



TROPHIA

REPORT

## Fisheries monitoring programs in the Southern Gulf of Carpentaria – a review

---

**For:** Australian Centre for Tropical Freshwater Research

**By:** Dr Anthony Hart

**Date:** 11 June, 2002

**Status:** Draft – not to be circulated

**DIN:** P01010-006

---

<b>FISHERIES MONITORING PROGRAMS IN THE SOUTHERN GULF OF CARPENTARIA – A REVIEW .....</b>	<b>1</b>
<b>1. INTRODUCTION.....</b>	<b>3</b>
<b>2. METHODS.....</b>	<b>3</b>
2.1. REVIEW CRITERIA .....	3
2.2. ENVIRONMENTAL VALUES .....	4
2.2.1. <i>Conservation values</i> .....	4
2.2.2. <i>Biophysical values</i> .....	5
2.3. TYPES OF FISHERIES MONITORING PROGRAMS .....	5
<b>3. ASSESSMENT OF FISHERIES MONITORING PROGRAMS.....</b>	<b>6</b>
3.1. COMMERCIAL FISHERIES .....	6
3.1.1. <i>Northern Prawn Fishery</i> .....	7
3.1.2. <i>The N9 Fishery – Offshore Net Fishery</i> .....	7
3.1.3. <i>The N3 Fishery – Inshore Gillnet Fishery</i> .....	8
3.1.4. <i>C1 Mud Crab (Scylla sp.) Fishery</i> .....	9
3.1.5. <i>L4 and L5 Line fisheries</i> .....	10
3.1.6. <i>Recreational fishery</i> .....	11
3.1.7. <i>Indigenous fishery</i> .....	12
3.2. RARE AND ENDANGERED FISH SPECIES MONITORING .....	13
3.3. FISHERIES HABITAT MONITORING .....	15
3.4. GENERAL SUMMARY .....	18
<b>4. PRIORITIES FOR EXPANSION OF MONITORING PROGRAMS .....</b>	<b>18</b>
4.1.1. <i>Recreational fishing survey</i> .....	19
4.1.2. <i>Indigenous fishing survey</i> .....	20
4.1.3. <i>Endangered fish species monitoring</i> .....	21
<b>5. ACKNOWLEDGEMENTS .....</b>	<b>22</b>
<b>6. REFERENCES .....</b>	<b>22</b>

## 1. INTRODUCTION

This document reports on the fisheries component of the Southern Gulf Environmental Information Program (SGEIP) undertaken by the Australian Centre for Tropical Freshwater Research (ACTFR) on behalf of the Department of State Development, Queensland.

The general objective was to critically assess existing fisheries monitoring information in the Southern Gulf, and make recommendations on priorities for expansion of the monitoring programs.

## 2. METHODS

### 2.1. Review Criteria

The study was principally a desktop study. The Multiple Use Strategic Plan documents (MUSP, 1999) for the Southern Gulf were reviewed to obtain initial references. Information on existing monitoring programs was obtained from a range of sources. The sources investigated included government, industry, community groups, Universities and CSIRO. Assessments were made using the following criteria:

- scientific credibility
- ability to protect environmental values as identified within the Multiple Use Strategic Plan
- cost-effectiveness
- level of duplication across region
- reporting style (e.g. helpfulness to stakeholders).

The second step was to identify gaps in the existing programs and recommend areas of research needed. Priorities for expansion of fisheries monitoring were based on the following:

- scientific credibility
- ability to protect environmental values identified in the MUSP
- feasibility
- cost-effectiveness
- potential funding sources,

- level of stakeholder and community support.

A management meeting to discuss the By-Catch Action Plan for the Gulf Set Net fishery was held in Karumba on the 21<sup>st</sup> and 22<sup>nd</sup> of April, 2002. The meeting provided the opportunity for various experts in the field and representatives of all stakeholders in the Gulf fisheries community to gather together. People interviewed at the meeting included Neil Gribble, the Senior Fisheries Biologist for the Queensland Fisheries Service (QFS), Stirling Peverell and Jason Stapley, also of the QFS, and responsible for commercial fisheries monitoring programs in the Gulf, various commercial and recreational fishing representatives, Dr Col Limpus of the Environmental Protection Authority (EPA), the representative of the North Queensland Conservation Council, and members of the Carpentaria Land council representing indigenous peoples interests. The participants were asked about their opinions on fisheries monitoring programs and their opinions of the gaps in the knowledge base. Follow-up contacts were made to consolidate information.

## **2.2. Environmental values**

The MUSP (MUSP, 1999) identifies 2 generic types of environmental values relevant to fisheries monitoring programs. These are: 1) Conservation values, and 2) Biophysical values.

### **2.2.1. Conservation values**

These include biodiversity, scientific reference sites and ecological processes that maintain the ecosystem, and where possible, the significance of conservation values was assigned using well-defined criteria (Abrahams et al, 1995). Conservation values relevant to maintaining fisheries in the Southern Gulf are divided into two groups - areas of conservation significance, and species of conservation significance.

#### **Areas of conservation significance**

The Gulf of Carpentaria is considered unique in that it is one of the few tropical shallow water embayments in the world where many shallow water habitats are relatively undisturbed. This is due largely to the fact that it has been effectively closed to fish trawling since the declaration of the Australian Fishing Zone in 1979 (but not prawn trawling). There are extensive mangrove and seagrass ecosystems, which are known nursery habitats for commercially fished species, and provide food for protected species such as dugong. There are also specifically protected fish habitat areas in the Southern Gulf designated by the Fisheries Habitat Protection Act (1994). Beumer et al., (1997) and Danaher and Stevens (1995) described the values protected by Fish Habitat Areas.

## Species of conservation significance

The MUSP identified a number of significant conservation species that are present in the Southern Gulf. A proportion of these are affected indirectly (loss of habitat or food resources) or directly by the activities of the fishing industry. The species include the bottlenose dolphin (*Tursiops truncatus*), Dugong (*Dugong dugong*), the salt-water crocodile (*Crocodylus porosus*), and the various species of marine turtle (Loggerhead, Green, Leatherback, Hawksbill, Olive Ridley, and Flatback), and the freshwater sawfish (*Pristis microdon*). These are all vulnerable to a greater or lesser extent as by-catch of the various fisheries. Dugong and turtle are also caught as indigenous harvest.

