



Fisheries Resources of Albatross Bay, Gulf of Carpentaria

2006

R. Baker & R. Sheppard



Fisheries Resources of Albatross Bay, Gulf of Carpentaria

July 2006

R. Baker • R. Sheppard

QI 06062
ISSN 0727 6273

The Department of Primary Industries and Fisheries seeks a better quality of life for all Queenslanders – a quality of life supported by innovative world-class food and fibre industries, by responsible and ecologically sustainable use of natural resources and by capable and self-reliant rural communities.

This publication has been compiled as part of the assessment of the suitability of Albatross Bay for declaration as a Fish Habitat Area in order to protect and manage the regions important fisheries resources. The information contained within this publication is provided as general advice only. For application to specific circumstances, professional advice should be sought.

For further information contact:
Rebecca Sheppard
Fisheries Resource Officer
Fisheries & Aquaculture Development
Department of Primary Industry & Fisheries
(07) 4722 2656

While every care has been taken to ensure the accuracy of the information contained within this document at the time of publication, readers should make appropriate enquiries to determine whether new information is available on any particular subject matter. The State of Queensland accepts no responsibility for decisions or actions taken as a result of any data, information, statement or advice, expressed or implied, contained in this report.

The correct citation of this document is:

Baker R. and Sheppard R. (2006) Fisheries resources of Albatross Bay, Gulf of Carpentaria. Queensland Department of Primary Industries and Fisheries Information Series, QI06062.

© The State of Queensland, Department of Primary Industries and Fisheries 2006

Copyright protects this publication. Except for the purposes permitted by the Copyright Act, reproduction by whatever means is prohibited without the prior written permission of the Department of Primary Industries, Queensland.

Enquiries should be addressed to:
Director-General
Department of Primary Industries and Fisheries
GPO Box 46
Brisbane QLD 4001

Table of Contents

List of Acronyms and Abbreviations	3
Acknowledgements.....	4
Executive Summary.....	5
Recommendations:.....	6
Chapter 1 Introduction	7
1.1 Fisheries management, fish habitats and fisheries	7
1.2 Regional Fish Habitat Focus	8
1.3 Purpose of report	8
Chapter 2 Defining the Albatross Bay Study Area	9
2.1 Albatross Bay Study Area (ABSA) Description	9
2.2 Local Authority Boundaries.....	10
Chapter 3 Faunal Communities in Albatross Bay and associated estuaries	11
3.1 Introduction	11
3.2 Data sources.....	11
3.3 Results	12
3.4 Discussion.....	14
3.5 Conclusion	15
Chapter 4 Fisheries of Albatross Bay	16
4.1 Introduction	16
4.2 Fishery Data Sources	16
4.3 Northern Prawn Fishery (NPF)	17
4.4 Coastal Net and crab fisheries	19
4.5 Indigenous Fisheries.....	20
4.6 Recreational Fishing	21
Chapter 5 Habitat Diversity	23
5.1 Introduction	23
5.2 Habitats of the ABSA	23
5.3 Unique habitat features.....	36
5.4 Conclusions.....	37
Chapter 6 Riparian Zone	38
6.1 Introduction	38
6.2 Riparian Zones within the ABSA	38
6.3 Conclusion	40
Chapter 7 Climate, Catchment Flows and Impoundment Structures...	41

Chapter 8	Water Quality	43
8.1	Introduction	43
8.2	Mine and Port Operations	44
8.3	Dredging operations	46
8.4	Conclusions.....	46
Chapter 9	Land use within and adjacent to Albatross Bay.....	48
9.1	Introduction	48
9.2	Comalco Bauxite Mine	49
9.3	Port of Weipa	49
9.4	Other Land Use.....	50
9.5	Artificial Structures	51
9.6	Housing and related infrastructure	56
9.7	Future development proposals	56
9.8	Conclusions.....	57
Chapter 10	State and Regional Planning and Management.....	58
10.1	Introduction	58
10.3	Regional Production and Development.....	61
10.4	Conclusion	62
Chapter 11	Suitability of Albatross Bay for FHA declaration	63
11.1	Introduction	63
11.2	Assessment of Albatross Bay in relation to the FHA selection criteria	66
11.3	Conclusion	69
References	70
Appendix A: Species list of teleost and elasmobranch fishes from Albatross Bay and Embley Estuary.....		77
Appendix B: Mangrove plants from the Albatross Bay region of western Cape York.		89

List of Acronyms and Abbreviations

ABSA	Albatross Bay Study Area
AFMA	Australian Fisheries Management Authority
ANZECC	Australian and New Zealand Environment and Conservation Council
BoM	Bureau of Meteorology
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DATSIP	Department of Aboriginal and Torres Strait Islander Policy
DPI&F	Department of Primary Industries and Fisheries (Queensland)
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency (Queensland)
FHA	Fish Habitat Area
GoC	Gulf of Carpentaria
LTMP	Long term monitoring program
NPF	Northern Prawn Fishery
NPFMAC	Northern Prawn Fishery Marine Advisory Committee
NRM	Natural Resource Management
PCQ	Ports Corporation of Queensland
PNG	Papua New Guinea
QBFP	Queensland Boating and Fisheries Patrol
RAAF	Royal Australian Air Force

Acknowledgements

Many people contributed to the production of this report. We gratefully acknowledge all those who provided their time, knowledge, advice and support.

The preparation of this report was partially funded by Seagrass-Watch. The Seagrass-Watch program in Queensland is supported by CRC Reef, CRC Torres Strait, the Great Barrier Reef Marine Park Authority, Queensland Parks & Wildlife Service (EPA) and the Queensland Department of Primary Industries & Fisheries. Initial funding for Seagrass-Watch was provided by Coast & Clean Seas, Natural Heritage Trust and CoastCare.

Thanks to Dave Sully for the area of interest plan and habitat maps presented in the report. Anthony Roelofs, Louise Johns and Dave Sully (DPI&F) participated in field surveys to document major habitat types and artificial structures and help with Seagrass-Watch. Anthony also provided valuable insights of the Weipa region gained through several years of seagrass monitoring in the area.

Mick Morrison (Coordinator), Anthony, Lionel and Morris (Rangers) from the Nanum Wungtim Land and Sea Office at Napranum helped out with the seagrass monitoring at the Napranum Seagrass-Watch site, and provided insights into the importance and significance of fisheries resources to local Indigenous people.

Water quality data and information on the dredging activities for the Port of Weipa was provided by Sean Craig of Ports Corporation of Queensland. Peter Eaglen from Comalco provided details of Comalco's operating and environmental policies.

Tom Okey and Shane Griffiths (CSIRO) provided fisheries and ecosystem information.

Owen Witt and Bob Russell (QBFP) provided insights into the fishing activities in Albatross Bay. Thanks also to Owen for guiding us on the field surveys of the ABSA.

Thanks to everyone who provided comments on the draft report, in particular John Beumer, Karen Danaher, Kurt Derbyshire, Peter Elliot, Jane Mellors, Anthony Roelofs, Carla Wegscheidl and Lew Williams.

In order to standardise the procedures of the FHA declaration process, this report follows closely the format of previous reports:

Long P, McKinnon S (2002) Habitats and Fisheries Resources of the Fitzroy River Estuary. Information Series Q102104. Queensland Department of Primary Industries, Brisbane.

Baker R, Sheppard R (2005) Fisheries resources of Cleveland Bay (Townsville). QDPIF Information Series, QI05021

Executive Summary

The report provides an overview of the status of fish habitats and fisheries resources of Albatross Bay in the Gulf of Carpentaria. It brings together a substantial amount of information, research, data, reports and local knowledge relating to the fish, fisheries and fish habitats of the area. Current activities, disturbances, land-uses and management regimes relevant to the protection and management of the regions fisheries resources are also summarised. The report clearly highlights the importance and values of the habitats of Albatross Bay and its adjacent estuaries in supporting highly productive local and regional fisheries.

For the purpose of this report, the study area has been termed the Albatross Bay Study Area (ABSA). Primarily a desktop study, this report also collates additional and current information gathered via land, sea and aerial surveys of the ABSA to document artificial structures, other disturbances, habitats and unique features.

The ABSA includes all tidal waters and intertidal lands inshore of a line between Jantz Point in the north and Boyd Point in the south. It includes the major estuarine systems of the Pine, Mission, Embley and Hey Rivers, as well as a number of smaller estuarine systems. The ABSA is adjacent to and within the Cook Shire and Napranum and Aurukun Local Council areas. Approximately 3500 people live on the shores of Albatross Bay in the townships of Weipa and Napranum.

The ABSA is a large tropical embayment with extensive estuarine systems. It lies in the north-eastern section of the Gulf of Carpentaria on the western side of Cape York Peninsula. A diverse range of habitats are present, including open waters, coral reefs, seagrass meadows, mangrove forests, estuarine waters, intertidal banks, salt pans, marshes, and marine and freshwater wetlands. This diverse complex of high quality habitats supports valuable local and regional fisheries. The area has been intensively studied over the past few decades, particularly in relation to the value of the coastal habitats of the ABSA in supporting the highly valuable Northern Prawn Fishery. A comprehensive Department of Primary Industries and Fisheries (DPI&F) and Ports Corporation of Queensland (PCQ) seagrass health monitoring program has been running since 2000. The mangrove-lined estuaries and the extensive seagrass meadows within the ABSA are important juvenile nursery habitats for banana and tiger prawns, as well as a range of other species of direct and indirect fisheries significance.

The marine resources of the ABSA remain an integral part of the lifestyle, health and culture of the region's Indigenous people. Traditional Owners have a cultural responsibility for the care and management of the land and sea country in and surrounding the ABSA. Recreational fishing is a major activity of locals and visitors alike. The growing tourism industry is largely focussed on recreational fishing, and the effective management of the ABSA's fisheries resources is a critical component of the future economic growth of the region.

Cattle grazing and Comalco's bauxite mining operation (centred in Weipa), together constitute the most prominent land use activities in the ABSA catchment. Some water quality issues have been identified in and around specific port facilities, however there are no documented impacts of the mining and port operations on the fish habitats of the area. The DPI&F/PCQ seagrass monitoring program has provided good information on the general health of the seagrass meadows within the Port of Weipa, however very little other research has focussed on the downstream effects of catchment use in the study area. Consequently, past impacts of mining and port operations on the fish habitats and fisheries resources of the area are largely unknown. Beyond the mining and port operations, the remainder of the ABSA and its catchment is largely undisturbed and in near pristine condition, and land uses are compatible with the management intent for Fish Habitat Areas.

The imminent development of the Aurukun bauxite deposit to the south of the ABSA, and the likelihood that the mined bauxite will be exported through the Port of Weipa and the ABSA, make this assessment of the fish habitats and fisheries resources of the ABSA particularly timely. Regardless of the future management status of a potential Fish Habitat Area in the ABSA, the development of further mining and expansion of port facilities should only proceed with due acknowledgement and consideration of the importance and value of the natural resources within and surrounding the ABSA to the regions economy (including dependant commercial, recreational and subsistence fisheries), lifestyle and culture. The sustainable management of the fish habitats and fisheries resources within the ABSA will continue to be strongly promoted by the DPI&F.

The following is a list of recommendations arising from the preparation of this report:

Recommendations:

1. Proceed to public consultation with a view to the declaration of the ABSA as an 'A' management Fish Habitat Area under the *Fisheries Act 1994*. Chapter 11 outlines how the ABSA meets the FHA selection criteria.
2. Ensure a high level of involvement of Traditional Owners during the consultation process to ensure that any declarations accommodate the aspirations of local Indigenous people, and that regardless of the future FHA status, future management arrangements are compatible and complimentary with traditional land and sea management practices.
3. Promote close consultation between DPI&F and Comalco, Ports Corporation of Queensland, and the developer of the Aurukun bauxite deposit, to ensure provision for future significant developments within and around the ABSA and that these give due acknowledgement and consideration to the value and importance of the regions natural resources.

Chapter 1 Introduction

Albatross Bay (12^o45'S, 141^o40'E) is a tropical embayment near Weipa on the western side of Cape York Peninsula within the Gulf of Carpentaria (GoC). It lies approximately 630 kilometres (km) north-west of Cairns (830 km by road), and 250 km south of Cape York. Four main estuaries drain into Albatross Bay: the Pine, Mission, Embley and Hey Rivers, each with a large estuarine inlet in the lower reaches. Albatross Bay is a marine coastal embayment with predominately sandy mud substrate (Jones 1987).

All rivers and streams draining into Albatross Bay fall within the Embley Basin, which stretches from Mapoon in the north to near Boyd Point in the south, and covers an area of more than 4600 km² (National Land and Water Resources Audit 2002). There are no major dams or water storages within the basin and the local communities and industries rely mainly on groundwater. The Embley Range rises to around 500 metres (m) in the eastern part of the ABSA catchment, and the average annual rainfall is around 1600 mm/yr (National Land and Water Resources Audit 2002).

The Embley basin is covered with medium to dense woodlands dominated by *Eucalyptus tetradonta*. It also has small areas of rainforest, and freshwater and marine wetlands (National Land and Water Resources Audit 2002). Land use is dominated by bauxite mining around Weipa and cattle grazing.

In addition to the township of Weipa, there are three main Aboriginal communities in the region, Napranum on the shores of the Embley Estuary, Mapoon to the north and Aurukun to the south. The Traditional Owners of the area retain strong ties to their lands and actively manage the surrounding land and sea. Many Indigenous people who live at New Mapoon near the tip of Cape York also have strong ties to the area, having been forcibly relocated to New Mapoon from Mapoon in the 1960's.

The marine fauna of Albatross Bay and the adjacent estuaries have been the focus of intensive study since the 1980's, primarily in relation to management of the Commonwealth-managed Northern Prawn Fishery (NPF). Consequently there is a great deal of information, reports and published literature on the fisheries resources of Albatross Bay.

