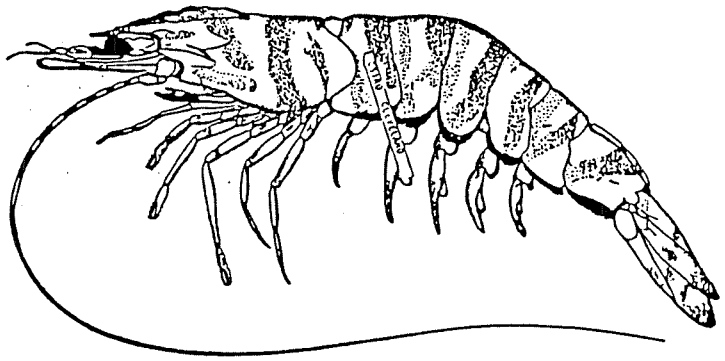
For further details please contact:

Brian Taylor
Industry Liaison Officer
CSIRO Marine Laboratories
PO Box 120
CLEVELAND QLD 4163
Phone: (07)2862022

15/1/86

PROPOSED AGENDA FOR PRESEASON PRAWN WORKSHOP

PACIFIC INTERNATIONAL HOTEL, CAIRNS - 11th FEBRUARY 1986



CSIRO DIVISION OF FISHERIES RESEARCH
QUEENSLAND FISH MANAGEMENT AUTHORITY

Pre-season Prawn Workshop

As usual, a pre-season prawn workshop was held to review background information and discuss plans for the northern prawn fishery and its coming season.

The conference was held in steamy Cairns n February 11 and was well organised as a oint venture by the CSIRO Fisheries lesearch Division and the Queensland Fish Management Authority.

Nearly one hundred fishermen attended, lus a very large squad of state and federal overnment employees.

The pre-season conference is one of the nost useful get togethers of fishermen and heir attendant bureaucrats held in Australia nd it covers the whole of the northern rawn fishery. This year was no exception nd the conference provided for a very aluable interchange of information and suggestions that will lead to further improvements in this industry.

One of the main topics of conversation was about numbers of boats likely to be the optimum to be allowed to fish in the northern prawn fishery declared management zone.

This number is steadily being reduced as the Commonwealth Government purchases entitlements from fishermen wishing to leave the industry. No final figure was agreed upon, although the QCFO President, Dale Bryan, suggested an initial target of 180 boats with a further reduction over time to about 150. 1986

CSIRO's pre-season prawn workshop 'one of best ever'

By staff reporter
BELINDA HARDY

MORE than 140 commercial fisherman from all over Australia attended a pre-season prawn fishery workshop yesterday organised by the CSRIO.

A CSIRO industry liason officer, Mr Brian Taylor, said the workshops had been an annual event since 1982 and were a means of improving communication between the fishing industry and the Government.

"Besides a large number of Cairns fishermen we had a lot of companies and individual commercial fishermen coming from Perth, Sydney, Brisbane and Canberra to take part in the workshop," he said.

Speakers from the Queensland Fish Managment, CSRIO, Queensland fisheries, Northern Territory Fisheries and the Bureau of Meteorology covered management, biological development and research in the industry over the past year.

Mr Taylor said fishermen at the workshop also were informed of new trends in the prawning industry following the voluntary two-month closure by East Coast fisherman and the examination of the declared management zone in Northern Australia.

"From the data received last year the size, number and quality of prawns certainly are a lot better with the season closure and this is what we were aiming to get," Mr Taylor said.

Last year, fisherman were not catching a great number of prawns but the dollar value of the Australian prawn had increased to make it quite a profitable season for them, he said.

"Fishermen received good prices for prawns overseas not only because of the decline in the Australia dollar but because we have a reputation of having large and good quality prawns and it is this reputation we must protect to gain the edge on competition by countries breeding smaller prawns in the form of aqua culture," he said.

"Prawns are Australia's most valuable seafood export in that they earn far more than other marine products.

"Keeping this in mind, the fishing industry people do see the importance of the regular closure season and so were interested to see their efforts paying off in the data collected and presented by our researchers," he said.

Another interesting issue raised at the workshop was the effect the weather has on the prawning industry.

Mr Taylor said information from the Bureau of Meteorology suggested that Northern fishermen could expect above average catches this season because of the higher levels of rainfall in the Gulf region.

"Rainfall does affect the availability of prawns and there is a definite link in that the more rain there is the more prawns there are," he said.