### 2.2.2. Biophysical values

The principal biophysical value in relation to fisheries is the maintenance of the fish stocks at a level capable of being sustained in the long term. This is achieved by using information from fisheries monitoring programs.

### 2.3. Types of fisheries monitoring programs

There are four generic types of fishery monitoring programmes that can secure the conservation and biophysical values identified in the MUSP strategy. These programmes need not be mutually exclusive of one another.

- 1) Commercial fisheries monitoring – this is the compulsory recording of catch and/or effort data as part of the conditions of holding a fishing license. This type of data can give a gross indication of the abundance of the stocks of a particular species if accurate estimates of both catch and effort are obtained. Commercial fisheries monitoring can include biological data such as length, sex, and age of the fish, and monitoring of by-catch. This is particularly relevant for the study area, as by-catch of significant conservation species is taken during the fishing of the commercial species. The methods for commercial fisheries data collection are well developed and well understood. They form the basis for all fisheries management. Their principal limitation is that they are not independent of the fishery and the activities of the fishers, and are hence subject to many potential biases.
- 2) Fisheries Independent monitoring programs. These surveys are designed to get an estimate of the state of the fishery resource independent of the fishery. Most research surveys of non-commercially fished marine biota also fall into this category. They are generally very costly because the data collection has to rely on independent observers, but are also

desirable because of their independence. If the funds are available, they can be designed effectively using pilot studies to help sort out the sampling issues.

- 3) Recreational Fisheries monitoring programs. These surveys target the recreational component of the fisheries and rely on information gleaned from interviews with recreational fishers and indicators of recreational effort, e.g. boat trailer counts, vantage point counts. The survey methods for this type of monitoring are quite well established (see Pollock et al., 1997; 1994 and Jones et al., 1995) and hold much potential for use in the Southern Gulf because fishing is entirely vessel-based, access points are few, and the recreational fishing season constrained into a few months of the year. The data however can very extremely variable due to differences in fisher skills. Surveys of indigenous fishing effort also fall into this category, however there are many cultural and access issues that make indigenous fishing surveys more problematic.
- 4) Fish habitat monitoring programs. The methodology and conventions of these types of programs are far less developed than the first three types because the value of fish habitat to sustaining fisheries has only recently being explicitly recognised, and accurate GPS based mapping technology has only become available relatively recently. There are a number of streams of ideas on monitoring fish habitat. The most developed appears to be Habitat Suitability Index (HSI) modelling. HSI modelling is a method for predicting the spatial habitat preferences of a species based on its preference for important environmental variables (Coyne and Christensen, 1997). The approach has been extensively used in North America to identify areas of particular habitat importance to fish (e.g. Brown et al., 1997; Rubec et al., 1998; 1999). Properly applied, the HSI modelling approach can formalise the integration of literature reviews and observed abundance data by using modern Bayesian techniques to update prior knowledge with likelihood fits to available data (Hilborn and Mangels, 1997).

### **3. ASSESSMENT OF FISHERIES MONITORING PROGRAMS**

#### **3.1. Commercial Fisheries**

Commercial Fisheries in the region include the Northern prawn Fishery (managed by the Australian Fisheries Management Authority), and the state-managed Estuarine and inshore net fisheries, the various line fisheries, the mud-crab fishery, and a proposed developmental Sea cucumber Fishery in the Wellesley Islands area.

### 3.1.1. Northern Prawn Fishery

The Northern Prawn fishery targets tiger (*Penaeus semisulcatus* and *P. esculentus*) and endeavour (*Metapenaeus endeavouri* and *M. ensis*) prawns (Stobutzki et al., 2001). The South-eastern boundary of the commercial fishing rounds extends onto the Southern Gulf.

**Commercial fisheries monitoring.** The fishery has observer programs to monitor accurate catch and effort data (Bishop and Die, 2001). The data is used in risk analysis and sustainability indicators for prawn stocks (Dichmont et al., 2000). Substantial by-catch monitoring is also carried out (Stobutzki, 2001), and much effort has been put into by-catch reduction programs using devices such as TED's (Turtle Exclusion Devices) on trawl nets (Robins, 2000).

**Fisheries independent monitoring.** Independent surveys are carried out to predict recruitment and effective spawning stock (Die et al., 1999).

**Review Table – Northern Prawn Fisheries**

<i>Criterion</i>	<i>Assessment</i>
scientific credibility;	Generally high quality
Ability to protect environmental values as identified within the Multiple Use Strategic Plan (MUSP);	Yes
level of duplication across region	Mostly done by CSIRO, therefore duplication seems negligible.
reporting style (eg helpfulness to stakeholders).	Available mainly as FRDC and CSIRO research document.
cost-effectiveness;	Difficult to quantify

### 3.1.2. The N9 Fishery – Offshore Net Fishery

The N9 operates from the 7 to 25 nautical mile band from the coast and targets fish other than barramundi, in particular tropical shark and grey mackerel. However, this fishery is starting to catch substantial numbers of Spanish mackerel (3 tonnes in 1992, 33 t in 2000; Williams, 2002). There are 5 vessels in the fishery.

**Commercial fisheries monitoring.** As well as providing catch and effort information, the license conditions require the acceptance of fishery observers on board to monitor biological data, including by-catch (Williams, 2002). The expected coverage is 10% of all nets. The fishery has been subject to a 3 yr research project monitoring of the by-catch, however that is currently up for review, and a by-catch action plan is presently being developed for the fishery.

**Fisheries independent monitoring.** No fishery independent monitoring program is in place to monitor the abundance of the target stocks, however the cost of doing so would be prohibitive

#### Review Table – N9 Offshore Net Fishery

<i>Criterion</i>	<i>Assessment</i>
scientific credibility;	Appropriate for a commercial fishery, especially with the mandatory requirement for fisheries observers
ability to protect environmental values as identified within the Multiple Use Strategic Plan (MUSP);	Concrete steps are being taken towards this with the formulation of the by-catch action plan. By-catch monitoring has been undertaken, with estimates showing that only 6% of all numbers caught is classified as by-catch. Fishery also involved in the trial of “pingers”, ultrasonic sound devices that warn off dolphins and whales
level of duplication across region	None.
reporting style (eg helpfulness to stakeholders).	Condition and trends report on this fishery are available on <a href="http://www.dpi.qld.gov.au/fishweb">www.dpi.qld.gov.au /fishweb</a> . Summary brochures are also available from the QFS.
cost-effectiveness;	Difficult to quantify

### 3.1.3. The N3 Fishery – Inshore Gillnet Fishery

The fishery operates in the Gulf rivers and creeks to 7 mile offshore. It is a multispecies fishery that targets Barramundi and King Salmon, but also catches lesser species such as Blue Salmon, Shark, Jewelfish and Queenfish. Currently the fishery has about 90 active boats. The fishery is closed for four months (October – January) of the year during the barramundi breeding season.