1.1 Fisheries management, fish habitats and fisheries

Subsistence, recreational and commercial fishing are important to the region's culture, lifestyle and economy. Coastal and estuarine habitats are important for a large proportion of fisheries species, and are the focus of much recreational fishing by both local residents and an increasing number of visitors to the region. It has been estimated that more than 75 % of species landed in Queensland's commercial fisheries rely on a variety of habitats found in healthy estuaries during some part of their lifecycle (Quinn 1992). These coastal habitats are also the marine environments most directly impacted by adjacent human activities (Hutchings & Saenger 1987, Blaber

1999, Alongi 2002, Blaber 2002). Management, maintenance and protection of healthy, functioning coastal and estuarine ecosystems are vital for the ongoing sustainability of fisheries resources.

1.2 Regional Fish Habitat Focus

Fish Habitat Areas are declared under the *Fisheries Act 1994* as part of a program that commenced during the 1960's aimed at protecting the state's critical fish habitats. The protection of important fish habitats is seen as a vital step in the sustainable management of Queensland's fisheries resources. This approach recognises the interconnectivity of marine habitats, the reliance of many species on multiple habitats during their lives, and the importance of protecting all habitats that play a role in supporting fisheries. It also provides a safety net by protecting habitats which may have fisheries values that are currently poorly understood. Management of fish habitats at a regional scale which incorporates the full spectrum of habitats, rather than the protection or management of a particular habitat or species, is seen as an important tool in protecting fisheries resources.

As a result of a program that identified gaps in the Fish Habitat Area network in Queensland, Albatross Bay is under consideration for declaration as a FHA. For the purposes of this report, the area of investigation is termed the Albatross Bay Study Area (ABSA), and is defined in chapter 2.

The ABSA contains a variety of habitats ranging from mangrove forests and estuarine waters to coastal seagrass beds and fringing reefs. The area is an important part of the highly valuable Northern Prawn Fishery, and also supports other commercial fisheries, recreational and Indigenous fishing. The commercial fishing operations of local Indigenous communities also provide particularly valuable economic and social benefits for the region.

1.3 Purpose of report

This report provides a review of the fisheries values of Albatross Bay as they relate to the Fish Habitat Area selection criteria (McKinnon *et al.* 2003). We provide a summary of the available information pertaining to the fish habitats and fisheries resources within and surrounding Albatross Bay, including information on the adjacent land uses and management issues that impact on the fisheries values of the area.

Chapter 2 Defining the Albatross Bay Study Area

2.1 Albatross Bay Study Area (ABSA) Description

The Albatross Bay Study Area (ABSA) covers approximately 125 165 ha, including the waters of Albatross Bay from Jantz Point in the north to Boyd Point in the south, a distance of almost 40 km. It also includes the tidal and intertidal areas of all the estuaries draining into the Bay, the main ones being the Pine, Mission, Embley and Hey Rivers. Each of these estuaries has extensive mangrove-lined estuarine inlets linked to the bay (Fig. 2.1).



Figure 2.1: The Albatross Bay Study Area (ABSA).

2.2 Local Authority Boundaries

The land surrounding the ABSA falls mainly within the Cook Shire and the Napranum Local Council area (Fig. 2.2). Most of the Hey River Estuary and part of the upper Embley River lie within the Aurukun Shire. Additionally, two fragmented parcels of land adjacent to the study area are under the jurisdiction of the Aurukun Shire. One parcel lies south-west of Weipa, and west of Napranum, on the far side of the Embley Estuary mouth, and runs south along the shore of Albatross Bay. The second parcel lies on the southern side of the Mission River near the upper tidal reaches (Fig. 2.2).

The township of Weipa (population 2500), lies within the Cook Shire but is administered by Comalco who created the town in the late 1960's to house and service the bauxite mine workforce. Three aboriginal communities are located in the region, each with a Community Council. The Councils have different legislative responsibilities to those of Shire Councils, and have jurisdiction over the Deed of Grant in Trust (DOGIT) lands of each community (Fig. 2.2). Napranum lies 13 km south of Weipa on the shores of the Embley Estuary. The community is home to around 1000 people. To the north at Port Musgrave is the community of Mapoon (population 200), and to the south is Aurukun (1200 people) at Archer Bay. Traditional Owners from each of these communities have interests in Albatross Bay and the surrounding area. Furthermore, the community of New Mapoon on the tip of Cape York was established when residents from Mapoon (Old Mapoon) were forced to move there in 1963/64. As such, many of the people who live at New Mapoon have historical and relational ties to the Albatross Bay area.

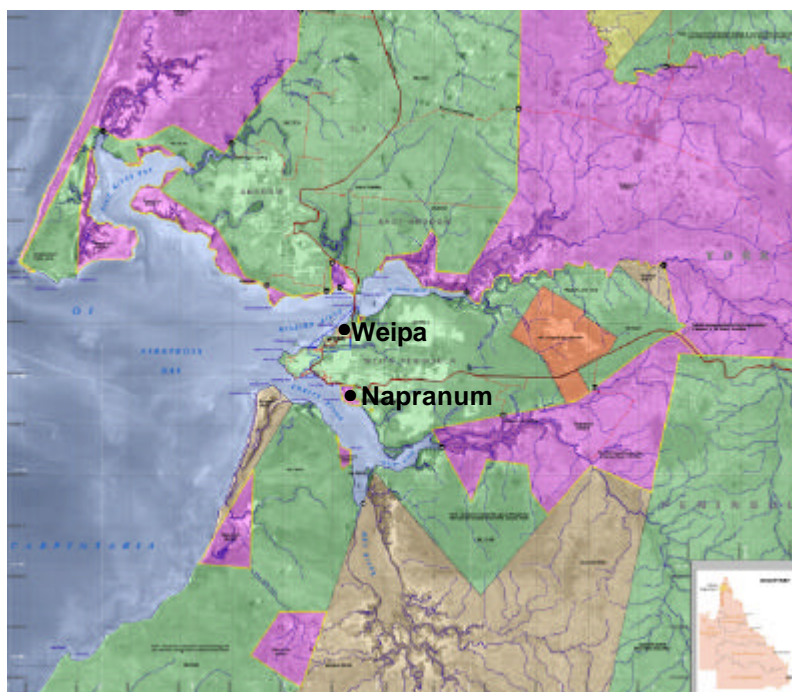


Figure 2.2: Boundaries of lands under jurisdiction of Napranum (purple), Aurukun (grey) and Cook Shire (green) Councils (Map produced by Comalco Aluminium Limited and downloaded from DATSIP website).

Chapter 3 Faunal Communities in Albatross Bay and associated estuaries

Chapter Summary

More than 360 species of fish and crustaceans have been recorded within Albatross Bay and the adjacent estuarine systems. Many of these are of direct significance to local and regional fisheries, while others are of indirect importance forming links in the food chains that support fishery species. The diversity of species within the ABSA is greater than that reported for other tropical areas in the Indo-West Pacific, and reflects a mosaic of high quality fisheries habitats.

3.1 Introduction

Albatross Bay's marine fauna has been extensively studied, largely due to the importance of the area to the Northern Prawn Fishery (NPF) (see Ch. 4). Since the mid 1980's CSIRO has undertaken substantial surveys of the fish and prawn faunas of both the coastal and off-shore waters of the bay and the estuarine systems draining into it. The offshore fish surveys have used mainly prawn or fish trawls to sample the fauna (Blaber *et al.* 1990a, 1994; Brewer *et al.* 1991, Martin *et al.* 1995, Stobutzki *et al.* 2001), while estuarine studies have employed a wider range of gears including gill and seine nets and beam trawls (e.g. Blaber *et al.* 1989, Haywood *et al.* 1998). This intensive study during the 1980's and 1990's has culminated in the development of a mass-balance trophic model for the Albatross Bay ecosystem, which aims to describe the entire foodweb of the system (Okey 2006). It incorporates information about environmental effects on foodweb interactions and provides insights into the dynamics of the banana prawn fishery in the region.

3.2 Data sources

The marine fauna of Albatross Bay has been extensively studied, particularly the biology and ecology of commercial penaeid prawns, and, in more recent times, aspects of the biology of bycatch species. There are many scientific papers and reports related to all aspects of prawn life cycles, including adult distributions, breeding cycles, juvenile habitat requirements, dietary habits, predators and effects of environmental parameters on each of these. Of most relevance to this report are the studies which have provided details of the species that occur in the area, and particularly those studies highlighting the habitat requirements of valuable commercial species.

Blaber *et al.* (1990b) provides a checklist of the 344 species of teleost and elasmobranch fishes sampled by CSIRO from Albatross Bay and the Embley Estuary up to 1989. Only a few additional species (~20) have subsequently been sampled from the area during more recent CSIRO surveys (Blaber *et al.*

1995, S. Griffiths, CSIRO, pers. comm.). The combined species list is provided in appendix A.

The NPF itself has one of the most comprehensive data sets of any Australian fishery (see Ch. 4). Consequently, the composition of the catch is known with a high degree of accuracy and the catch data provides useful information on the species caught in the area. There is also substantial literature on the by-catch of the NPF, including both fishes and other vertebrate by-catch such as turtles, sawfish and sea snakes (e.g. Milton 2001, Stobutzki *et al.* 2001, Robins *et al.* 2002, NPFMAC 2003).

3.3 Results

A total of 344 species of teleost and elasmobranch fishes were recorded during CSIRO surveys of Albatross Bay and the Embley Estuary pre 1989 (Blaber *et al.* 1990b). In the estuary 197 species were recorded, while 237 were sampled in the bay. Ninety species were common to both areas. An additional 15 species were reported from the shallow (<7m) inshore zone between the estuary and trawlable depths in the bay (Blaber *et al.* 1995).

A diverse range of fishes of importance to Indigenous, recreational and commercial fisheries are abundant in the area. These include barramundi (*Lates calcarifer*), blue and king threadfin salmon (Polynemidae – 3 spp.), mullet (Mugilidae – 5 spp.), sharks (Carcharhinidae – various spp.), flathead (Platycephalidae – various spp.), estuary cod (*Epinephalus* spp.), whiting (*Sillago* spp.), trevally and queenfish (Carangidae – various spp.), mangrove jack, fingermark or golden snapper, red emperor and nannygai (*Lutjanus* spp.), grunter (*Pomadasys* spp.), bream (*Acanthopagrus berda*), jewfish (Sciaenidae), and catfish (Ariidae – several spp.) (e.g. Blaber *et al.* 1989, 1990a, 1994, 1995). Mudcrabs (*Scylla serrata*) are also common in the area and a commercial mudcrab operation is run by the Mapoon community (see Ch. 4).

Other species are likely to become more important to recreational sport fisheries as the industry expands in the area, including tarpon (*Megalops cyprinoides*), milk fish (*Chanos chanos*), golden trevally (*Gnathanodon speciosus*) and permit or snub-nosed dart (*Trachinotus* spp.). Similarly, a range of pelagic species have also been recorded during more recent CSIRO surveys and include many of potential significance to recreational and commercial fisheries in this region. These include several mackerals and tunas (Scombridae), wahoo (*Acanthocybium solandri*), marlin (*Makaira indica*), sailfish (*Istiophorus platypterus*), dolphinfish (*Coryphaena hippurus*) and rainbow runner (*Elegatis bipinnulata*) (S. Griffiths, CSIRO unpub. data).

The NPF primarily targets white banana (*Penaeus merguensis*) and tiger prawns (*P. esculentus* and *P. semisulcatus*) which account for around 80 % of the catch (AFMA 2004). Other species captured include red-legged banana (*P. indicus*), blue endeavour (*Metapenaeus endeavouri*), red endeavour (M.

ensis), and king prawns (*Melicertus latisulcatus* and *M. longistylus*). Scampi (*Metanephrops* spp.), squid (*Photololigo* spp.), scallops (*Amusium* spp.) and bugs (*Thenus* spp.) are also taken (AFMA 2004).

While not target species or of commercial fisheries value, some by-catch species are of particular fisheries significance because of the substantial efforts to reduce the incidental capture of these species, several of which are listed as endangered or vulnerable. The four species of sawfish recorded in Albatross Bay; *Pristis pristis*, *P. pectinata*, *P. zijsron*, and *Anoxypristis cuspidata* (Blaber *et al.* 1990b), are all listed as Critically Endangered on the IUCN Red List (IUCN 2006). It is believed the Gulf of Carpentaria may be one of the last regions on the planet to support sawfish (DPI&F 2004). Due to the toothed rostrum that gives them their name, sawfish are particularly vulnerable to capture in fishing nets. Accordingly, the gill net fishers within the Gulf have developed a code of practice to minimise the capture and improve release success of sawfish in the fishery (DPI&F 2004).

Flatback (*Netator depressus*), Olive Ridley (*Lepidochelys olivacea*) and Loggerhead (*Caretta caretta*) turtles have been recorded in trawl catches around Weipa, and prior to 2000, the NPF was estimated to capture 5000 turtles per year (Robins *et al.* 2002). In response to a ban on imports of prawns to the USA from fisheries that caused unacceptably high mortality of endangered turtles, the NPF introduced turtle excluder devices (TED's) in 2000. The estimated number of turtles captured annually has subsequently dropped to less than 200, and the survival rate of captured turtles has also improved (Robins *et al.* 2002) (and the US ban on imports of NPF prawns has been lifted).

Aerial surveys during the 1990's revealed low numbers of dugongs in the area around Weipa compared to areas in the southern and western GoC, and the Dugong Status Report and Action Plan (Marsh *et al.* 2001) implies that dugong are no longer hunted around Weipa. However, extensive feeding trails have been observed during seagrass surveys of the ABSA (Roelofs *et al.* 2003, 2005b) and turtle and dugong are in fact hunted in the area by Indigenous people (EPA 2004 - see Ch. 4.4).

There have been at least 13 species of sea snakes recorded as bycatch in the NPF. Several have life history characteristics that make the populations vulnerable to fishing mortality (Milton 2001). In particular, there is concern that *Hydrophis pacificus* may be excessively taken by trawlers, while the limited information on *Disteira kingii*, *Astrotia stokesii* and *Aipysurus laevis* suggests these species are also vulnerable (Milton 2001).