"On a more topical note fisherman were also told of the important role they play in helping the bureau tracking cyclones. Geoff Love from the bureau urged all fishermen to keep in contact when a cyclone was around and radio in information," he said.

But overall, Mr Taylor judged the workshop a success with more people attending than in the past few years.

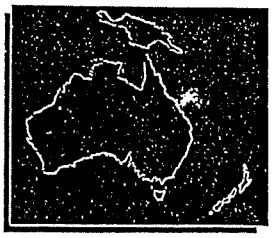
"I think we all learned a lot and those attending went away with a bit more information that I hope will be valuable to them," he said.

CAIRNS POST WEDS 12-2-86.

1986

AROUND THE COAST

News from all over



THE NATIONAL SCENE

Australian Fishexpo –an invitation to be heard

Australian FISHEXPO 86, to be held in Adelaide from July 30 to August 1, offers the opportunity for fishermen to be heard. "It is an opportunity which should be taken," the Chairman of the Australian FISHEXPO 86 Committee, Mr Mel Pach, said.

"Fishermen will have the attention of the community in general, and the politicians and bureaucrats in particular, so they should use FISHEXPO as a forum for expression of their ideas and grievances."

Mr Pach said he appreciated the fact that fishermen would have to sacrifice income to attend, but they would be rewarded in the following ways:

- A good representation from Australia's fishing ports would be a demonstration of interest from fishermen in the management of their industry;
- The issues of production costs, resource sharing with both recreational and international commercial interests, finance, and government policies, could be raised;
- A knowledge of the current thinking of community interest groups, environmentalists, fisheries administrators and researchers, would be gained from attending the seminar component of FISHEXPO; and
- An opportunity would be presented to view modern equipment and discuss directions in fishing technology with exhibitors.

"These are some very good reasons for joining us in Adelaide this year," Mr Pach said.

"Too often our industry has only pulled together in times of crisis, and I believe this must change, with grass roots interest being shown at such functions as FISHEXPO, SEADAYS and government and industry-sponsored workshops."

Mr Pach said that by working together fishermen could safeguard their viability.

"This viability is affected by a number of factors, ranging from costs of production to management by government authorities," he said.

"At FISHEXPO fishermen can ask exhibitors how they can help contain costs and they can explore the efficiency of the latest equipment available to them that will be on display in an adjacent hall to the FISHEXPO Conference.

"Most importantly, they can contribute to the management debate.

"After all, it was only recently that the Bureau of Agricultural Economics stated that the outlook for fishing hinged on effective long-term management schemes."

Mr Pach said that although the BAE had stated that we could expect our principal markets (Japan and the United States) to grow, the value of returns to fishermen had not been keeping pace with expectations.

"The forecast returns for 1985-86 will not exceed the inflation rate in all fisheries other than oysters, tuna and abalone," he said. "This indicates a need for fishermen to protect their incomes."

In 1985-86, fishermen are expected to be paid a total of $558 million for their catch, with rock lobsters at $177 million and prawns at $180 million, taking up the biggest share.

While returns to fishermen may only be steady, their contribution to the wider economy is expanding.

To illustrate, there are more than 100 fish processing establishments in Australia, employing 4000 people, and our total value of exported fish and fish products in 1985-86 is projected at $446 million – a rapid rise from $354 million in 1982-83.

"It is an important industry and we want FISHEXPO to reinforce this fact in the community and bring together all parties interested in the future of fishing," Mr Pach said.

The conference programme has now been finalised and there is still limited space for suppliers to display their products to the large audience expected to attend this major event.

1986 Prawn Workshop

By BRIAN TAYLOR

An estimated 140 participants attended the 1986 northern prawn fishery preseason workshop in Cairns on February 11th. The annual one-day event was organised and run by the CSIRO, with financial assistance from the Queensland Fish Management Authority and for the first time was held during total closures of both the northern and northeastern prawn fisheries.

Representatives from the fishing community, from commercial enterprises and from various government departments, made up the greater part of those participating. Speakers from industry and government covered topics under the general headings of management, biological research, weather forecasting and aquaculture and talks, were illustrated with slides and/or video film.

Audience participation was encouraged by having a question and general discussion period after each presentation.

The first session of the day commenced when the then chairman of NORMAC (Northern Prawn Fishery Management Committee), Mr R. Slack-Smith, presented an overview of recent management initiatives taken by this committee.

A panel of NORMAC members then fielded questions from the audience about the present management situation. Some lively debate ensued, particularly as regards the need for management and the operation of the "buy back" scheme.