**Commercial fisheries monitoring.** A daily catch and effort logbook program has been in place since 1978, and there is some on-board observation by scientific observers, although the maximum size-limit on boats (14m) limits the room needed to safely house an observer and data is lacking from the ‘offshore’ component of this fishery, i.e the last mile of the three mile boundary fishery.

**Fisheries independent monitoring.** The QDPI Long Term Monitoring Program (LTMP), a fishery independent monitoring program for barramundi, began in 1999 and samples sites from the Mitchell River and Staaten River in the Southern Gulf. Samples are taken from four locations in each river (foreshore, mouth, mid-estuarine and upper-estuarine). The rivers are visited annually in April. Observers’ hire out commercial fisheries vessels to do the sampling, and data are collected on length, weight, sex, and maturity.

**Review Table – N3 Inshore Gillnet Fishery**

<i>Criterion</i>	<i>Assessment</i>
scientific credibility;	Appropriate for a commercial fishery, although there is concern that scientific observer programs are currently not mandatory. The existence of a fishery independent monitoring program is an advantage, although work is needed on determining the power of the program to detect changes in the size and abundance of barramundi and other species
ability to protect environmental values as identified within the Multiple Use Strategic Plan (MUSP);	Concrete steps are being taken towards this with the formulation of the by-catch action plan. By-catch monitoring has been undertaken, with estimates showing that a small % of all numbers caught is classified as by-catch.
level of duplication across region	None.
reporting style (eg helpfulness to stakeholders).	Condition and trends report on this fishery are available on <a href="http://www.dpi.qld.gov.au/fishweb">www.dpi.qld.gov.au /fishweb</a> . Summary brochures of the fishery and the LTMP are also available at this website.
cost-effectiveness;	Difficult to quantify

**3.1.4. C1 Mud Crab (*Scylla sp.*) Fishery**

Although this is a crab fishery, barramundi (N3) license holders also partake in this fishery. There are 51 barramundi boats and 18 specialist crab boats that fish for mud crabs. Catches in this fishery have steadily increased from 28 tonnes in 1989 to 156 tonnes in 2000 (Williams, 2002).

**Commercial fisheries monitoring.** Fishers are required to fill in a catch and effort logbook as part of their license requirements. This has been in operation since 1989. No by-catch monitoring is undertaken, although the nature of the fishing gear is very selective and usually only mud-crabs are caught. There have isolated instances where turtles have enmeshed themselves in the crab catching apparatus, however this is not recognised as a problem (QFMA, 1999).

**Fisheries independent monitoring.** A fishery independent monitoring program for mud crabs began in 1999 and takes samples from the Norman River, Staaten River, and Nassau River. Samples are taken from four locations in each river (foreshore, mouth, mid-estuarine and upper-estuarine). Sites in each river are visited annually in April. Observers' hire out commercial fisheries vessels to do the sampling, and data are collected on length, weight, sex, and maturity.

**Review Table – C1 Mudcrab Fishery**

<i>Criterion</i>	<i>Assessment</i>
scientific credibility;	Appropriate for a commercial fishery. The existence of a fishery independent monitoring program is an advantage, although work is needed on determining the power of the program to detect changes in the size and abundance of mudcrabs.
ability to protect environmental values as identified within the Multiple Use Strategic Plan (MUSP);	Fishing gear is very selective, hence no by-catch issues or habitat destruction issues. There have isolated instances where turtles have enmeshed themselves in the crab catching apparatus, however this is not recognised as a problem (QFMA, 1999).
level of duplication across region	None.
reporting style (eg helpfulness to stakeholders).	Condition and trends report on this fishery are available on <a href="http://www.dpi.qld.gov.au/fishweb">www.dpi.qld.gov.au /fishweb</a> .
cost-effectiveness;	Difficult to quantify

**3.1.5. L4 and L5 Line fisheries**

These fisheries principally target Spanish mackerel by trolling within the Gulf waters. The L4 fishery extends from the shoreline to 25 miles offshore. The L5 line fishery is restricted to 3 miles offshore. In 2000, The Gulf line fisheries caught 123 tonnes of Spanish mackerel, approximately 17% of Queensland's total catch.

**Commercial fisheries monitoring.** Compulsory commercial fishery logbooks (CFISH) since 1988.

**Fisheries independent monitoring.** No independent monitoring surveys are available for this fishery. There is a current research project by QDPI to investigate the age structure and recruitment of this species, but it is on the east coast of Queensland (Williams, 2002).

**Review Table – L4 and L5 Line Fishery**

<i>Criterion</i>	<i>Assessment</i>
scientific credibility;	Appropriate for a commercial fishery, although data quality hampered by the highly migratory nature of this species.
ability to protect environmental values as identified within the Multiple Use Strategic Plan (MUSP);	Fishing gear (mainly troll lines) is very selective, hence there are no real by-catch issues for endangered species.
level of duplication across region	None.
reporting style (eg helpfulness to stakeholders).	Condition and trends report on this fishery are available on <a href="http://www.dpi.qld.gov.au/fishweb">www.dpi.qld.gov.au /fishweb</a> .
cost-effectiveness;	Difficult to quantify

**3.1.6. Recreational fishery**

There is limited data on the recreational harvest from the Gulf (Williams, 2002), however of the 100,000 tourists who visit the Gulf annually, 90% list recreational fishing as one of their main reasons for coming (Kehoe, 1999). An estimate does exist for grunter (*Pomadysys kaakan*). 40-60 tonnes of grunter were harvested by recreational anglers adjacent to the Norman River mouth near Karumba (Williams, 2002). A paper for the Office of State Development summarises the role of recreational fishing in the Gulf in a socio-economic context (Kehoe, 1999).