3.4 Discussion

3.4.1 Species Richness

The ABSA supports a rich and diverse assemblage of species including many of direct and indirect fisheries significance, indicating the high fisheries value of the regions habitats. The species richness of the area is greater than that reported for other regions in the tropical Indo-West Pacific (cf. Blaber 1980, Blaber & Milton 1990, Robertson & Duke 1990, Sheppard *et al.* 2001, Baker & Sheppard 2005). Albatross Bay and its estuaries, particularly the Embley, is the most extensively studied coastal system in the eastern GoC, and as such it represents a regional benchmark system for comparison with other potential FHAs in the eastern GoC. In addition to the species which already support valuable fisheries, there is a range of pelagic species with potential to support valuable commercial, recreational and Indigenous fisheries in the future.

3.4.2 Nursery Value of ABSA for fisheries species

Coastal habitats within the ABSA are important nurseries for many important fisheries species in the region. In particular, seagrass beds within estuaries and shallow coastal waters of the Bay are important nursery habitats for juvenile tiger prawns, while mangrove lined estuaries are critical habitats for juvenile banana prawns (Staples *et al.* 1985, Vance *et al.* 1990, 2002). Combined, these species dominate local catches in the NPF (AFMA 2004), and degradation of these habitats would be of serious concern for the future of the NPF in the area.

Many other important fisheries species in the region also rely on estuarine and seagrass habitats as juvenile nurseries (Blaber *et al.* 1989, 1995). The importance of coastal nursery habitats to species such as barramundi, mangrove jack, threadfin salmon and mudcrabs has been well established (e.g. Hill 1982, Russell & Garrett 1985, Sheaves 1995, Russell & McDougall 2005), and the protection of such habitats is a critical step in ensuring the sustainability of fisheries based on these species.

3.4.3 Introduced marine species

The Port of Weipa was surveyed in October 1999 to document native and introduced species as part of the Ports Corporation of Queensland's Ecoports programme (Hoedt *et al.* 2001). A total of 569 taxa were recorded, none of which are designated as pest species by the Australian Ballast Water Management Advisory Committee. Only one recognised introduced species was recorded, the green algae *Caulerpa racemosa*. One specimen was sampled and it was not considered a threat to the local environment (Hoedt *et al.* 2001).

3.5 Conclusion

The waters of Albatross Bay and the associated estuaries are home to a diverse range of fauna, many of which support significant local and regional fisheries. Some species, such as tiger prawns, utilise the area primarily as a nursery, while others use various habitats within the ABSA throughout their life cycle (e.g. barramundi, banana prawns). The waters of Albatross Bay are the focus of the highly valuable banana prawn fishery and the extensive mangrove lined estuarine systems within the ABSA are important habitats in supporting this fishery. Some of the most abundant species captured in the NPF, such as Leiognathids (Staunton-Smith *et al.* 1999, Stobutzki *et al.* 2001), while not utilised commercially here, are of considerable fisheries value elsewhere in South East Asia (Robertson & Duke 1987), and may become important here in the future. Similarly, many of the pelagic species recorded during recent CSIRO surveys (S. Griffiths CSIRO unpub. data) have the potential to become more important to commercial and recreational fisheries in the future. The diversity of the fish fauna in the ABSA reflects the mosaic of valuable habitats found there.

Chapter 4 Fisheries of Albatross Bay

Chapter Summary

The Albatross Bay Study Area (ABSA) supports productive and highly valuable commercial and recreational fisheries both within and adjacent to the area. The main target species in the ABSA region rely on a range of coastal and estuarine habitats throughout various parts of their life cycles. Subsistence and recreational fishing by local people are important parts of the peoples lifestyle, culture and health, and recreational fishing tourism is a rapidly growing industry in the region

4.1 Introduction

Albatross Bay and the associated estuarine systems are home to a diverse array of species (Ch. 3), many of which support valuable commercial, recreational and Indigenous fisheries. In addition to the direct economic values of the region's fisheries, fisheries resources are an important part of the lifestyle and culture of people who live in the area, a large proportion of whom are Indigenous Australians. A high proportion of Weipa residents own recreational boats (Bob Russell, QBFP, pers. comm.), and a large proportion of tourists travel to the area to fish.

4.2 Fishery Data Sources

Data on the number of vessels and catches of coastal fisheries in the Albatross Bay region were sourced from the DPI&F's CFISH data base (CFISH 2006). Details of the NPF come from AFMA's annual NPF data summaries (e.g. Pedrau & Garvey 2005). Details of the fisheries such as fishery history, gear restrictions and management issues were sourced

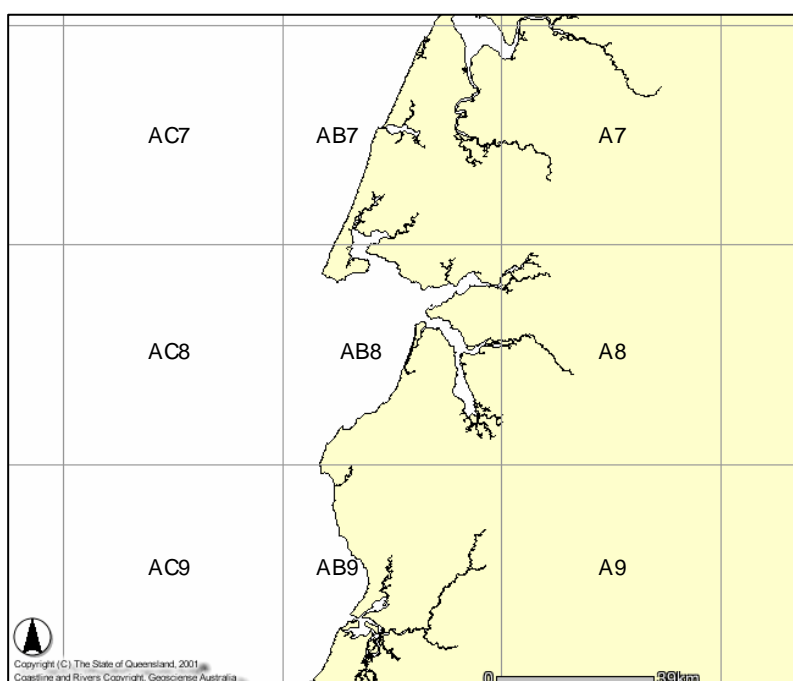


Figure 4.1: 30' commercial catch grids around the ABSA.

from several reports on the Northern Prawn Fishery (NPF) and the Gulf of Carpentaria inshore finfish Management Plan (Queensland Government 1999).

For the purpose of analysing and discussing the commercial catch from the CFISH data base, the 30' grid AB8 is referred to as "Albatross Bay" (Fig. 4.1). This grid extends 10 km south of Boyd Point to Thud Point, and 10 km off shore from the defined western boundary of the ABSA (Chapter 2). Apart from this, grid AB8 lies entirely within, and covers most of, the ABSA. Grid A8 covers the upper tidal reaches of the Mission and Embley estuaries which are closed to commercial fishing and thus have no catches reported from them. Grids AC7, AC8 and AC9 are termed "Albatross Bay offshore", and catches from these grids are listed because the species captured in this area are highly likely to utilise habitats within the ABSA during some stage of their lifecycle.

Since 1996, DPI&F has implemented a data collection system (RFISH) to monitor the recreational fishing catch. Unfortunately the resolution of this monitoring is inadequate to make any estimates of the recreational catch in the Weipa area. Within the RFISH database, the ABSA falls within the Far North Statistical Division, which stretches from the Herbert River just north of Townsville on the east coast, through the Torres Straits to the Edward River on the mid-western coast of Cape York Peninsula. This is a massive area and consequently the RFISH data at this scale is not useful for estimating recreational catches in the ABSA.

4.3 Northern Prawn Fishery (NPF)

4.3.1 Fishery description

The NPF began in the 1960's as a multispecies trawl fishery primarily targeting penaeid prawns (AFMA 2004). It is a Commonwealth managed fishery extending from Cape Londonderry in Western Australia to Cape York in Queensland. Since its commencement there has been extensive research and management aimed at ensuring the long-term sustainability of this highly valuable fishery. The NPF mainly targets banana prawns (*Penaeus merguensis*) and tiger prawns (*Penaeus esculentus* and *P. semisulcatus*) during two separate fishing seasons with quite different fishery characteristics. These species account for around 80 % of the catch. They reach commercial size at 6 months of age, although older, larger prawns (9-12 months) fetch higher prices. Other species captured include red-legged banana (*P. indicus*), blue endeavour (*Metapenaeus endeavouri*), red endeavour (*M. ensis*), and king prawns (*Melicertus latisulcatus* and *M. longistylus*). Scampi, squid (*Photololigo* spp.), scallops (*Amusium* spp.) and bugs (*Thenus* spp.) are also taken. Most of the catch is frozen on board the trawlers and around 90 % is exported, primarily to Japan. It is one of the most valuable fisheries in Australia. The most recent estimate put the total value at around \$80 million, the Queensland portion of which was valued at \$45 million (AFMA 2004).

Banana prawns are the main catch in the Weipa area, and historically Albatross Bay is one of the main banana prawn fishing grounds of the NPF. Catch rates are highly variable and correlated to local rainfall; however catch and effort have declined in the Weipa section of the NPF over recent years (Perdrau & Garvey 2005). Annual catch in the Weipa area has been between 3 and 1073 tonnes over the last twelve years (average 320 tonnes) (Pedrau & Garvey 2005). In some seasons up to 100 trawlers work the waters of Albatross Bay. For the last 5 years there has been between 50 and 70 trawlers working within the ABSA (B. Russell, QBFP, pers. com.). Banana prawns are found mainly in waters less than 20 m deep (AFMA 2004). The banana prawn fishery operates during daylight hours, and targets visible prawn 'boils', often located by spotter planes. Trawl shots are generally for a short period (15-30 minutes) targeted directly at the boils. As such, catches tend to have little by-catch relative to other trawl fisheries. The season is short (usually 2 – 3 weeks).

The longer tiger prawn season is focussed during August and September. The tiger prawns are more dispersed and often occur in deeper waters than the banana prawns. As such trawlers targeting tiger prawns have longer shots (hours) and much higher levels of by-catch than the banana prawn fishery. Trawling for tiger prawns is only permitted at night. Typically less than 20% of the total catch is prawns, and the NPF discards an estimated 30 000 tonnes of bycatch annually (CSIRO 1998). Current research programs are aimed at determining the ecological sustainability of current levels of bycatch.

The NPF is controlled and managed via input controls: limited entry, closed seasons and areas, and gear restrictions. There is an Industry-initiated ban on the take of shark, ray or sawfish products by the NPF.

4.3.2 Habitat requirements of NPF species.

The links between the commercial prawn stocks and coastal nursery habitats within the ABSA are well established (e.g. Staples *et al.* 1985, Vance *et al.* 1990, 2002). Banana prawns rely on the mangrove lined estuaries draining into Albatross Bay as juvenile nurseries, while juvenile tiger prawns utilise the area's extensive seagrass meadows. Although there are several large estuarine inlets along the western coast of Cape York, such as Port Musgrave to the north and Archer Bay to the south, Albatross Bay is the largest and contains the most extensive system of mangrove-lined waterways. It has around 3000-5000 ha of seagrass meadows (Roelofs *et al.* 2003), and while the waters of the western Gulf of Carpentaria have far more extensive seagrass meadows, Albatross Bay's seagrass meadows represent a significant proportion of this habitat in the eastern Gulf (Poiner *et al.* 1987, Roelofs *et al.* 2005a).

4.4 Coastal Net and crab fisheries

4.4.1 Fishery description

Coastal net, line and mudcrab fisheries operate within the ABSA. The main species taken in the region are Grey and Spanish Mackerel, shark, mud crab, barramundi and threadfin salmon (CFISH 2006). Fishery trends and catch composition within Albatross Bay (Grid AB8) tend to mirror those of the adjacent offshore waters (Grids AC7, 8 & 9; Fig. 4.1). Within Albatross Bay, total catch and effort have shown a major decline over the last decade. Between 1995 and 2005 the average annual catch for Albatross Bay (Grid AB8) was 118 tonnes (ranging from 35 tonnes (2003) to 260 tonnes (1997)) with an average value of over \$820 000. In the mid 1990's about 30 boats fished the area. Since then the boat numbers have declined to around 10-15 in the last couple of years. Importantly however, the catch per unit effort (CPUE) has remained relatively stable. It is therefore most likely that decline in fishing effort within Albatross Bay is due to boats choosing to operate in different areas within the Gulf coastal fisheries.

Fishing effort and catch composition within Albatross Bay is highly variable. For example, Grey Mackerel dominated catches over the last ten years with total landings of more than 430 tonnes valued at over \$3 million. However, annual catches have ranged from less than 1 tonne (2005) to almost 130 tonnes (1997). Landings of other species have tended to be more stable, with an average of 22 tonnes of Spanish Mackerel (range 5-35), 25 tonnes of shark (2-65), and 6 tonnes of barramundi (2-16) (CFISH 2006).

There has been a general decline in the commercial mud crab harvest within Albatross Bay over the last ten years, especially since 2000 when a high of 33 tonnes were landed, falling until 2005 when no mud crab landings were reported (CFISH 2006, Fig. 4.2).

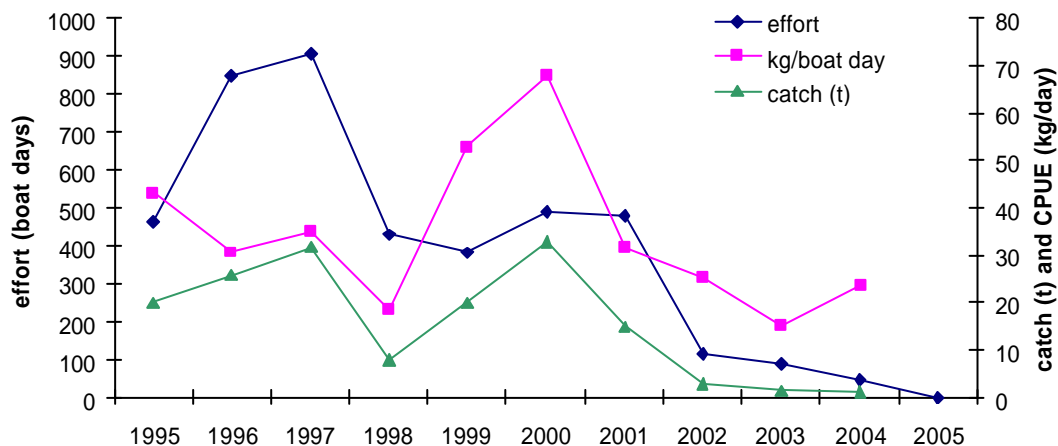


Figure 4.2: Mud crab catch and effort in Albatross Bay (Grid AB8) (data sourced from CFISH 2006).