The first of three presentations by industry was that concerning the impact of aquaculture on the capture prawn fisheries of Australia. It was generally suggested that provided we continue to catch large prawns there should be no direct competition at least for quite some time.

Other industry presentations later in the day included operational and marketing aspects of the limited scampi resource recently discovered off the northwest coast of Western Australia, and an owner/operator view of the management regime in the northern prawn fishery.

Researchers from CSIRO, Northern Territory and Queensland, presented details of their operations and the results from biological studies of banana, tiger and endeavour prawns in areas from northeast Queensland and Torres Strait to Fog Bay in Northern Territory. Of considerable interest from the Groote Eylandt area was the relative contribution of juvenile tiger prawns from each of the major nursery areas on to the commercial grounds.

This point was established by tag release/recapture experiments and the help of fishermen in providing accurate tag return data was acknowledged. Of particular concern from this same area was the decline in the catch of tiger prawns and the importance and relevance of statistical data provided by industry was also acknowledged here.

Log book data, in conjunction with other research information, allowed the decline in brown tiger prawn catch per unit effort to be identified as a separate component of the total tiger prawn catch and this can now be monitored.

The Regional Director of the Bureau of Meteorology from Darwin, Dr G. Love, then outlined some of the problems encountered in tracking cyclones and in issuing warnings, and said that fishermen could help by reporting meteorological features whilst at sea when cyclones were in their general area. He also said that wind speed buoys were to be deployed in the Gulf of Carpentaria during 1986, and he requested that fishermen be careful of these.

Other presentations included an announcement by OTC about a survey on the usage of coastal radio stations by ships at sea and an explanation by the Queensland Boating and Fisheries Patrol of procedures to be followed when gear trials were required during the closed season in the DMZ (Declared Management Zone).

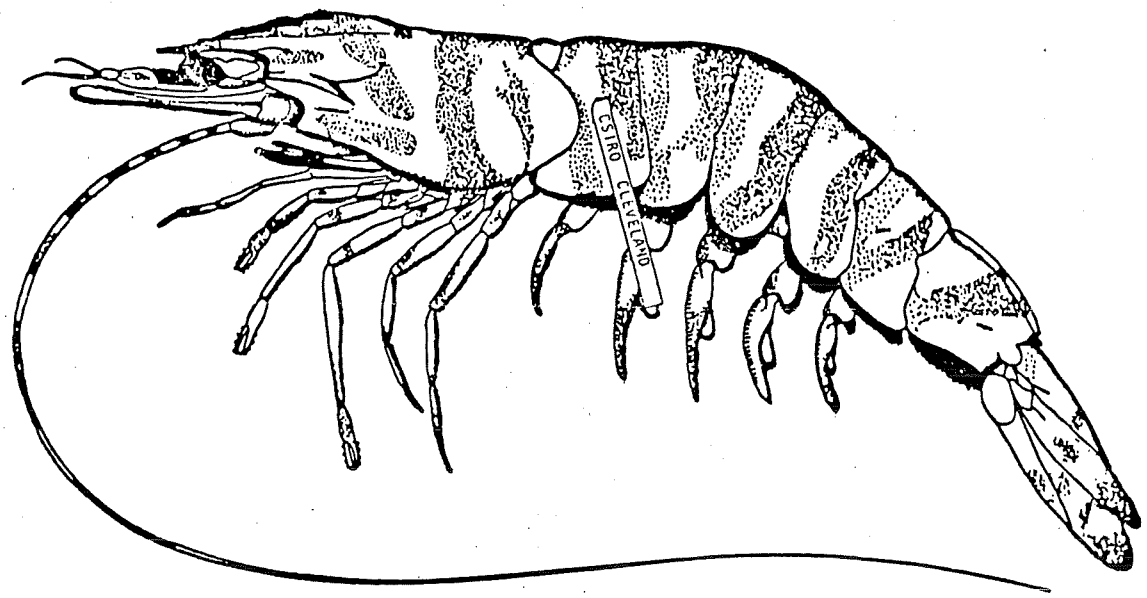
The opportunity was also taken to introduce Dr Mike Walker, who was recently appointed executive/technical officer of FIRC (Fishing Industry Research Committee).