The Northern Fisheries centre (QDPI) put forward a proposal two years ago to do a recreational fishing survey out of Karumba, however it was not considered a high enough priority by the Queensland Fisheries Research Advisory Board to put forward as a proposal to the Fisheries Research and Development Corporation (N. Gribble, pers. comm.).

**Recreational fisheries monitoring.** No programs specific to the southern Gulf are currently in place. State-wide recreational fishing surveys have been undertaken biennially since 1996 by QDPI (Higgs, 2001). The FRDC funded national recreational and indigenous fishing survey (FRDC 2001) is due for completion in the coming months and collected data from the Southern Gulf, separated into two regions. 1) Mornington Area; 2) West Cost of the Cape, including Karumba. This has essentially been a one-off survey, however proposals are currently being put to the FRDC to extend the programme (Coleman, pers. comm.).

**Review Table – Recreational Fishery**

<i>Criterion</i>	<i>Assessment</i>
scientific credibility;	At a statewide level, the surveys are appropriate, but no detailed information is available for the Southern Gulf. The national survey is more targeted.
ability to protect environmental values as identified within the Multiple Use Strategic Plan (MUSP);	Unknown, due mainly to lack of data. Certain species (e.g grunter) are potentially under threat from recreational fishing.
level of duplication across region	Potentially some overlap of the Queensland Rfish surveys, and the National Recreational fishing survey.
reporting style (eg helpfulness to stakeholders).	State-wide recreational fishing trends are available on request from QFS (Queensland Fisheries Service). Results from the national survey will be available as a FRDC report.
cost-effectiveness;	Difficult to quantify

### 3.1.7. Indigenous fishery

There are a number of indigenous communities on Cape York, however the catch is largely unknown. Their principal target is catfish, which is highly abundant, but not utilised by any other section of the fishing community. They also eat protected species such as dugong and turtles (Marsh et al., 1997). A nationally focused fishing survey is presently underway and will publish some data on indigenous effort in the Southern Gulf region (Coleman et al., 2001).

**Indigenous fishery monitoring programs.** An indigenous subsistence fishing survey kit was developed by QDPI in conjunction with the Balkanu Cape York Development Centre (Turner, 1999). The survey kit is comprehensive and includes a database to enter information on, but it was never properly implemented and no results are available (S. Helmke, pers. comm.), due mainly to lack of follow up. The Kowanyama Community Council holds some data. To date, this data has not been utilised but has potential.

A national recreational fisheries survey funded by the FRDC developed a sound methodology to target indigenous communities (Coleman, 2001). For example, in the northern territory, most river and estuarine system are surveyed and recreational and indigenous fishery data is available from 52 regions (Coleman, pers comm.).

**Review Table – Indigenous Fisheries**

<i>Criterion</i>	<i>Assessment</i>
scientific credibility;	Under development
ability to protect environmental values as identified within the Multiple Use Strategic Plan (MUSP);	Unknown
level of duplication across region	None
reporting style (eg helpfulness to stakeholders).	No current reporting.
cost-effectiveness;	Difficult to quantify

**3.2. Rare and endangered fish species monitoring**

There are a number of marine species in the Southern Gulf that are protected under the Nature Conservation Act (Qld), the Endangered Species Protection Act (Commonwealth), the Fisheries Act (Qld), and various treaties and agreements (MUSP, 1999). There is a legislated requirement under the Environmental Protection and Biodiversity Conservation (EPBC) Act to report any catches of these species in a 'Commonwealth' area. The potential threat of fishing activities the southern Gulf to these species has been explicitly recognised, and one of the objectives of the *Fisheries (Gulf of Carpentaria Inshore Finfish) Management Plan 1999* is to 'minimise' the unintended adverse effects of fishing on protected wildlife. One of the current proposals is to make the completion of an Endangered Species Awareness Course a condition of a holding an N3 or N9 fishing authority. Concerns were raised at the by-catch meeting in Karumba that the current course was too 'impractical', focusing on detailed minutiae of how to distinguish various types of species. It was felt that the emphasis should be on best practice protocols methods for releasing these animals from entanglement as quickly and safely as possible.

**Crocodiles**

Estuarine crocodiles (*Crocodylus porosus*) are listed as vulnerable under the Nature Conservation Act (Qld), and as a 'Marine Protected Species' under the EPBC Act. Periodic surveys of estuarine crocodiles in the Gulf are undertaken by the Environmental Protection Agency. The most recent of these is Read (1998).

The observer program in the N3 fishery has recorded the incidental capture and release of 5 estuarine crocodiles between 1999-2001, while one fisher reported in a logbook the catch of 2 estuarine crocodiles (Tobin and Halliday, 2002).

## Cetaceans

There are a number of species of dolphin listed as 'rare' or 'endangered' within the Southern Gulf that are susceptible to the N9 and N3 fisheries, although none of these have as yet been recorded as by-catch. In the period 1999-2001, the observer program in the N9 (Offshore fishery) reported the incidental capture and mortality of 4 bottlenose dolphins, which are not endangered, but are a notifiable species under the Queensland Nature Conservation Act (1994). The Wellesley islands are thought to be an area of significant habitat for bottlenose dolphins. No ongoing monitoring programs of cetaceans are being undertaken, although information on the Irrawady River Dolphin is urgently required (C. Limpus, pers. comm.).

## Dugongs

Periodic surveys of dugongs (*Dugong dugong*) in the Gulf are taken (Marsh et al., 1999; 1997). The population size for the Queensland coast of the Gulf of Carpentaria in December 1997 was estimated at  $4266 \pm 657$  (Marsh et al., 1998 - need to get reference). The most significant aggregation appears to be in the dense seagrass beds around Wellesley Islands. However, the area of sparse seagrass beds around Karumba may be important for dugong moving between the Gulf and Torres Strait (SNK, 1996).

## Sharks and Sawfish

Three species of shark found in the Southern Gulf and protected under the EPBC Act (EPBC, 1999). These are the Speartooth (*Glyphis sp. A*), the Grey Nurse (*Carcharius taurus*), and the Whale Shark (*Rhincondon typhus*). The Speartooth is critically endangered, while the other two are vulnerable (QFS, 2002). The N3 observer program recorded the catch and release of two Grey Nurse Sharks during 1999-2001 (Tobin and Halliday, 2002).