Effort applied to commercial mud crab harvest has also fallen sharply over this time. A severe drought between 2001 and 2003 may have contributed to the decline in catch rates during these years, and combined with the collapse of Ansett Airlines, the primary means of freighting product out of Weipa, led to the shifting of effort into other regions or fisheries (DPI&F 2005).

Net fishing is banned in the Pine, Mission, Embley and Hey River estuaries draining into Albatross Bay (Qld Government 1999). The Pine River (upstream of its junction with Pine River Bay) is reserved as a catch-and-release only recreational fishery. Pine Bay and the coastal foreshores of Albatross Bay are open to commercial netting.

4.4.2 Habitat requirements of fishery species

A large proportion of species captured in Queensland's commercial fisheries utilise coastal and estuarine habitats during some part of their life cycle (Quinn 1992), and the species landed in Albatross Bay are no exception. Grey mackerel (*Scomberomorus semifasciatus*) use estuarine waters as juvenile nursery habitats (Blaber *et al.* 1990) and dominate commercial landings within the Bay (CFISH 2006). Similarly, spanish mackerel inhabit the coastal and offshore waters of Albatross Bay (Blaber *et al.* 1990b) where they are highly prized in both commercial and recreational catches. Barramundi, sharks, threadfin salmon, mud crabs, and a large proportion of other species landed commercially in the ABSA utilise a range of coastal, estuarine and freshwater habitats throughout their life cycles (Hill 1982, Blaber *et al.* 1989, 1990, Haywood *et al.* 1998), and connectivity between these habitats is critical for the ongoing sustainability of these stocks (Russell & Garrett 1985, Staunton-Smith *et al.* 2004).

4.5 Indigenous Fisheries

There are three main Aboriginal communities in the Albatross Bay area, Aurukun, Napranum and Mapoon. People living in these communities come from many language groups and clans. Natural resources from the marine environment are utilised extensively by local Indigenous people. In addition to subsistence fishing targeting a range of popular coastal and estuarine species such as barramundi, salmon, grunter and mud crabs, some marine resources are collected for cultural purposes.

Commercial fishing operations within Indigenous communities provide considerable benefits to the region and community beyond direct revenue, such as employment and training, economic growth, greater involvement of Indigenous communities in fisheries management, greater self-sufficiency and less reliance on external financial support. Mapoon Seafoods commenced operations in April 2003. The business aims to encourage young people from the community to become involved in the commercial fishing industry, and to provide an income for the community (Mapoon Aboriginal Shire Council 2006). A local commercial fisher has provided equipment, training and

expertise in the mud crab fishery, and the business ultimately aims to buy out the commercial license. While mainly capturing mud crabs, Mapoon Seafoods is expanding into netting for species such as barramundi. The business sells seafood to both the local community and across the Cape, including markets in Cairns. A new venture in the region is Aurukun Wetland Charters, operating out of Aurukun to the south of the ABSA. The business specialises in guided fishing charters. Given the past and present significance of the marine resources to local Indigenous people, it is likely that these resources will play a key role in the future economic growth of Indigenous communities in the Albatross Bay region.

Turtle and dugong are hunted in the area by Indigenous people and form an important part of the culture and lifestyle (EPA 2004). Although not managed under fisheries legislation, turtle and dugong rely on habitats of fisheries significance, particularly seagrass meadows, and the protection of such habitats has broader benefits in the conservation of biodiversity in the region.

The region is home to not only local Traditional Owners who may hunt according to tradition or custom, but also to people from other regions such as Torres Strait, who must have permission from the local Traditional Owners to hunt in the area. The Angumothimaree Paynaranama people have a memorandum of understanding (MoU) with the EPA for hunting turtle and dugong in Pine River Bay. Traditional Owners are negotiating other MoU's for hunting within other parts of the region. Hunters within the area first have to satisfy requirements through the Traditional Owner approval and permit process. Permits may only be approved for the summer months (Dec–Mar) and for hunting of either one male turtle or one male dugong per vessel during daylight hours. Permits will only be granted for specific cultural reasons, and, hunting flags need to be displayed during hunting (EPA 2004).

4.6 Recreational Fishing

Recreational fishing is a popular activity within the ABSA, targeting a range of popular estuarine and coastal species such as barramundi (*Lates calcarifer*), mangrove jack (*Lutjanus argentimaculatus*), fingermark (*Lutjanus johnii*), threadfin salmon (Polynemidae), queenfish (*Scomberoides* spp.) and mackerel (*Scomberomorus* spp.). Guided sportfishing is a rapidly growing industry in Weipa attracting clients from around the world targeting sportfish such as snub-nosed dart (*Trachinotus* spp.), golden trevally (*Gnathanodon speciosus*), queenfish and barramundi. It can provide substantial economic inputs to the community while having minimal impact on fish stocks. At least nine guided fishing operations operate in the area, including a new venture run by the Aurukun community. Tourist fishers also flock to the area during the cooler dry-season between May and August when the roads are passable. As many as 90 % of tourists who visit Weipa do so primarily to fish (Hart 2002 in GHD Pty. Ltd. 2005). Although there is no data available on the level of recreational catch within the ABSA, the high level of recreational boat ownership and fishing tourism, and the relatively low levels of commercial

coastal fishing effort within the ABSA suggest that the recreational catch of estuarine and coastal finfish and mud crabs would be a significant component of the total fisheries landings in the ABSA.

Chapter 5 Habitat Diversity

Chapter Summary

Many species of direct or indirect fisheries significance utilise multiple habitats within the ABSA. Different habitats may be used daily, seasonally or at different stages of the organisms lifecycle. The FHA program recognises the importance of protecting a range of connected and interrelated habitat types within an area for the benefit and sustainability of fisheries resources.

The ABSA contains a diverse array of high quality habitats including extensive seagrass meadows, mangrove-lined estuarine waterways, saltpan and saltmarsh, fringing reefs, rocky foreshores and open marine waters. Thirteen of the 14 habitat types listed in the FHA selection criteria are found within the ABSA (no surf bars), and combine to form high quality fish habitats which support valuable commercial, recreational and subsistence fisheries. The protection of these habitats is a critical component in the sustainable management of the region's fish stocks.

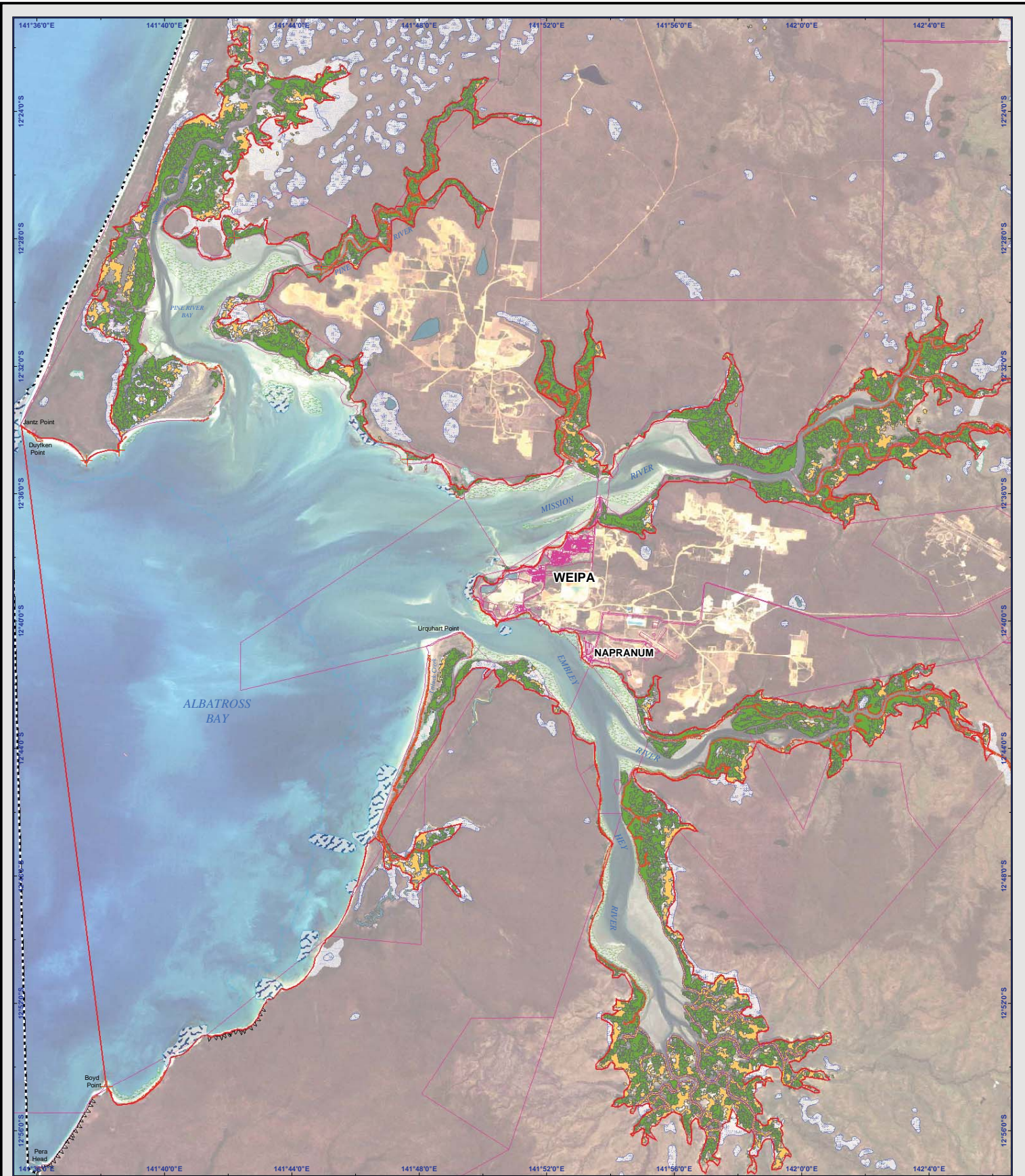
5.1 Introduction

Sustainable fisheries rely on the availability of a range of suitable and quality habitats to support fisheries species throughout their life cycles (e.g. Vance *et al.* 1990, Coles *et al.* 1992). Many species rely on multiple habitats during their lives, and degradation of any one habitat may have wide reaching implications for fish stocks and ecosystem functioning (Sheaves 2005). Habitat alteration or degradation that impacts on food chains may also have indirect, flow-on effects for fisheries species (Robertson 1988). The loss of fish habitat in general, and coastal fisheries habitats in particular, has been identified as a major threat to the continuing sustainability of Queensland's fisheries resources (Williams 2002).

The importance of estuarine and coastal nursery habitats within the ABSA for juveniles of commercially important penaeid prawns provides one of the most studied examples of direct and critical links between offshore fisheries and coastal habitats (e.g. Staples *et al.* 1985, Vance *et al.* 1990, 2002). The ABSA contains a mosaic of habitats important not only to the NPF, but also for coastal commercial, subsistence and recreational fishing, all of which contribute to the economy, lifestyle and wellbeing of the local communities.

5.2 Habitats of the ABSA

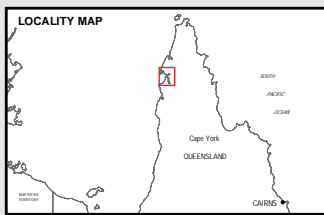
Below is a description of the extent and values of each of the habitats within the ABSA (Fig. 5.1), as defined in the FHA selection criteria (McKinnon *et al.* 2003).



REFERENCE

FHA-Study Area	Lakes/Swamp	Shoreline
5mdepth	Lake	Terrestrial vegetation
Cadastra	Swamp	Saline coastal flat
Territorial Base	Marine swamp	Bedrock
Reefs	Sub_to_inund	Cliff
Seagrass	Wetland Class	
	Mangroves	
	Vegetated Saltpan	
	Saltpan	

2.5 1.25 0 2.5 5 7.5 10
Kilometres



DISCLAIMER:
 Figure ABSA 5.1 only shows the outer boundary of the Study Area for the proposed Fish Habitat Area.
 The Boundary shown has been prepared from existing vegetation data and no field or consultation factors have been taken into account.
 The final Outer Boundary will vary given the normal rounds of consultations that follow this initial Study.



FISH HABITATS ALBATROSS BAY STUDY AREA

BASE MAP derived from the Digital Cadastral Data Base (03 SEP 2005) supplied by, and reproduced with the permission of, the Department of Natural Resources, Mines and Water, Brisbane.
 Landsat Imagery, Lakes/Swamp and Reef data - Copyright Commonwealth of Australia - ACRES, Geoscience Australia
 Wetlands: Coastal Wetlands Vegetation Mapping - Danaher, K., deVries, C. DPI&F Qld 1986-88,1991
 Shoreline Data : Environmental Protection Agency, Queensland Nov. 2001
 Seagrass Data : Roelofs, A.J., Rasheed, M.A., McKinnis, S. and Taylor, H. (2006)
 Port of Weipa Long Term Seagrass Monitoring, 2003-05 Ecoports Monograph Series No.23
 Ports Corporation of Qld. 31pp

1:10000 MAP REFERENCE
7272

FIGURE
ABSA - 5.1

GEOGRAPHIC PROJECTION
GEOCENTRIC DATUM OF AUSTRALIA - 1994

5.2.1 Marine waters >6 m deep at low tide – A large portion of Albatross Bay is >6 m deep, reaching almost 20 m at the offshore boundary of the ABSA. Most trawling for banana prawns occurs in waters <20 m deep (AFMA 2004) and trawlers regularly work the waters of the bay (Bob Russell, QBFP, pers. comm.). The trawl grounds are also important habitats for a diverse range of other species (e.g. Blaber *et al.* 1990a), as well as providing migration pathways for species moving between adult and juvenile habitats (e.g. tiger prawns, mangrove jack, mackerel).