AGENDA FOR THE 1987 PRE-SEASON PRAWN WORKSHOP

0830	Registration
0900	Welcome and introduction
0910	Effort trends in the DMZ - Rik Buckworth, NT Ports and Fisheries
0940	Biological basis for changes to management of DMZ tiger fishery - Burke Hill, CSIRO
1015	Morning tea
1100	Monitoring and assesment of the effectiveness of management regimes - David Collins, BAE
1120	Aquaculture and the prawn fisheries of Equador - Ian Somers, CSIRO
1150	Activities of the Qld Fishing Industry Training Committee - Ken Ellis, QFITC
1210	Industry representation on NORMAC - Dick Lee, A Raptis and Sons
1240	Lunch
1400	East coast prawn fishery management - David Mitchell, QFMA
1420	Qld DPI research - Torres Strait - Reg Watson, Qld DPI
1440	NW shelf deepwater crustacea fishery - Peter McNamara, A Raptis and Sons
1500	Fish predation on prawns - Steve Blaber, CSIRO
1520	Afternoon tea
1600	Qld DPI research - Moreton Bay bugs - Clive Jones, Qld DPI
1620	Qld DPI research - Red spot king prawns - Mike Dredge, Qld DPI
1640	Fishing Industry Research Trust Account - Mike Walker, FIRTA
1700	Close

The times allocated to each speaker include a few minutes for questions. They are flexible however, and you are encouraged to participate in any discussion at the end of each presentation.

1987 PRE-SEASON PRAWN WORKSHOP



Toward the end of the 1986 fishing season I distributed a preliminary notice advising you of the proposed date and venue for the 1987 workshop. These are now confirmed:

Tuesday March 3rd , 0830.
Pacific International Hotel,
Cairns.

The agenda is on the reverse side of this notice. Once again the day promises to be both interesting and enlightening for all involved in the DMZ and/or East Coast Prawn Fisheries and you are urged to make every effort to attend.

The date of the workshop falls between a two day prawn farming seminar on February 28th and March 1st (enquiries to SCP Fisheries Consultants, phone 02 439 1411) and a NORMAC meeting commencing on March 4th, both of which are being held in Cairns. The NORMAC chairman has advised us that the morning session of NORMAC on the 4th is to be an open forum. You are cordially invited to attend and take part in this session which will also be held at the Pacific International.

Brian Taylor,
CSIRO Marine Laboratories,
Cleveland.
07 286 2022

1988 PRESEASON PRAWN WORKSHOP

Pacific International Hotel, Cairns - February 16th

Organised by CSIRO Division of Fisheries, Cleveland
Sponsored by Trinity Petroleum Services Pty Ltd, Cairns

PROPOSED AGENDA

0815	Registration	
0845	**Opening Remarks**	**Murray France, NFCA**
0855	SESSION 1	**Chairman Darryl Grey, NT Fisheries**
	Bicentennial project - history of NPF	Mike Walker, FIRTA
	Research Funding	Burke Hill, CSIRO
	A new CSIRO/industry commercial catch sampling program	Ian Somers, CSIRO
	Why study juvenile prawns?	Derek Staples, CSIRO
	Fish predation of prawns	Steve Blaber, CSIRO
	General discussion	
1030	MORNING TEA	
1100	SESSION 2	**Chairman Derek Staples, CSIRO**
	Oh no! Not another NPF logbook	Margot Sachse, NT Fisheries
	Do female tigers like it with the lights on?	Darryl Grey, NT Fisheries
	Torres Strait prawn research	Reg Watson, Qld Fisheries
	Red spot king prawns	Mike Dredge, Qld Fisheries
	General discussion	
1230	LUNCH	
1345	SESSION 3	**Chairman Dick Lee, A Raptis & Sons**
	Export inspection and control	Garry Graham, AQIS
	Marketing prawns	John Bissell, Toros Seafood Exports
	Economic analysis study of the NPF	David Collins, ABARE
	General discussion	
1515	AFTERNOON TEA	
1545	SESSION 4	**Chairman To be advised**
	East coast management and log books	David Mitchell, QFMA
	Fuel and lubrication	Trinity Petroleum Services
	Fishing cadetships in NPF	Dick Lee, A Raptis & Sons
	Operation and strategies of the NPF Trading Corporation Pty Ltd	Roy Annear, NPF Trading Corp
	General discussion	
1650	**Closing Remarks**	**Don Mackay, Qld Independants**
1700	Finish	

1988 PRESEASON PRAWN WORKSHOP NOTICE

The 1988 preseason prawn workshop is to be held at the Pacific International Hotel, Cairns on Tuesday February 16th. Registration will commence at 0815 - this is simply a matter of recording your attendance and your affiliation with the prawning industry. Everyone with an interest in the fishery is invited to participate.