Commonwealth protection for species of sawfish is widening under the EPBC Act. While only the freshwater sawfish (*Pristis microdon*) is listed as 'vulnerable', there is increasing concern for the other two species, the narrow sawfish (*Anoxypristis cuspidate*) and the Dwarf Sawfish (*Pristis clavata*). Sawfish have a higher rate of entanglement in fishing nets than other sharks owing to their long sword and lateral teeth (Rose and McLoughlin, 2001). All species occur from time to time in the Southern Gulf.

## Turtles.

Turtle populations in the Gulf have been recognised as being under threat from bycatch in fisheries, harvesting of adults, juveniles, and eggs by indigenous Australians, and from predation of eggs by feral animals, such as pigs (MUSP, 1999). A recovery plan for turtle populations is currently being implemented under the Commonwealth EPBC Act of 1999 (EPBC, 1999).

In the early 1990's, Poiner et al., (1990) estimated that over 4000 turtles were caught in the northern Prawn Fishery, and this study initiated investigations into reducing this number. By 1999 catches of turtles had reduced substantially since the commercialisation of TED's (Turtle Exclusion Devices) in the NPF fleet (Robins, 2000).

Since their inception, the observer programs in the N9 and N3 fishery have recorded small catches of Green, Flatback, and Loggerhead turtles, the majority of which have been released alive (Stapley and Gribble, 2001; Tobin and Halliday 2002).

Catch of endangered species, e.g. dugong or turtles by floating nets (ghost fishing) was identified as a serious concern. Foreshore degradation during cyclonic conditions causes net previously buried in sand to be re-activated and moved out into the Gulf again where it begins fishing again.

Quantification of the extend of wild pig predation on turtle nesting sites, particularly flatbacks, is urgently required (C. Limpus, pers. comm.).

**Review Table – Rare and Endangered Species Monitoring Programs**

<i>Criterion</i>	<i>Assessment</i>
scientific credibility;	Where surveys are carried out, generally good, and will improve with continued by-catch monitoring.
ability to protect environmental values as identified within the Multiple Use Strategic Plan (MUSP);	The monitoring programs may be adequate, but may not be enough. An example is dugong, where results suggest that dugong sanctuaries may be required to protect the species in the long term.
level of duplication across region	None
reporting style (eg helpfulness to stakeholders).	Most reports are available from the respective government departments. One of the proposed actions of the bycatch management plan is to publicly release a summary report each year, similar to the fisheries condition reports.
cost-effectiveness;	Difficult to quantify.

### 3.3. Fisheries habitat monitoring

The recognition of the importance of fish habitat in the Gulf to the maintenance of fisheries and marine ecosystems in general has resulted in the gazetting of four Fish Habitat Areas under the Queensland Fisheries Act 1994 (Beumer et al., 1997). All areas protect commercial, recreational, and indigenous fisheries resources, particularly recreational barramundi fishing areas. They are

also important prawn and fish nursery areas. Some of them have sampling locations for the fisheries independent monitoring program run by QDPI (see Section 3.1), and collect data on habitat characteristics and water quality (LTMP, 2000).

- Eight Mile Creek Fish Habitat Area – fringing mangroves along stream banks and extensive unvegetated sand flats within and outside the estuary.
- Mornington Inlet – Bynoe River Fish Habitat Area – closed and open mangrove forests, seagrass meadows, extensive unvegetated salt flats and foreshore sand banks. The Mitchell River Sites for fisheries independent monitoring of barramundi are within this area.
- Statten-Gilbert Fish Habitat Area - closed and open mangrove forests along foreshore and in riverine areas, extensive unvegetated salt flats, nearshore banks and scald areas. The Staaten River Sites for fisheries independent monitoring of barramundi are within this area.
- Nassau River Fish Habitat Area – closed mixed mangrove communities with some closed *Avicennia patches* and extensive salt pans associated with the estuary.

The Wellesley Islands is also recognised as habitat of international conservation significance for fisheries, supporting breeding colonies of green and flatback turtles that are at levels of world significance, one of the few nesting sites of the Olive Ridley turtle in Australia, third largest population of dugongs in Queensland, and significant for bottlenose dolphins (MUSP, 1999).

Existing monitoring information on fisheries habitats in Queensland can be obtained by access in the CHRIS (Coastal Habitat Resource Information System) website.

<http://chrisweb.dpi.qld.gov.au/chris/>

The objective of CHRIS is quite detailed. The website states that:

“CHRIS is an interactive mapping resource centre for coastal fisheries habitat, environmental datasets and fisheries catch data. It integrates the existing diverse coastal fisheries habitat and environmental data sets held by DPI and other agencies (including coastal vegetation mapping, mangroves and seagrass) with land tenure, topographic and bathymetric data, protected area information (fish habitat areas, closed waters and marine parks) and relevant coastal planning and development information to facilitate the monitoring of the condition and trend of coastal fisheries habitats. Summary information from the QFISH commercial and recreational catch and effort information system is also available through CHRIS.”

It therefore has potential to be a very useful tool and may be a good template to study if there is a desire to create a website for the SGEIP. However, I attempted to interrogate CHRIS on a number of occasions, and found it difficult to operate.

## Mangroves

Mangroves are critical to the life cycle of commercially fished species in the Gulf of Carpentaria. For example, the post-larval and juvenile stages of the banana prawn (*Peneaus merguensis*), which make up 40% of the catch of the NPF, are restricted to mangrove-line estuaries (Rothlisberg et al, 1985). Those areas in the Gulf that have the highest concentration of mangroves (around Karumba) also produce the greatest catches of banana prawns (Robertson and Alongi, 1995).

Although there have been detailed studies of mangroves, most of the work on the habitat value of mangroves for crabs, fish, and prawns is correlational. There are no answers to questions of the relative values of large vs small mangroves, habitat value within mangroves (stratification), or the values of thin mangrove fringes.

## Seagrasses

Seagrasses are essential food for the endangered dugong, and provide shelter and food for juvenile tiger prawns *Penaeus esculentus* and *P. semisulcatus* (Loneragan et al., 1998; Coles and Lee Long, 1985; Staples et al., 1985), which make up almost 50% of the catch of prawns in the NPF (SNK, 1996). Although there have been limited studies investigating the relationship between macrofaunal assemblages and seagrasses in the Gulf, dugong notwithstanding, studies in other regions indicate close links between fisheries and seagrasses (ref's).