5.2.2 Marine waters <6 m deep – Most of the waters of the inner bay, within 5 – 10 km of the shore, are <6 m deep (Oakey 2006). These waters contain a range of important habitats such as seagrass meadows and fringing reefs (see below). In addition, Blaber *et al.* (1995) recorded 15 species of fish from shallow, unvegetated inshore waters of the bay that had not previously been reported in either the adjacent offshore or estuarine waters (Blaber *et al.* 1990b). The presence of juveniles not recorded from other habitats in the region suggested that these inshore shallow waters are not only used as transition zones between other habitats, but may also function as nurseries (Blaber *et al.* 1995).

5.2.3 Aquatic beds – The shallow waters of Albatross Bay contain approximately 3000 – 5000 ha of seagrass meadows (Roelofs *et al.* 2003). Intertidal seagrass meadows were first surveyed during the 1980's documenting distribution and species composition (Poiner *et al.* 1987).



Figure 5.2: *Enhalus acoroides* seagrass meadow in the lower Embley River, opposite the bauxite loading wharf.

In 2000 the Ports Corporation of Queensland commissioned the DPI&F to conduct seagrass surveys within the Port of Weipa, and this monitoring is ongoing (Roelofs *et al.* 2003, 2005b, 2006). The surveys document the distribution, species composition, biomass and percent cover of seagrass

meadows within port limits. A total of 6 species of seagrass in two families have been identified during the surveys: *Halodule uninervis* and *Syringodium isoetifloium* (Cymodoceaceae), and *Enhalus acoroides*, *Halophila decipiens*, *H. ovalis* and *Thalassia hemprichii* (Hydrocharitaceae) (Roelofs *et al.* 2003, 2005b). The community-based seagrass monitoring program, Seagrass Watch, also has a site at Napranum which is monitored annually (www.seagrasswatch.org).

Seagrass meadows within the ABSA are important nursery habitats for commercially important tiger prawns (e.g. Staples *et al.* 1985), as well as a range of other fish and crustacean species of direct or indirect (e.g. prey species) fisheries significance (Blaber *et al.* 1989, Haywood *et al.* 1998).

Dugong and turtles are hunted by local Traditional Owners over coastal seagrass habitats (see Ch. 4.4) and are of considerable significance for local Indigenous people. Although the standing population of dugong may be low (Marsh *et al.* 2001), the seagrass meadows of the ABSA are amongst the most extensive in the eastern GoC (Roelofs *et al.* 2005a) and are likely to be an important feeding area for dugongs moving through the waters of the eastern Gulf. The protection of seagrass meadows afforded by FHA declaration for fisheries purposes would have broader benefits for the conservation of turtles and dugong in the region.

In addition to the seagrass meadows, parts of the rocky-reef systems along much of the bay coastline are covered with extensive macro-algal beds.

5.2.4 Coral reefs – There are fringing reefs around Jantz/Duyfken Point area in the north, and along much of the southern foreshore of the bay (Fig. 5.3). Coral occurs on the rocky shores along the Weipa Peninsula in the lower reaches of the Embley and Mission Rivers. The reefs within the ABSA are home to a range of coral reef species such as coral trout (*Plectropomus* spp.), red emperor (*Lutjanus sebae*) and stripeys (*L. carponotartus*), and contribute to the diversity of fisheries habitats within the Bay.



Figure 5.3: Fringing reef along southern shore of Albatross Bay near Boyd Point.

5.2.5 Sand, shingle or pebble beaches – Sandy beaches stretch along most of the southern shoreline of Albatross Bay, from Urquhart Point at the mouth of the Embley to Boyd Point, as well as around Duyfken/Jantz Point (Fig. 5.4). Sandy beaches also occur along the shores in the lower reaches of the estuaries draining into the Bay.



Figure 5.4: Sandy beach at Landfall Point, typical of much of the Albatross Bay coastline.

Several of the guided fishing operations in Weipa specialise in guiding anglers to catch sportfish along the shallow sandy shores of the Bay. Important species in this fishery include permit or snub-nosed dart (*Trachinotus* spp.), queenfish (*Scomberoides* spp.), golden trevally (*Gnathanodon speciosus*), milkfish (*Chanos chanos*) and barramundi (*Lates calcarifer*).

5.2.6 Estuarine waters – The ABSA has four major estuarine systems draining into it, the Pine, Mission, Embley and Hay River systems. Each of these systems has large estuarine inlets or embayments in the lower reaches (Fig. 5.5). These combined with the numerous smaller estuaries provide a significant area of estuarine waterway within the ABSA which support diverse fish assemblages (Blaber *et al.* 1989, Haywood *et al.* 1998). Additionally, the highly valuable banana prawn fishery of Albatross Bay is reliant on mangrove-lined estuarine habitats as juvenile nurseries (Vance *et al.* 1990, 2002).



Figure 5.5: Lower reaches of the Mission River looking south from Red Beach.

Estuaries are important nursery habitats for a range of species of commercial and ecological importance (e.g. Blaber *et al.* 1989). It has been estimated that more than 75% of species landed in Queensland's commercial fisheries are reliant on estuarine habitats during some part of their life cycles (Quinn 1992). A large proportion of recreational and subsistence fishing occurs in estuarine waters (Williams 2002) and species such as barramundi, mangrove jack, grunter, bream, salmon and mud crabs are popular targets (Ch. 3).

5.2.7 Intertidal flats – There are extensive intertidal flats within the ABSA, particularly in the lower reaches of the four main estuarine systems (Fig. 5.6). Throughout much of the ABSA the intertidal flats are covered with seagrass meadows (Fig. 5.2) (Roelofs *et al.* 2005b). While unvegetated flats may appear to be less productive than habitats such as seagrass meadows, primary production can still be high (Alongi 1994), and these habitats are used by a range of fish species (e.g. Blaber *et al.* 1989, 1995, Haywood *et al.* 1998). The estuarine flats and coastal sandy beaches are popular locations for guided sportfishing operations targeting a range of sportfish (see 5.2.5).



Figure 5.6: Intertidal sand/mud bank adjacent to the Mission River Bridge.

5.2.8 Marshes and Salt pans – Although not as extensive as in the southern parts of the Gulf of Carpentaria, salt pans and marshes occur along much of the coast of the ABSA, often forming a zone between mangrove forests and terrestrial vegetation (Fig. 5.7). Within the Port Musgrave/Weipa area, salt pans were the third most dominant intertidal vegetation unit described by Danaher (1995), after closed *Rhizophora* and closed *Avicennia*. On vegetated marshes the dominant vegetation is usually saltcouch, *Sporobolus virginicus*, and the marine succulents *Halosarcia* and *Sesuvium*.

Unvegetated salt pans have been found to outwell nutrients into the adjacent estuaries following inundation on large spring tides, and this may represent a significant contribution to the productivity of estuarine systems containing extensive salt pans (Ridd *et al.* 1988). An aerial survey in May 2006 revealed that most of the marsh areas surrounding the ABSA were heavily vegetated (e.g. Fig. 5.8) and fringed by brackish/freshwater swamps (see 5.2.10).



Figure 5.7: Typical marsh/saltpan area forming a zone between the mangrove forest and terrestrial vegetation.



Figure 5.8: Mosaic of terrestrial vegetation, saltpan, marsh, mangroves and saline swamps adjacent to an estuarine waterway within the ABSA.

5.2.9 Mangrove forests – Albatross Bay and the adjoining estuaries contain extensive mangrove communities (Fig. 5.9). Thirty-six species of mangrove plant have been recorded on western Cape York, and thirty of these have distributions that include Albatross Bay (Duke 2006, Appendix B). The ABSA region is dominated by closed *Rhizophora*, *Avicennia*, and *Ceriops* forests (Danaher 1995).



Figure 5.9: *Rhizophora* and *Ceriops* community, typical of the mangroves fringing waterways throughout the ABSA.

Juveniles of many species of fishes and crustaceans show strong affinities with mangrove habitats associated with estuarine waters (Staples & Vance 1987, Robertson 1988, Robertson & Duke 1990a, Vance *et al.* 1990) and these habitats are considered important nurseries for many species of commercial, recreational and ecological importance (Robertson & Duke 1987, Vance *et al.* 1990, 2002).

5.2.10 Marine swamps/lagoons – An aerial survey in May 2006 recorded extensive areas of marine swamps throughout the estuarine areas of the ABSA. Many of the smaller mangrove-lined creeks and drains open up into broad shallow swamps on marshes or salt pans in their upper reaches (Fig. 5.10). The extent and persistence of these habitats depends on seasonal variations in tidal patterns and rainfall. During the summer wet-season it is highly likely that pools within the saltpan/marsh complex would provide important habitats for a range of species such as juvenile barramundi (e.g. Russell & Garrett 1985).



Figure 5.10: Marine lagoon where a mangrove creek (entering from right) ends on a marsh/saltpan. These seasonal habitats are important for a range of species including barramundi.

5.2.11 Freshwater/brackish swamps – These occur in the upper reaches of the estuarine systems draining into Albatross Bay, and in a fringe around the landward edge of much of the mangrove/marsh complex (Fig. 5.11). There are also extensive shallow depressions on the coastal plain between Pine River/Nomenade Creek and the Pennefather River (Fig. 5.12). These are a unique habitat feature (see 5.3) which form freshwater paperbark swamps. The swamps north of the Pine River system appear to have limited connectivity with the adjacent marine systems. However, the seasonally extensive freshwater swamps surrounding most of the mangrove/marsh habitats throughout the ABSA (e.g. Fig. 5.11) represent a large area of freshwater habitat available for use by a range of marine species such as barramundi, mangrove jack, mullet and tarpon. The extent and persistence of freshwater swamps in the region is dependant on seasonal rainfall, and therefore varies from year to year.



Figure 5.11: Typical freshwater swamp draining into a mangrove creek joining the Embley River near Napranum.



Figure 5.12: Freshwater swamp in a depression on the floodplain adjacent to the Pine River/Nomenade Creek system.

5.2.12 Rocky shores – This habitat type (Fig. 5.13) is found along much of bay coastline, particularly in the lower bay around Boyd Point, to the north in the Duyfken/Jantz Point area, and around much of the Weipa Peninsula between the Mission and Embley estuaries (Fig. 5.1). The exposed red bauxite/white kaolin cliffs around Boyd Point and Pera Head are noted as a regionally unique feature of conservation significance because they are one of the best examples of this formation in the world (Abrahams *et al.* 1995) (Fig. 5.14).



Figure 5.13: Rocky reef along the foreshore of the Weipa Peninsula, near Kerr Point.

There are also numerous rock-bars throughout the estuarine systems of the ABSA. These would typically support extensive oyster reefs and provide food and shelter for a range of fish and crustaceans.



Figure 5.14: Bauxite (upper red layer) and kaolin (lower white layer) cliffs along the shore of Albatross Bay near Boyd Point.

5.2.13 Overhanging/undercut river banks - Undercut river banks normally form as a result of natural erosion processes. They develop on the outside of meandering bends where tidal currents or flood waters gradually erode banks. Such erosion may be artificially increased in areas of significant boating activity. Within the ABSA, natural undercut banks are found on the outside of bends in many of the areas waterways (Fig. 5.15).



Figure 5.15: Undercut rock shelf along the shore of Triluck Creek, Albatross Bay.

5.2.14 Surf bars – There are no surf bars within the ABSA, due to its orientation facing away from prevailing SE winds, and its position within the relatively sheltered waters of the Gulf of Carpentaria.

5.3 Unique habitat features

The ABSA contains a diverse range of high quality interconnected and relatively undisturbed habitats which combine to support valuable fisheries in the region. Being adjacent to the largest human population on western Cape York, the ABSA is likely to experience increased pressures from human activities in the future. The protection and maintenance of the full range of habitats and the connectivity between them is an important component in the management of the regions fisheries resources.

Seventy-five percent of the Weipa area is considered as very high wilderness quality (Abrahams *et al.* 1995). Between Pine River/Nomenade Creek and the Pennefather River to the north, the floodplain is covered by numerous shallow depressions or sink holes unique to the area (Fig. 5.12). These form freshwater swamps during the wet season, and such habitats in other regions are particularly valuable as barramundi nurseries (Russell & Garrett 1985). The Embley estuary has the only record of the river garfish *Zenarchopterus buffonis* on western Cape York Peninsula (Abrahams *et al.* 1995).

The Embley and Hey River area also contains extensive shell mounds or middens of great cultural significance to the region (Bailey *et al.* 1994). In addition to their cultural significance, middens provide useful data on historical utilisation of the fisheries resources of the area.

The ABSA contains habitats that are important to a range of locally and globally threatened and endangered species. Although not managed by fisheries legislation, many of these species rely on habitats with high fisheries values, and the protection of these habitats has substantial benefits in the conservation of the threatened species and biodiversity in the region. Additionally, while not target species, several of the threatened and endangered species, such as sea turtles and sawfish, are taken incidentally as by-catch in the regions fisheries, and considerable effort is being made to address this.

Each of the four species of sawfish recorded in Albatross Bay (Appendix 1) are listed as critically endangered on the IUCN Red List of threatened species (IUCN 2006), while only one, *Pristis microdon*, is listed under the *Environmental Protection of Biodiversity and Conservation Act 1999* (EPBC 1999), as vulnerable. None of the sawfish species are listed on Queensland's threatened species lists (*Nature Conservation Act 1992*, EPA 2006).

Six of the worlds seven species of marine turtle are found in the waters of northern Australia, including the Gulf of Carpentaria. These are all listed as vulnerable, endangered, or critically endangered by the IUCN, EPBC and EPA (IUCN 2006, EPBC 1999, EPA 2006). Saltwater Crocodiles (*Crocodylus*

porosus) are abundant throughout the ABSA, and are listed as vulnerable under Queensland's *Nature Conservation Act 1992* (EPA 2006). Similarly, dugongs (*Dugong dugon*) inhabit tropical waters throughout northern Australia and are considered vulnerable by both the IUCN and EPA. The area also supports a breeding population of the endangered little tern, *Sterna albifrons* (Abrahams *et al.* 1995).