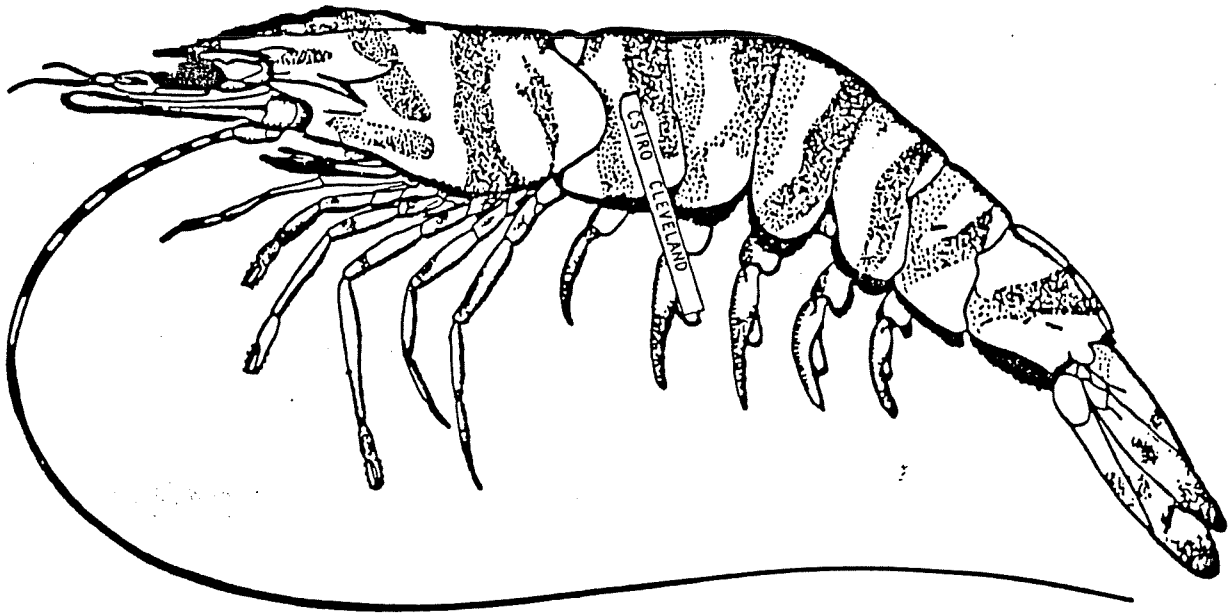
The workshop is a one day only event and there is no charge. **The agenda and the session times are shown on the reverse side of this notice** and I sincerely hope that you find the proceedings both interesting and informative. Time has been allowed for a brief discussion period immediately after each speaker and your active participation in the discussion periods both after each speaker and at the end of each session is encouraged. You, (and probably many others), will then be assured of gaining maximum benefit and you will have contributed to the success of the workshop.

If you have any ideas or suggestions about the style of the workshop or about the agenda, please do not hesitate to approach me either at the workshop or at any other time and let me know. These events are organised for your benefit and I need your ideas to ensure that an interesting agenda is arranged.

I have been asked to take this opportunity to remind you of the open NORMAC session to be held the next day, Wednesday 17th February. This session is also to be held at the Pacific International Hotel and will commence at 0900. All NPF operators are invited.

I look forward to seeing you at the workshop.

Brian Taylor
29th January, 1988



CAIRNS POST
Page 2 TUES. 16/2/88

One day seminar on prawn fishery

A ONE day preseason prawn workshop will start at 8.15 am today at the Pacific International Hotel.

Organised by the CSIRO Division of Fisheries, the workshop is open to anyone with an interest in the fishery.

An organiser, Mr Brian Taylor, said the topics discussed at the workshop would include a new CSIRO/fishing industry commercial catch sampling program, Torres Strait prawn research, export inspection and control and fish predation of prawns.

The workshop would start at 8.45 am after the 8.15 am registration, continue until 12.30 pm when there will be a short lunch break and continue again until 5 pm.

Prawn workshop in Cairns

THIS year's northern prawn pre-season seminar will be held in Cairns on February 16.

Seminar organiser Brian Taylor, from CSIRO, said the date had been chosen because it was during the closures of the northern, Torres Strait and north-eastern Queensland prawn fisheries, and so should be convenient for the maximum number of fisherman.