Poiner et al., (1987) produced the earliest map of seagrass distribution in the Gulf. They estimated 906km<sup>2</sup> of seagrass habitat, mostly in the Southern or Western parts of the Gulf. Elliot (1993) updated this map. No significant areas of seagrass beds were reported around Karumba by Poiner et al., (1987), however a study by consultancy group Dames and More reported the presence of 10km<sup>2</sup> of low density, monospecific sea grass beds (SNK, 1996). These beds have been subject to an ongoing monitoring study since 1994, following the establishment of the lead and zinc export facility at Karuma (Queensland Department of Primary Industries, 1999). One of the meadows experienced a major change in species composition and decrease in area (Queensland Department of Primary Industries, 1999).

QDPI have formally recognised the importance of fisheries habitat research and have created a marine fish habitat program for Qld. The aim of the program is to conduct research in conjunction with ongoing monitoring programs that map the extent and assess the condition and trend of particular fisheries habitats (seagrasses and mangroves).

## Review Table – Fisheries Habitat Monitoring Programs

<i>Criterion</i>	<i>Assessment</i>
scientific credibility;	Acceptable within their defined criteria of habitat. Most studies are correlational in nature, rather than longitudinal.
ability to protect environmental values as identified within the Multiple Use Strategic Plan (MUSP);	Yes.
level of duplication across region	None
reporting style (eg helpfulness to stakeholders).	Most reports are available from the respective government departments.
cost-effectiveness;	Difficult to quantify.

### 3.4. General summary

Many gaps in the data were identified. In particular there seems to be a lack of targeted population surveys independent of fish populations, however this is understandable given the cost of undertaking these types of surveys. The principal highlighted areas of concern expressed by most people interviewed for this project were lack of data for recreational and indigenous fisheries. A substantial filling of this gap will occur once the report from the National Recreational Fishing survey is released in a few months time, however data specific to the Southern Gulf area is likely to be minimal. There were also concerns for certain rare species caught in nets during commercial fishing programs, e.g., the Wide Saw Fish (*Pristis pectinata*), and for the issues of 'ghost fishing' by floating nets. Monitoring of endangered fish species is being carried directly, as in the case of dugong surveys, and indirectly, as in the case of by-catch surveys. Monitoring of fisheries habitat is less well defined, and mostly involves correlation studies, rather than longitudinal studies. An exception is the Karumba seagrass meadows, which have been surveyed comprehensively since 1994. Cost-effectiveness was very difficult to quantify in any of the monitoring programs. Even so, there are techniques such as cost-benefit analyses (Snedecor and Cochran, 1989), which can be used to optimising sampling designs of fisheries monitoring programs. Examples are found in Hart (2002), Montgomery (2000), and Horppila and Peltonen (1992).

## 4. PRIORITIES FOR EXPANSION OF MONITORING PROGRAMS

Recommendation for future fisheries monitoring as part of the SGEIP can be divided into two main criteria. 1) Stand alone programs; 2) value-adding to existing programs. Each has its own advantages and limitations. Outcomes of stand-alone programs are the easiest to control, assuming

that the resources (financial, logistical, institutional) are sufficient to undertake it. Value adding to existing programs has the potential to be cost-effective, but the difficulties of 'slotting' into existing programs in other institutions must not be underestimated. My recommendations take into account these limitations, and utilise knowledge gained from this study.

The three recommended priorities of research are recreational fishing surveys, indigenous fishing surveys, and rare and endangered fish species monitoring.

#### **4.1.1. Recreational fishing survey.**

The proposed recreational fishing survey is essentially a stand-alone project.

Overall Objective: to monitor the recreational fishery in the Karumba-Normanton region.

Specific objective 1: to monitor the changes in recreational catch rates of the principal species (Barramundi, Grunter, King Salmon, Blue Salmon, Saratoga, Bream, Spanish Mackerel, Black Jewfish, Jewel Fish, Mud crab) in the Karumba-Normanton region.

Specific objective 2: to monitor the changes in size of the principal species (Barramundi, Grunter, King Salmon, Blue Salmon, Saratoga, Bream, Spanish Mackerel, Black Jewfish, Jewel Fish, Mud crab) in the Karumba-Normanton region.

A number of factors make a targeted research program like this one possible. First, all fishing in the area is vessel based, and boat access ramps are few and logistically manageable. Second, the techniques for doing recreational fisheries surveys are well established. Third, the recreational fishing season in the area is contracted into a few months of the year (May-August), hence a comprehensive coverage is possible. Fourth, the affiliation of the ACTFWR with JCU means that a cost-effective way of undertaking the research would be to assign two masters students to do the surveys. The program should run over two years, with pilot studies and sampling design issues sorted out in the first year, and application of the design in the second year. The study would yield the first estimates of temporal changes in the recreational fishery, but most importantly, carry out simulations and power analysis of the ability of such monitoring programs to detect changes in the catch rates and sizes of the target species. Also, there are a number of small resorts established to cater for recreational fishers (Birri Lodge, Sweers Island, and Escott Lodge) and there is a possibility of setting up charter logbook programs with them. Consideration is needed to selecting the right students; they would have to be motivated, be able to live in the Gulf for a three months during the winter, and be well supported (food, accomodation, travel).

**Review Table – Proposed Recreational Fishery Monitoring**

<i>Criterion</i>	<i>Assessment</i>
scientific credibility;	Good.
ability to protect environmental values as identified within the Multiple Use Strategic Plan (MUSP);	Yes.
feasibility	Scientific - High Financial (outside of DSD funding) - unknown.
Potential funding sources.	FRDC - however FRDC pursues a national agenda, and regional projects need to be ranked as priority compared to the entire state.  Australian Government Envirofund: Natural Heritage Trust funding for Community Group Projects of up \$30,000. - applications found by visiting the EA website. <a href="http://www.erin.gov.au">www.erin.gov.au</a>
level of stakeholder and community support	High in the region itself, but may not be enough to secure FRDC funds.

**4.1.2. Indigenous fishing survey**

The proposed survey is essentially value adding to existing programs. As mentioned in section 3.1.7, an Indigenous Subsistence Fishing survey kit has already been developed, but never implemented, and there is presently a national indigenous survey being completed, with the reports due out in mid 2002. The proposed program would seek to harness the methodology developed in these earlier projects and apply them specifically to indigenous communities in the Southern Gulf region. The Wellesley Islands in particular would be amenable to such a survey, other communities in the Southern Gulf are more diffuse. It would be advisable to wait until the full report from the National Indigenous Fishing survey is published before proceeding with this proposal. One of the potential advantages of having an indigenous fishing survey is the use of catfish, their principal target species, as a biological indicator.