5.4 Conclusions

The habitats of the ABSA do not function independently but combine to provide a large and diverse area of high quality fish habitats. The importance of protecting all available habitats within an area is a central focus of the FHA concept (McKinnon *et al.* 2003). Capturing a diverse range of habitats ensures that all habitat requirements of fish species are met, and reduces the risk of missing crucial habitats not currently recognised for their fisheries values. The ABSA contains a diverse range of high quality fish habitats which support a variety of subsistence, recreational and commercial fisheries. The largest human population on western Cape York resides on the shores of Albatross Bay. In addition to the expanding mining activities in the region, Weipa is also the focus of the increasing tourism industry, largely based on recreational fishing. Given the importance of habitats within the ABSA for the region's fisheries resources and a diverse range of threatened species, and the increasing pressures associated with human activities, the protection of these habitats is a high priority.

Chapter 6 Riparian Zone

Chapter Summary

The majority of the riparian zone within the ABSA is in near pristine condition. Comalco policy is to retain a 200 m buffer around all mining operations, thus providing adequate buffers for adjacent fisheries habitats. Other than mining and the towns of Weipa and Napranum, land use around the ABSA is cattle grazing at low stocking densities which has had minimal impact on riparian zones.

6.1 Introduction

The riparian zone is the area of land that adjoins, directly influences or is influenced by a body of water (Bavins *et al.* 2000). For the purposes of this report and marine fisheries management in Queensland, the riparian zone is considered to commence at the upper limit of tidal action (Highest Astronomical Tide level) and extends an arbitrary distance of 100 metres inland from that contour (Bavins *et al.* 2000). Although riparian vegetation communities are predominately terrestrial, some marine plants may form part of these communities.

A naturally vegetated riparian zone serves a variety of functions that benefit the adjacent tidal habitats and their associated aquatic fauna. These functions include the provision of:

- Improved bank stability preventing erosion;
- Buffers to filter sediment, nutrients and chemicals;
- Physical habitat;
- Detrital input;
- Shading; and
- Buffers the waterway from adjacent, possibly intensive, land uses.

Assessment of the presence and condition of riparian vegetation provides an indicator of the level of impact that adjacent land uses are having on the waterway. Details of the importance and functions of fish habitat riparian buffer zones are provided in Bavins *et al.* (2000).

6.2 Riparian Zones within the ABSA

The bauxite mining operations at Andoom (north of Weipa township between the Pine and Mission Rivers) and Weipa (on the Weipa Peninsula between the Mission and Embley Rivers) are a prominent feature of the landscape around Albatross Bay. Comalco policy is to retain a 200 m buffer from adjacent waterways and sites of cultural significance (Peter Eaglen, Comalco Environment Manager, pers. comm.). This buffer therefore includes the maintenance of a 100 m riparian zone as prescribed in Queensland's fisheries management guidelines (Bavins *et al.* 2000). The buffer zone maintained by

Comalco is measured from where the *Eucalyptus tetradonta* zone begins landward of mangroves, saltmarsh or other vegetation. This not only occurs around the tidal/mangrove areas but also around other important natural structures such as swamps. Boundaries may also be established based on cultural heritage surveys. While the buffer zones are not enforced by legislation, Comalco has made this initially self-imposed requirement into a commitment in their Environment Management Overview Strategy (EMOS) and Plan of Operations (PoOps) documents that are regulated by the Department of Natural Resources, Mines and Water (Peter Eaglen, Comalco Environment Manager, pers. comm.).



Figure 6.1: Part of the Andoom mining operation adjacent to the Pine River system, showing the buffer zone (centre) of *Eucalyptus tetradonta* woodlands between mine works and mangrove vegetation.

At a broader scale, aerial photos indicate that a large proportion of the woodlands surrounding Albatross Bay are finely criss-crossed by a grid pattern of cleared lines related to sampling the quality of bauxite throughout the mining lease.

Comalco has a program to revegetate disturbed areas after mining operations are completed. Nanum tawap, a local business owned by 5 clan groups from Napranum, harvests timber from Comalco lease areas prior to the area being cleared for mining. In 2004 they harvested over 1500 cubic metres of timber. Nanum tawap workers also collect seeds from native trees, later used by Comalco for revegetation of areas after the completion of mining activities. However, an EPA audit of the environmental conditions at the mine in 2001 noted an accumulation of areas that had not been rehabilitated within two

years of the cessation of mining operations, and that this was an area of environmental management at the site that required improvement (EPA 2001).

6.3 Conclusion

Although a prominent feature of the landscape, mined areas represent only a small proportion of the ABSA catchment. The 200 m buffer around mining operations exceeds the 100 m prescribed in Queensland's fisheries management guidelines (Bavins *et al.* 2000). Thus, despite their prominence, mining operations should have minimal impact on the adjacent fish habitats at the current level of operation. The remainder of the ABSA catchment is largely undisturbed with natural and near pristine functioning riparian zones.

Chapter 7 Climate, Catchment Flows and Impoundment Structures

Chapter Summary

The Albatross Bay region has a tropical monsoonal climate and a catchment of 4622 sq km. Average annual rainfall is over 1700 mm. The local communities and industries primarily use groundwater and there are no major impoundments within the catchment. Waterway connectivity is unimpeded allowing for the natural movements of fish between a range of aquatic habitats.

The area has a tropical monsoonal climate with distinct wet and dry seasons (BoM 2006). The average maximum temperatures range from 31 to 35 degrees, while minimums are from 18 to 24 (Fig. 7.1a). The Albatross Bay catchment is 4622 sq km (National Land and Water Resources Audit 2002). Average annual rainfall within the catchment is over 1700 mm and is highly seasonal with most of the annual rain falling between December and March (Fig. 7.1c). Humidity generally tracks rainfall (Fig. 7.1b).

Throughout Queensland there are widespread alterations to catchments and river environments caused by dams, weirs and barrages constructed for water supplies, flood mitigation and agricultural activities. Such alterations to waterways and natural flow regimes can have significant implications for fisheries resources. In the Western Cape York region, there is little development of this nature, and the majority of waterways are unimpeded. There are no major water storages in the Albatross Bay catchment (National Land and Water Resources Audit 2002). Natural flow regimes occur and fish movements between habitats are unimpeded by human activities.

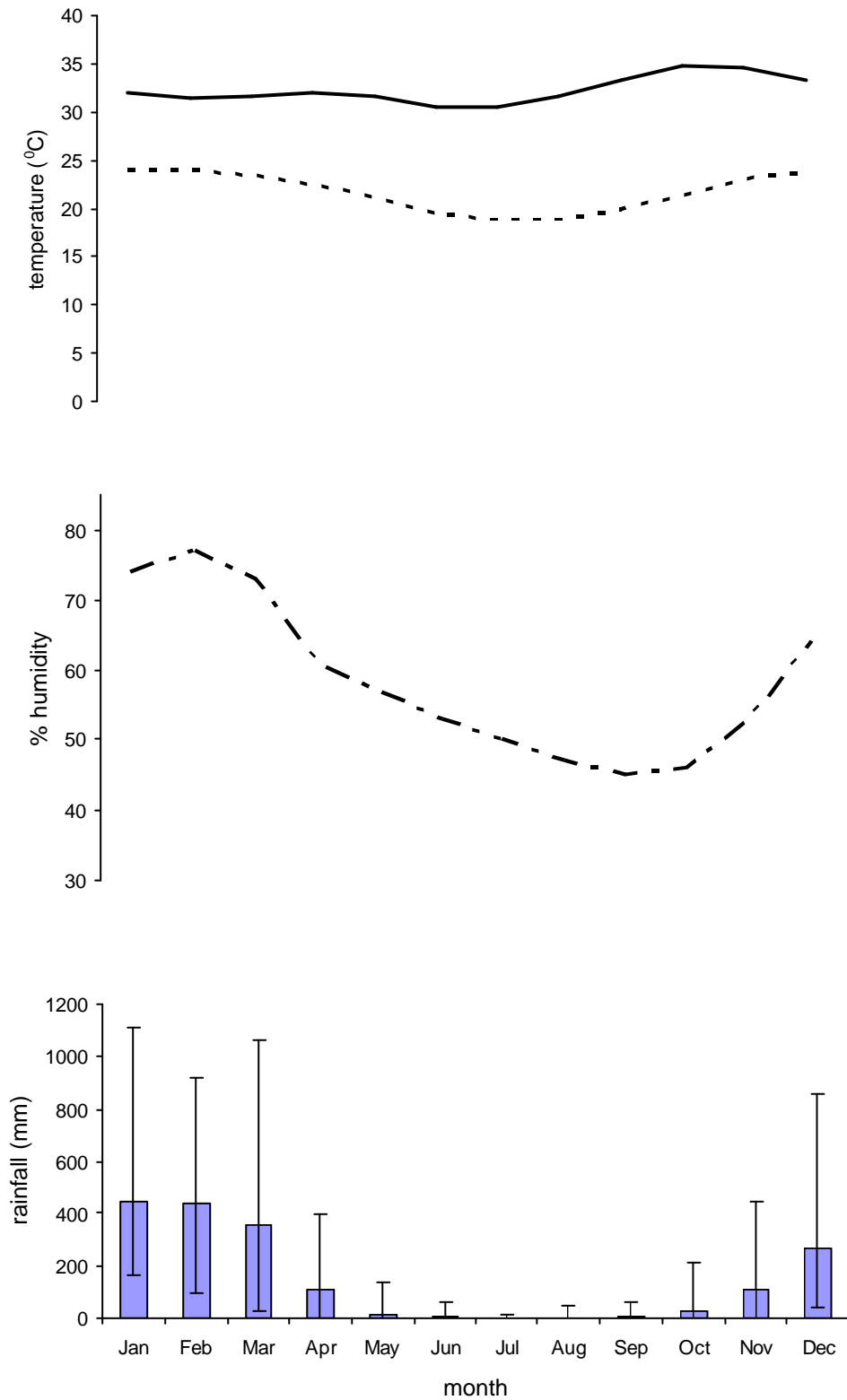


Figure 7.1: Weipa monthly climate averages between 1914 and 2004, measured by the Bureau of Meteorology (BoM 2006). (a) Maximum and minimum temperatures, (b) 3pm relative humidity, (c) rainfall – bars show range.

Chapter 8 Water Quality

Chapter Summary

The available data indicates that the water quality of Albatross Bay is generally of a high standard. Elevated levels of some contaminants have been measured at specific sites adjacent to the mining facilities near the port and the sewerage outlets. Improved management practices at these sites should see continued improvement of water quality. Regular dredging operations are carried out to maintain the shipping channel into the port, and these are monitored and regulated to ensure minimal adverse impacts on the surrounding marine environment.

8.1 Introduction

Good water quality is important for the maintenance of aquatic ecosystem functioning and healthy fish habitats. Degradation of water quality can occur through land clearing, industrial and urban development, pollution and stream modification. This can impact on the fisheries values of an ecosystem by increasing disease, reducing fish health, degrading habitat quality to the point it becomes uninhabitable. In severe cases, it can cause mortality of aquatic organisms unable to avoid the adverse conditions when particular water quality parameters fall below tolerance limits.

Throughout Australia water quality issues are receiving increased attention and in 2000 the Australian and New Zealand Environment and Conservation Council (ANZECC) in conjunction with the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) released revised guidelines for the assessment and monitoring of water quality. These guidelines are not intended as mandatory rules due to the complex, dynamic and often poorly understood physico-chemical and biological processes that affect and are affected by water quality. The guidelines do however provide a useful baseline for the assessment of water quality, and are based on the philosophy of continual improvement in water quality with a focus on issue-based management rather than management of individual parameters (ANZECC 2000).

The ANZECC Guidelines (2000) recognise that ambient water quality values are likely to vary among regions and different system types, and it is recommended to produce guidelines specific to particular areas. Accordingly, the Queensland Water Quality Guidelines 2006 (EPA 2006) outline regional water quality guidelines more specific than those in the ANZECC guidelines. However, the Queensland guidelines do not include reference sites or guideline values for the Gulf Region. While stating that in the absence of local guidelines the ANZECC values should be used by default, they note that the ANZECC values are unlikely to be relevant to this region.

The Ports Corporation of Queensland and Comalco commissioned a baseline study of water and sediment quality within Albatross Bay and the estuarine systems in 1995 (Larcombe & Taylor 1997). The report proposes guideline

values for water and sediment quality for Albatross Bay, mainly based on the maximum measured parameter values during the study. Although these values represent the ambient water and sediment quality after 40 years of potential impact from mining and port operations, they set a benchmark for water quality in the region and show a commitment by local industries for the maintenance and improvement of environmental conditions, in accordance with the ANZECC philosophy. However, the baseline study was conducted 10 years ago, and due to the lack of availability of more contemporary data, it is difficult to assess the current condition of the water quality in the region, or of the effectiveness of any measures taken in response to the baseline report's recommendations.

8.2 Mine and Port Operations

The following sections on water and sediment quality are based mainly on the baseline study conducted within the Port of Weipa in the mid 1990's (Larcombe & Taylor 1997). Although the Ports Corporation of Queensland Sustainability Report for 2004/05 states that data from annual water quality monitoring is available online, no such data could be found at the time of preparation of this report.

One of the key findings of the baseline study was that further research is required to develop local guidelines for the protection of the aquatic ecosystems in the Albatross Bay region (Larcombe & Taylor 1997). It also noted that while water quality was generally good, there were several key sites requiring attention for improvement of water and sediment quality. These were Evans Landing, the power station cooling-water outlet, the bauxite stockpile storm water outlet, and the Napranum sewage outlet, all along a relatively short section of the lower Embley where port facilities are focussed. Each of the sites showed elevated levels of various pollutants (outlined below).

8.2.1 Water quality

Water quality in and around the Port of Weipa was generally good at the time of the baseline study (Larcombe & Taylor 1997). A few parameters at particular sites were recommended for further attention of management action, and these are outlined below.

pH – within ANZECC guidelines, recommend monitoring the Napranum sewage outlet.