"I have been asked to make it clear that all prawn fishermen and anyone else with an interest in the industry are welcome to come along," he said.

"The workshop has been arranged basically to talk to fisherman about research projects, both biological and economic . There will be a number of talks of about 20 minutes, followed by question and answer periods, so fishermen have plenty of opportunity to get information of particular interest to them."

He said the agenda had not been finalised and fishermen were welcome to make suggestions.

However Mr Taylor pointed out that northern prawn fishery (NPF) management issues were not on the agenda.

"As was the case last year, the Northern Prawn Fishery Management Advisory Committee, NORMAC, is meeting the next day, February 17, and it will start with an open session when all NPF operators can raise specific management issues."

Further information: Mr Brian Taylor, CSIRO Marine Laboratories, 233 Middle Street, Cleveland, Q 4163; Tel. (07) 286 2022.

OLD FISHM'N JAN 88

Export reputation damaged

Prawn grades falsely labelled

By staff reporter
NATASHA BITA

FALSE labelling of Australian prawns was discrediting the nation's export controls, an Australian Quarantine and Inspection Service (AQIS) official said in Cairns yesterday.

And an Australian seafood exporter told delegates at this year's preseason prawn workshop his industry must find more innovative ways of selling in a competitive international market.

An AQIS science officer, Mr Garry Graham, told the workshop at the Pacific International Hotel that overseas companies had been sold Australian prawns of a standard lower than that stated on the packaging.

He said diverse and reliable sources from Japan, Europe and Australia had complained about the standard of exported prawns.

"If a particular grade is declared we (AQIS) allow a certain amount of leeway but at the moment it's far too lax," Mr Graham told The Cairns Post.

"We can't be confident that product is being accurately described. In terms of labelling, if the market wants a particular product we have to be certain that what the exporter says he's selling is actually what's in the box."

Mr Graham said exports must be true to label to protect consumers, the prawn industry and AQIS's credibility as a government certifier of Australian exports.

He said AQIS would consult with the prawn industry to find ways of ensuring honest packaging but changes could not be made until the northern prawn fishery's 1988 mid-season closure.

The managing director of Cairns-based company Toros Seafood Exports Pty Ltd, Mr John Bissell, told the workshop the Australian prawn industry must avoid "head-on" competition with other nations.

He said Australian prawn exporters should meet the specific requirements of new markets in Italy, Switzerland and Belgium.

He said small prawn cultivation in Taiwan, India, Indonesia, China and the Philippines threatened Australia's industry, which ranked ninth in the world.

"I think we're reasonably safe for a while but I'm sure the pressure of cultivated prawns will increase, causing prices to decrease," he said.

Mr Bissell said South American cultivated prawns had made a huge impact in the United States, pushing Australia out of the US small prawn market.

He said he had no doubt developing nations would eventually market larger prawns in competition with Australia.

But Australia's top-of-the-range prawn exports were of excellent quality. "It is very difficult to value-add to a premium product," he said.

"We've probably got to go to new markets and improve presentation."

Mr Bissell said Japan was taking advantage of its rising yen to pay less for its prawn imports.

"If the currency moves in the other direction in Australia's case we've got a lot of problems in this industry," he said.

CAIRNS POST THURS 18/2/88

Fishermen help in prawn study

COMMERCIAL fishermen will be trained to collect data for CSIRO prawn research in northern waters.

A CSIRO experimental scientist, Mr Ian Somers, told the 1988 preseason prawn workshop in Cairns this week the federal research body hoped to extend data gathering to the commercial environment.

He said the CSIRO could cut its commercial prawn research costs by training fishermen to collect data from Australia's 6000 km of coastal fisheries.

Mr Somers told The Cairns Post 10 fishermen from four or five fishing companies would begin an intensive training session in Brisbane in two weeks.

He said the fishermen would analyse a sample of each day's catch and keep a record of prawn species, sex and size for the trawling company and the CSIRO.

He said scientists would compare the data sent from different fishermen within a region.

"We'll develop confidence or lack of confidence in individuals.

"We have very little control once they leave us. But if it works it's the most cost-effective way we have of getting the information we need."

Mr Somers said the CSIRO would contribute to the wages of fisherman trained to gather scientific data for about an hour each day.

Depending on the success of this year's session, 10 fishermen would be trained annually until one person on each trawling vessel was qualified.

Mr Somers said the CSIRO would continue the off-shore prawn research during the closed fishing season.