**Review Table – Proposed Indigenous Fishery Monitoring**

<i>Criterion</i>	<i>Assessment</i>
scientific credibility;	Unknown at this stage. Need to wait for publication of the National Recreational and Indigenous Fishing survey before proposal can be developed.
ability to protect environmental values as identified within the Multiple Use Strategic Plan (MUSP);	Yes.
feasibility	Reasonable
Potential funding sources.	FRDC – however FRDC pursues a national agenda, and regional projects need to be ranked as priority compared to the entire state.  Australian Government Envirofund: Natural Heritage Trust funding for Community Group Projects of up \$30,000. - applications found by visiting the EA website. <a href="http://www.erin.gov.au">www.erin.gov.au</a>
level of stakeholder and community support	High in the region itself.

**4.1.3. Endangered fish species monitoring**

There were a large number of gaps within this area, however a priority project that could be undertaken within the constraints of the anticipated DSD funding is the quantification of pig predation on turtle nesting sites.

Overall Objective: to quantify the extent and significance of pig predation on turtle nesting sites.

Specific objective 1. to estimate the proportion of turtle nesting sites subject to pig predation

Specific objective 2. To estimate mortality rates of pig predation at nesting sites

The requirements for this project are similar to that for the recreational fishing surveys, i.e the affiliation of the ACTFWR with JCU means that a cost-effective way of undertaking the research would be to assign an MSc or PhD student to do the surveys. The project should focus on developing an appropriate method to quantify pig predation that can be utilised in an ongoing monitoring program. It must involve a pilot study to sort out sampling design issues, yield the first estimates pig predation, and carry out simulations and power analysis of test the ability of a monitoring program to detect changes in rates of pig predation on turtle nesting sites.

**Review Table** – Proposed Monitoring of Pig Predation on turtle nesting sites

<i>Criterion</i>	<i>Assessment</i>
scientific credibility;	If the methodology is developed properly, good.
ability to protect environmental values as identified within the Multiple Use Strategic Plan (MUSP);	If the design shows a reasonable ability to detect increases in pig predation rates, Yes.
feasibility	Reasonable
Potential funding sources.	ARC - a small grant to supplement DSD funding, specifically to obtain materials and resources. A good student would obtain a scholarship from the University.  Australian Government Envirofund: Natural Heritage Trust funding for Community Group Projects of up \$30,000. - applications found by visiting the EA website. <a href="http://www.erin.gov.au">www.erin.gov.au</a>
level of stakeholder and community support	Difficult to quantify, as public are largely unaware of the issue, but will probably be quite high.

**5. ACKNOWLEDGEMENTS**

Thanks go to the following people who contributed some portion of their time and expertise. Jim Higgs, Ann Colman, Stirling Peverall, Jason Stapley, Neil Gribble, Colin Limpus, John Kirkwood.

**6. REFERENCES**

Abrahams H, Mulvaney M, Glasco D, Bugg A (1995). *An Assessment of the Conservation and Natural Heritage Significance of Cape York Peninsula*. CYPLUS, Office of the Co-ordinator General of Queensland, Brisbane, Department of the Environment, Sport and territories, Canberra, and the Queensland Department of Environment and Heritage, Brisbane.

Beumer J, Carseldine L, Zeller B (1997). Declared Fish Habitat Areas in Queensland. Fisheries Group, QDPI, Brisbane.

Bishop J, Die D (2001). Final report: accuracy of catch and effort data for the Northern Prawn Fishery. CSIRO Marine Division Report. AFMA Project-98/0083.

Brown SK, Buja KB, Jury SH, Banner A (1997). Habitat suitability index models for Casco and Sheepscot Bays, Maine. NOAA Strategic Environmental Assessments Division, and US Fish and Wildlife Service.

Coleman A, West L, Henry G (2001). The indigenous fishing survey in Northern Australia - another methodological challenge. Paper presented at the Australian Society for Fish Biology Annual Conference.

Coles RG, Lee Long WJ (1985). Juvenile prawn biology and the distribution of seagrass prawn nursery grounds in the south-eastern Gulf of Carpentaria. In: Second Australian National Prawn Seminar, ed. By P. Rothlisberg, B. Hill, and D. Staples. pp 55-60

Coyne MS, Christensen JD (1997). Habitat Suitability Index Modeling: Technical Guidelines. NOAA Strategic Environmental Assessments Division, 19p.

Danaher K, Stevens T (1995). Resource Assessment of Tidal Wetland Vegetation of Western Cape York Peninsula. Report to Ocean Rescue 2000.

Dichmont CM, Die D; Punt AE; Venables W, Bishop J, Deng A, Dell Q (2000). Risk analysis and sustainability indicators for prawn stocks in the Northern Prawn Fishery. Final Report to the Fisheries Research and Development Corporation. Project no: 98/109.

Die D, Loneragan N, Mick Haywood M, David Vance D, Fiona Manson F, Brian Taylor B, Janet Bishop J (1999?). Indices of recruitment and effective spawning for tiger prawn stocks in the Northern Prawn Fishery. Final Report to the Fisheries Research and Development Corporation. Project no: 95/014.

Elliot C (1993). Marine Biota Atlas for the Gulf of Carpentaria. Report prepared for Comalco Aluminium Limited by Living Planet Analysis, Weipa. Christopher Beck Books. Brisbane.

EPBC (1999). Environmental Protection and Biodiversity Conservation Act. Commonwealth of Australia.

FRDC (2001). Implementation of the National Recreational and Indigenous Fishing Survey. Information supplied from the ARRIP database ([www.frdc.com.au](http://www.frdc.com.au)) - Record number. FRDC00236.

Fisheries Act - Qld (1994).

Fisheries (Gulf of Carpentaria Inshore Finfish) Management Plan 1999.