Dissolved Oxygen (DO) concentration – consistently below ANZECC guidelines, which are probably inappropriate for this region. Larcombe & Taylor (1997) suggested new guidelines of >4.0 mg/l. Seek ways to increase DO in power station cooling water outlet. Their report considered a DO measurement of 4.38 mg/l very low.

The DPI&F Long Term Monitoring Program (LTMP) detected DO levels below 4.38 mg/l at several sites in the Mission and Hey Rivers during surveys between 2000 and the present, particularly during 2006 sampling when DO concentrations at most sites were below 4 mg/l. However, point measurements of parameters such as DO can be highly variable even over short periods (Larcombe & Taylor 1997) and therefore it is difficult to determine if the LTMP data indicates a serious water quality issue in the region in 2006 or is simply a function of conditions at the specific locations and times the samples were collected.

Water temperature – mostly within guidelines, but efforts should be made to reduce the elevated temperatures of discharged power station cooling water by at least 8°C.

Petroleum hydrocarbons, oil and grease – High levels detected in water samples from adjacent to the mine complex and Napranum sewage outlet. Improvement needed in handling and storage of these products.

Metals – nickel, copper, zinc and lead exceeded guidelines at many locations. Guidelines may be inappropriate; however, elevated levels of metals are a common indication of pollution from mining and port operations (e.g. Ross Creek in Cleveland Bay - Baker & Sheppard 2005).

Turbidity – ANZECC guidelines may be breached at discharge from bauxite stockpile and action was required to reduce sediment input to the estuary at this site.

Other parameters (chlorophyll a, nutrients, etc.) are within guidelines (Larcombe & Taylor 1997).

8.2.2 Sediment quality

Contaminants or pollutants in sediments have the potential to directly and indirectly affect fisheries species. Pollutants may gradually leach out of sediments into the water column or be disturbed and distributed during activities such as dredging, thereby directly influencing water quality. Additionally, many fisheries species utilise benthic prey resources which may be adversely affected by pollutants within sediments. Sediment quality parameters also provide an indication of longer-term water quality patterns or problems because sediments may accumulate pollutants from the water column (Larcombe & Taylor 1997). Parameters identified in and around the Port of Weipa that required further attention included:

Petroleum hydrocarbons, oil and grease – evidence of chronic pollution from mining operations, particularly around power station cooling water outlet and bauxite stockpile outlet. Improvement needed in the handling and storage of these products.

Metals – elevated in sediments around port and mine operations, particularly nickel, copper, zinc and lead.

Because the identified water and sediment quality issues were primarily focussed on specific sites of mine and port infrastructure and sewerage treatment plants, improvements to water quality should be achievable through the implementation of management actions as outlined in the report recommendations (Larcombe & Taylor 1997).

8.3 Dredging operations

The Ports Corporation of Queensland undertakes maintenance dredging at Weipa every one to two years (PCQ 2005). PCQ is also planning capital dredging works in 2006/07 to widen and deepen the South Channel. The work is required to accommodate the increased shipping volumes and traffic associated with the recent expansion of the Comalco mining operations. Although not required by legislation, PCQ voluntarily prepared an EIS for the proposed works (GHD Pty. Ltd. 2005).

The project will remove up to 3 750 000 m³ of dredged material to be disposed of in the Albatross Bay spoil grounds. Modelling has been undertaken to predict the behaviour of plumes resulting from dredging and dumping activities. By targeting dredging operations during times of favourable prevailing winds, tides and currents, dispersal and impacts of plumes should be minimal (GHD 2005). Sediment testing has found that levels of contaminants in sediments to be dredged are all below the Interim Quality Guidelines for dumping of dredge spoil at sea. Sediments also meet the requirements for sea dumping according to the National Ocean Disposal Guidelines for Dredged Material (NODGDM) (GHD 2005).

8.4 Conclusions

Although water quality at certain locations adjacent to port and mining operations exceeds guideline values for some parameters, the available data indicates that the water quality of the ABSA is generally of a high standard. The problem sites identified by Larcombe and Taylor (1997) are amenable to improvements through improved management practices at mine and port facilities. Because there is little contemporary data available, it is difficult to assess any trends or the current condition of water quality conditions around the Port of Weipa. However, given the relatively localised nature of polluted sites, and likely improvements in management procedures over the last ten years, water quality in the region seems to be reasonable, and should improve further if industry practices continue to improve. There are legislative guidelines and requirements for dredging operations at the port to minimise adverse impacts on the surrounding marine environment.

Comalco policy is to retain a 200 m buffer zone from adjacent waterways (Ch. 6), and if revegetation efforts of mined sites are improved (EPA 2001), potential impacts on water quality from the actual mined areas should be minimal.

Chapter 9 Land use within and adjacent to Albatross Bay

Chapter Summary

Land use practices can have significant impacts on the adjacent coastal and marine environments and the fisheries they support. Although a prominent feature of the landscape, the bauxite mine adjacent to the ABSA retains adequate buffers between mining operations and fisheries habitats, and is continually improving environmental practices. The remainder of the ABSA is largely undisturbed and land-use practices are compatible with FHA management within Albatross Bay.

9.1 Introduction

Adjacent land use can have significant impacts on coastal marine environments (Haynes & Michalek-Wagner 2000, Devlin & Brodie 2005). Land clearing, application of pesticides and fertilisers in agricultural and urban areas, sewage discharge and urban and industrial developments may all have impacts on the adjacent marine ecosystems and the fisheries they support.

Land use within the ABSA catchment, is dominated by cattle grazing and mining (Table 9.1). A large proportion of this land is under the Comalco mining lease (listed in Table 9.1 as livestock grazing), which covers 2500 sq. km (see 9.2 below). Although the shallow open-cut mine areas are a prominent feature of the landscape around the ABSA, only a small proportion of the mining lease is currently actively mined, and mined areas are revegetated after the completion of mining activities.

Land Use Description	Total Extent ('000 ha)	Total Extent (%)
No Data	.3	.1
Other protected areas including indigenous uses	145	31.1
Minimal use	9.7	2.1
Livestock grazing*	292.5	62.8
Dryland agriculture	.1	0
Built environment	.5	.1
Waterbodies not elsewhere classified	17.7	3.8

*includes mining operations

Table 9.1: Land use in the Embley River Basin, which includes the entire ABSA catchment and that of the Pennefather River and Janie Creek to the north (table from Australian Natural resources Atlas 2002).

Below is a description of the land uses within and adjacent to the ABSA that may influence future management of the regions fisheries resources.

9.2 Comalco Bauxite Mine

Surveys of the bauxite deposits around Albatross Bay in 1955 led to the commencement of mining operations on the Weipa peninsula in 1961 by the Commonwealth Aluminium Company (Comalco, now owned by Rio Tinto). The township of Weipa was constructed in the 1960's to house the workforce for the mine. Weipa remains under Comalco control and is managed via the Town Commission which functions similarly to a Local Council.

In 2005 the mine employed 723 workers, more than 90 of which were Indigenous people (Comalco 2006). The operation produced 15.47 million tonnes of bauxite in 2005, up from 12.65 million tonnes in 2004 (Fig. 9.1). Recently completed expansions of the mine are expected to further increase production to 16.5 million tonnes per year. The mining lease covers 2500 sq. km and contains an estimated 1.2 billion tonnes of ore. The Weipa operation produces washed bauxite which is exported or shipped to Gladstone for refining into alumina and aluminium. For every 4 tonnes of bauxite mined, approximately 1 tonne of aluminium is produced (Comalco 2006).

Nanum tawap harvests timber from the Comalco lease areas prior to the area being cleared for mining, and mined areas are revegetated after the completion of mining operations. However, there was an accumulation of areas that had not been rehabilitated within two years of the cessation of mining operations (see Section 6.2).

9.3 Port of Weipa

The Port of Weipa is run by Ports Corporation of Queensland with the infrastructure leased to Comalco. The port primarily exports bauxite, but also handles cattle and imports general cargo and fuel (Fig. 9.1). During 04/05, the port handled 374 ships. Maintenance dredging is carried out every one to two years to maintain the South Channel, in accordance with the Interim Quality Guidelines for Dumping of Dredge Spoil at Sea and the National Ocean Disposal Guidelines for Dredged Material (NODGDM). Capital dredging works are underway to widen and deepen the shipping channel to accommodate the increased shipping volumes and traffic associated with recent expansions of Comalco's mining activities. A second ship-loading wharf is also being constructed to alleviate a bottleneck in the Comalco operation, which is currently limited by shiploading times.

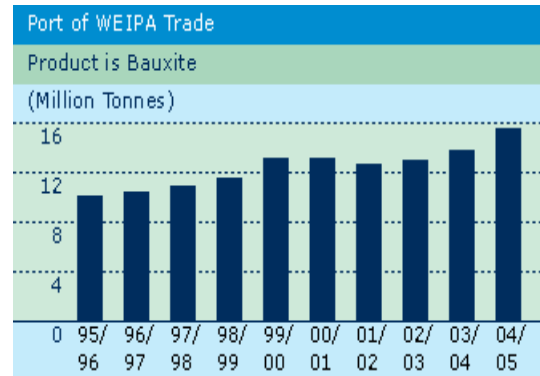
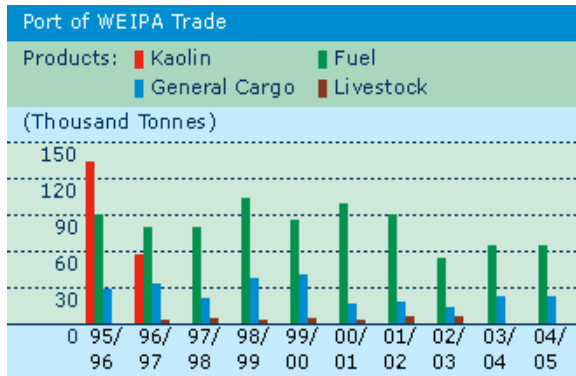


Figure 9.1: Port of Weipa trade between 1995 and 2005 (from Ports Corporation of Queensland: <http://www.pcq.com.au/weipa.cfm>).

9.4 Other Land Use

The majority of land surrounding the ABSA is used for cattle grazing or is under Deed of Grant in Trust (DOGIT) to local Aboriginal Councils (Fig. 2.2, Table 9.1). Despite housing the highest human population on the western Cape, this is a large area with a sparse population and environmental impacts throughout most of the ABSA catchment are minimal.

To the west of Weipa is RAAF Base Scherger, opened in 1998. It is one of the RAAF's 3 'bare bases', normally manned by caretakers only, but provides full airbase infrastructure for use if necessary. On average the base hosts one exercise per year in which the base is fully activated, with up to 400 personnel and aircraft coming in from other bases.

9.5 Artificial Structures

The presence of in-stream artificial structures indicates past and continuing impacts to the fish habitat values of an area (McKinnon *et al.* 2003). Structures such as port facilities, jetties, boat ramps and bridges are likely to require periodic maintenance and such works may result in ongoing disturbances of adjacent fish habitats.

Despite containing the largest population on western Cape York, the port facilities and adjacent bauxite mining operation, the ABSA contains very few artificial in-stream structures. Beyond the port facilities in the lower Embley estuary and shipping channel, artificial structures are limited to two bridges, several boat ramps, isolated moorings, and minor structures associated with an oyster lease and private huts (Figs. 9.2 – 9.11).



Figure 9.2: The bauxite ship loader at Lorim Point in the lower Embley estuary. This currently handles an average of 1 ship per day, limited by loading time and tides.



Figure 9.3: The southern side of the Mission River bridge, a popular location for land-based fishing and beach launching of recreational boats.



Figure 9.4: Cyclone mooring in the Hey River, south of Hey Point.



Figure 9.5: Derelict jetty and hut within the oyster lease in Roberts Creek.



Figure 9.6: Private beach hut near the mouth of Roberts Creek. Few permanent structures below HAT were observed around such huts.



Figure 9.7: Private jetty in front of beach hut in Triluck (Wooldrum) Creek.



Figure 9.8: Beach hut on the foreshore between Triluck Creek and the open waters of Albatross Bay.



Figure 9.9: Rocky Point boat ramp in the lower Mission estuary, Weipa.



Figure 9.10: boat launching site on the north side of Andoom Creek bridge.



Figure 9.11: Evans Landing boat ramp (foreground) and the Evans Landing fuel wharf.

9.6 Housing and related infrastructure

There are two main communities within the catchment of the ABSA. Weipa lies on the southern banks of the lower Mission River estuary and has a population of around 2500. Napranum, population 1000, lies 13 km to the south of Weipa on the shores of the Embley estuary. The growing tourist trade and continued mine expansion is likely to see these communities grow in the future. The sewerage treatment plant outlets for both settlements have been noted as sources of various pollutants to Albatross Bay (Ch. 8.2.1, Larcombe & Taylor 1997).

9.7 Future development proposals

Beyond the further expansion of production of the Comalco bauxite mine, there are two major development proposals for the region, the Papua New Guinea (PNG) – Queensland (Qld) gas pipeline, and the development of the Aurukun bauxite deposit.

The proposed PNG – Qld Gas Pipeline is likely to follow the Cape Developmental Road south from Cape York. A lateral pipeline (The “Gove Lateral”) will pass to the north of the ABSA between the Pine and Pennefather Rivers to cross the Gulf of Carpentaria to Gove, Northern Territory. From the lateral pipeline the Weipa spur will run south from around Myerfield, crossing the Mission River adjacent to the existing Mission River Bridge, within the

ABSA. Currently the Comalco mining operation, Weipa and Napranum are powered by a diesel-fired power station. The gas supply will provide an alternative for future power generation.

DPI&F is involved in the assessment process for this development, which will require fisheries development approvals under the *Integrated Planning Act 1997*. The timing of this proposal is such that construction of the Gove Lateral and Weipa Spur is scheduled for completion before any proposals for FHA declaration could be considered, and so any infrastructure would be excluded from any FHA declarations.

At present, the Chinese aluminium company Chalco is the Queensland Government's preferred developer of the Aurukun bauxite deposit to the south of the ABSA. It seems likely that bauxite mined at this site will be shipped through the Port of Weipa, however, there are no plans available to indicate the means or location of the infrastructure to transport bauxite between the proposed mine and the Port.