- Gulf of Carpentaria Commercial Fishermen (2002). Code of Conduct. Net, Line, and Crab Fisheries. Managing the Gulf Fishery for the future.
- Hart AM (2002). Surveys of pre-recruits of rock lobsters in CRA8 - a pilot study. Report to the CRA8 Management Committee Inc. 39pp
- Higgs J (2001). Recreational Catch Estimates for Queensland Residents. Results from the 1999 Diary Round. RFISH Technical Report #3. QFS Fisheries Assessment Unit.
- Hilborn R, Mangels (1997). The Ecological Detective. Princeton University Press, Princeton, New Jersey.
- Horppila J, Peltonen H (1992). Optimizing sampling from trawl catches: Contemporaneous multistage sampling for age and length structures. Can. J. Fish. Aquat. Sci. 49: 1555-1559.
- Jones, C.M., Robson, D.S., Lakkis, H.D., Kressel, J. (1995). Properties of catch rates used in analysis of angler surveys. Transactions of the American Fisheries Society 124: 911-928
- Kehoe WJ (1999). The Lure of The Gulf. The Role of Recreational fishing. A paper prepared for the Office of State Development. Government of Queensland. 41 pp.
- Loneragan NR, Kenyon RA, Staples DJ, Poiner IR, Conacher CA (1998). The influence of seagrass type on the distribution and abundance of postlarval and juvenile tiger prawns (*Penaeus esculentus* and *P. semisulcatus*) in the western Gulf of Carpentaria, Australia. J. Exp. Mar. Biol. Ecol. 228: 175-95.
- LTMP (1999). Fisheries Long-Term Monitoring Program. Monitoring Overview. Information Brochure obtained from QDPI.
- Marsh H, Eros C, Corkeron P, Breen B (1999). A conservation strategy for dugongs: implications of Australian research. Mar. Freshwater. Res. 50: 1323-1650.
- Marsh et al., 1998. need to get reference.
- Marsh H, Harris ANM, Lawler IR (1997). The sustainability of the indigenous dugong fishery in Torres Strait, Australia/Papua New Guinea. Conserv. Biol. 11(6): 1375-1386.
- Montgomery SS (2000). Effects of nearness to reef and exposure to sea-swell on estimates of relative abundance of *Jasus verreauxi* recruits on collectors. J. Exp. Mar. Biol. Ecol. 255: 175-186.

- MUSP (1999). Multiple Use Strategic Plan for the Southern Gulf of Carpentaria. Report to the Department of State Development.
- Poiner IR, Staples DJ, Kenyon R (1987). Seagrass communities of the Gulf of Carpentaria, Australia. *Aust. J. Mar. Freshw. Res.* 38: 121-31.
- Pollock, H.K., Hoenig, J.M., Jones, C.E., Robson, D.S., Greene, C.J. (1997). Catch rate estimation for roving and access point surveys. *North American journal of Fisheries Management* 17: 11-19
- Pollock, H.K., Jones, C.E., Brown, T.L. (1994). Angler survey methods and their application in fisheries management. *American Fisheries Society Special Publication* 25.
- QFMA (1999). Queensland Mud Crab Fishery. Discussion Paper No. 9 prepared for the Queensland Fisheries Management Authority by the Crab Management Advisory Committee.
- QFS (2002). Draft bycatch action plan for the Gulf of Carpentaria Gill Net Fishery. Unpublished draft discussion paper. Queensland Fisheries Service.
- Queensland Department of Primary Industries (1999). 'Port of Karumba Seagrass Monitoring, Interim Progress Report - Dry Season (October) 1998'. Unpublished report to the Ports Corporation of Queensland. (Queensland Department of Primary Industries: Northern Fisheries Centre, Cairns). 12pp.
- Read MA (1998). Distribution and Abundance of *Crocodylus porosus* in the Southern Gulf of Carpentaria, July 1997. Internal Report to Conservation Strategy Branch, Queensland Department of Environment, January 1998.
- Robertson and Alongi (1995).
- Robins J (2000). Commercialisation of Bycatch Reduction Strategies and Devices in Northern Australian Prawn Trawl Fisheries. Final Report to the Fisheries Research and Development Corporation. Project no: 96/254.
- Rothlisberg PC, Jackson CJ, Pendrey RC (1985). Distribution and abundance of early penaeid larvae in the Gulf of Carpentaria, Australia. In: *Second Australian National Prawn Seminar*, ed. By P. Rothlisberg, B. Hill, and D. Staples. pp 23-30.
- Rubec PJ, Bexley JCW, Norris H, Coyne MS, Monaco ME, Smith SG, Ault JS (1999). Suitability modelling to delineate habitat essential to sustainable fisheries. *Am. Fish. Soc. Symp.* 22: 108-133.

- Rubec PJ, Christensen JD, Arnold WS, Norris H, Steele P, Monaco M (1998). GIS and modelling: Coupling habitats to Florida fisheries. *J. Shellfish Research*. 17(5): 1451-1457.
- Snedecor GW, Cochran WG (1989). *Statistical methods*. 8th ed. Iowa State University Press.
- SNK (1996). *Marine Habitat Classification and Mapping Project, Gulf of Carpentaria*. Unpublished report to the Qld Department of Environment, May 1996. Sinclair Knight Mertz, Pty Ltd.
- Staples DJ, Vance DJ, Heales DS (1985). Habitat requirements of juvenile penaeid prawns and their relations to offshore fisheries. In: *Second Australian National Prawn Seminar*, ed. By P. Rothlisberg, B. Hill, and D. Staples. pp 47-54.
- Stapley J, Gribble NA (2001). *Tropical Resource Assessment Program: QFJA/N9 Summary Report 2000-2001*. Unpublished Report, Queensland Department of Primary Industries.
- Stobutzki I, Miller M, Brewer D (2001). Sustainability of fishery bycatch: a process for assessing highly diverse and numerous bycatch. *Environmental Conservation*. 28 (2): 167-181.
- Tobin AJ, Halliday IA (2002). *Catch Composition and Bycatch of the Barramundi (Lates calcarifer) Set Gillnet Fishery of the Gulf of Carpentaria*. Unpublished draft report to the Fisheries Research and Development program.
- Turner C (1998). *Indigenous Subsistence Fishing Survey Kit. Good fishing for the future*. Balkanu Cape York Development Centre P/L.
- Williams LE (2002). (Ed). *Queensland's fisheries resources. Current condition and recent trends 1988-2000*. Report accessed from [www.dpi.qld.gov.au /fishweb](http://www.dpi.qld.gov.au/fishweb) in April 2002.