9.8 Conclusions

The shallow open-cut bauxite mine is the most prominent land use within the ABSA catchment. Given the buffer zones retained between the mine and adjacent waterways and the commitment to the continual improvement of environmental practices by Comalco, the current land-use practices and level of operation are compatible with FHA management. The remainder of the ABSA and its catchment are relatively undisturbed, being used mainly for cattle grazing. The future development of the Aurukun bauxite deposit, and in particular the associated transport infrastructure, has the potential to disturb marine habitats and impact on the fisheries resources of the ABSA. Regardless of the success of any FHA proposals for the region, the development of the Aurukun bauxite deposit must give due consideration of the high value of the region's coastal fisheries resources.

Chapter 10 State and Regional Planning and Management

Chapter Summary

The ABSA has high conservation values, and is adjacent to current and future industries of State significance. In addition, Indigenous people in the region require the flexibility in regional plans and policies to explore the potential future options for the economic development of their communities. Planning and management for the region faces the challenge of balancing the complex and often disparate demands of the communities, industry and conservation.

10.1 Introduction

The Albatross Bay region, like the broader Cape York region, presents some unique challenges for State and regional planning and management groups. In particular, there are significant challenges to mesh together approaches to land and sea management of local Indigenous people and State and Local Government agencies. Indigenous views consider cultural, social and physical wellbeing as inextricably linked to the care and management of the surrounding land and sea. Government agencies tend to divide policies and plans on social, economic, health and Natural Resource Management (NRM) and manage each separately. Reconciling these different approaches and accommodating the wide diversity of views and aspirations among communities in the region represents a significant challenge.

The predominant land use in the adjacent catchment is cattle grazing, and the area contains developments of State and national significance such as the Comalco Weipa bauxite mine, the Aurukun bauxite deposit and proposed PNG gas pipeline project. Cape York is home to a large population of Indigenous Australians living in a number of communities. Various communities are engaged in commercial enterprises such as Nanum Tawap, Mapoon Seafoods and Aurukun Wetland Charters which provide considerable local economic and social benefits. Many people have aspirations for the future development of their communities, however in many cases communities do not presently have the capacity to realise these aspirations.

The local and state governments have developed a range of management plans, policies and strategies to guide the planning and future growth of the region. In addition, there are a number of important State and Commonwealth policies and legislation relevant to the protection of the environmental and cultural values of the region. Below is a brief outline of some of the major plans, policies and legislation that may influence the future management of the ABSA. The list is by no means exhaustive, however, reference to other relevant policies can be found within the plans listed below.

10.2.1 Cape York Peninsula Natural Resource Management Plan (2004)

The aim of the Cape York Peninsula Natural Resource Management Plan (2004) is to ensure the ecologically sustainable management of Cape York Peninsula's globally significant natural heritage. It builds on previous NRM plans for the region, such as the Cape York Peninsula Land Use Strategy (CYPLUS). The plan identifies the natural resource assets of the region and sets out strategies to achieve their sustainable management. By doing so, the plan also provides an investment strategy with clearly defined objectives and milestones, in accordance with the Federal Government's Natural Heritage Trust 2 (NHT2) funding program which the plan aims to access.

10.2.2 Natural Heritage Trust 2 (NHT2)

NHT2 is a Federal funding program of particular relevance to NRM on Cape York. It has three overarching objectives, two of which are particularly relevant to and compatible with FHA and fisheries resource management. These two are:

i. Biodiversity conservation – the conservation of Australia's biodiversity through the protection and restoration of terrestrial, freshwater, estuarine and marine ecosystems and habitat for native plants and animals.

ii. Sustainable use of natural resources – the sustainable use and management of Australia's land, water and marine resources to maintain and improve the productivity and profitability of resource-based industries.

Within the main objectives are ten areas of activity, several of which are specifically relevant to and compatible with FHA management principles. These include; protecting and restoring the habitat of threatened species; protecting and restoring significant marine and estuarine ecosystems; establishing and effectively managing a comprehensive, adequate and representative system of protected areas; improving the condition of natural resources that underpin industries; and securing access to resources for sustainable productive use.

10.2.3 The State Coastal Management Plan (2001)

The State Coastal Management Plan was released in 2001 by the Queensland EPA, and is the primary policy of the Queensland State Government for protecting the coastal environment. It describes how development in the coastal zone is to be managed as required by the *Coastal Protection and Management Act 1995*. The Act covers issues in relation to:

- coastal use and development;
- physical coastal processes (the effects of waves, tides, currents and coastal storms);
- public access to the coast;
- water quality;

- Indigenous Traditional Owner cultural resources;
- cultural heritage;
- coastal landscapes;
- conserving nature;
- coordinated management; and
- research and information.

Under the Plan the Queensland coast has been subdivided into 11 regions with a Regional Coastal Plan to be developed for each. The ABSA lies at the southern boundary of the Cape York Peninsula Region, which covers the area from the ABSA north, and south to the Bloomfield River on the east coast, but excluding the far northern Peninsula and Torres Strait. The regional plan for this area is yet to be developed, however the State Coastal Management Plan (2001) notes that the conservation values of the region are extremely high. It recognises the importance of the marine resources of the region for both local inhabitants and for the commercial fishing industry. It sees the use of Weipa's port facilities and expansion of bauxite mining as a key coastal management issue for the region.

10.2.4 Fish Habitat Areas

Fish Habitat Areas (FHAs) are declared by regulation under Section 120 of the *Fisheries Act 1994* as part of the identification, management and protection of critical fish habitats in Queensland. In recognition of the importance of maintaining quality fish habitats for sustainable fisheries, the FHA program aims to protect the full range of habitats in important fisheries areas and to develop a network of protected areas around the Queensland coastline.

The ABSA lies in the centre of a large gap in Queensland's FHA network (Fig. 10.1). The nearest declared FHAs are the Nassau River to the south of Kowanyama and the Escape River on the east coast near the tip of Cape York. There are a further three FHA's between the Nassau and the Northern Territory boarder, with the remainder of Queensland's FHAs lying on the east coast. Several sites for consideration as potential FHA's have been identified in western Cape York (Danaher 1995). The Kirke River near Aurukun was investigated and found to meet the FHA selection criteria, however the FHA proposal at the time of consultation was not supported by the Traditional Owners (Sheppard *et al.* 2001). Because community support is an important component of FHA declaration and management, the Kirke River FHA proposal was not pursued further.

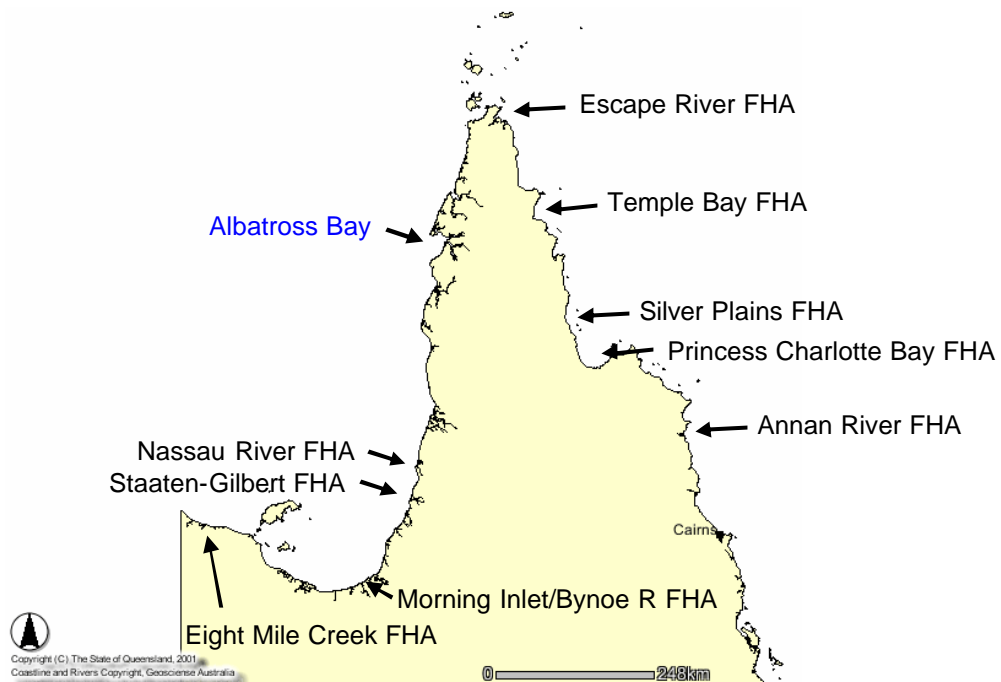


Figure 10.1: Western Cape York Peninsula represents a significant gap in Queensland's FHA network. Shown is Albatross Bay in relation to the declared FHAs between Cooktown and the Northern Territory border.

10.2.5 Regional and Local Government Plans

Each of the Shire and Community Councils is required to prepare plans under the *Integrated Planning Act 1997*. The plans are to guide the future development and growth of the region, and include the management and protection of natural resources. These plans are currently under development.

10.3 Regional Production and Development

At the time of the last census in 2001, the Cook Shire had a population of 9,700 people (ABS 2006). Over 3,200 of these people lived within the communities of Weipa and Napranum on the shores of Albatross Bay.

Existing major industries in the region include:

- Comalco bauxite mine;
- beef production;
- Port of Weipa;
- Defence – RAAF Base Scherger; and
- tourism.

Recent and proposed projects in the region include:

- Construction of the PNG – Qld gas pipeline, including the lateral branch to Gove in the NT passing across the north of the ABSA;
- Port expansion including extensive capital dredging works to widen and deepen the South Channel to accommodate larger ships; and
- Development of the Aurukun bauxite deposit and associated transport infrastructure.

10.4 Conclusion

The ABSA region is rich in natural assets including a complex of diverse and healthy fish habitats. Planning and management of future growth and development faces a challenge to balance the aspirations of communities for economic growth, with the need to protect the natural assets and resources of the region. Similarly, any environmental impact studies relating to the further expansion of the existing mine and port facilities, and the development of the Aurukun bauxite deposit, must give due consideration to the very high conservation values and the importance of the fisheries resources of the region.

Chapter 11 Suitability of Albatross Bay for FHA declaration

Chapter Summary

The ABSA meets all of the 4 fisheries criteria and the 8 habitat criteria, and has more than one unique feature. Based on this assessment the ABSA is recommended for declaration as an 'A' Management Fish Habitat Area.

11.1 Introduction

Fish Habitat Areas are declared under the *Fisheries Act 1994* and are based on the principle of protecting all habitats in key areas of fisheries significance. FHAs protect habitats from development-based alterations while allowing for all legal fishing activities.

The DPI&F has developed a set of criteria or guidelines to aid in the assessment of an area's suitability for declaration as an FHA (Table 11.1) (McKinnon *et al.* 2003). This chapter provides a summary of the findings of this report in relation to the FHA selection criteria.

Note that the selection criteria form only part of the process of determining whether a suitable area will achieve declaration. Details of the selection criteria are available in the DPI&F policy document *FHMOP 007: Fish Habitat Area selection and assessment* (McKinnon *et al.* 2003). DPI&F considers FHAs as a community asset. As such, consultation is undertaken to determine the level of community and stakeholder support for the formal declaration of areas considered suitable. Consultation results are a key consideration when the Executive Council (Cabinet and Governor-in-Council) decides on the declaration of a FHA. The DPI&F policy on the consultation process is outlined in *FHMOP 006: Fish Habitat Area declaration and review: departmental consultation procedures* (McKinnon & Sheppard 2001).

Table 11.1: Fish Habitat Area selection criteria for inshore/estuarine areas (from McKinnon *et al.* 2003)

	Suitability for Fish Habitat Area Declaration	
Fisheries Criteria	Compatible with FHA 'B' consideration	Compatible with FHA 'A' consideration
High fish species richness	Fish species richness comparable to that of regional 'benchmark' waterways.	
High diversity and abundance of regionally targeted fish species (adult or juvenile)	>10 regionally targeted fish species present in high abundance	>15 regionally targeted fish species present in high abundance
Supports existing fisheries	Regular, consistent use of area by commercial, recreational or traditional fishers	Major commercial and/or recreational and/or traditional fishery within the area
Supports external/regional fisheries	Commercial, recreational or traditional fishing occurs adjacent to the area or in offshore waters, targeting species that are directly linked to the area	Major commercial, recreational or traditional fishing adjacent to the area or in offshore waters, targeting species that are directly linked to the area
Habitat criteria		
Large in size	>100ha	>500ha
Diverse habitat types	>4 habitat types represented	>7 habitat types represented
Presence of functioning riparian buffer zone	>50% of the length of the riparian zone is adequately vegetated and functioning effectively	>80% of the length of the riparian zone is adequately vegetated and functioning effectively
Limited disturbance from artificial in stream structures	Minimal disturbance from artificial structures (e.g. jetties, boat ramps, revetment). Average separation between structures 100m-400m and/or <5% of riverbank altered by artificial structures	Nil to minimal disturbances from artificial structures. Average separation between structures >400m and/or <5% of the riverbank altered by artificial structures
Good water quality	<ol style="list-style-type: none"> 1. water quality is of a standard that generally meets the ANZECC guidelines for the protection of aquatic ecosystems; or 2. A documented water quality improvement program is in place, which will enable the area to meet ANZECC guidelines within 5 years or less. 	

<p>Limited disturbance from, or ongoing reduction of impacts from, water impoundment structures</p>	<ol style="list-style-type: none"> 1. No water impoundment structures are present on the main stream and any major tributary of the main stream; or 2. the main stream and any major tributaries of the mainstream, only have water impoundment structures that: <ul style="list-style-type: none"> • Allow for >75% of flows to overtop the structure or are managed to release adequate (from a fisheries perspective) environmental flows; and • Drown out regularly enough to allow for adequate fish passage or have a functional fishway; or 3. Assessment indicates that existing levels of fish passage and environmental flows in the mainstream and any major tributaries of the main stream will be maintained and a proposed program of water management activities that ensure a net improvement of fish passage and/or environmental flows through these waterways within a 10 year timeframe. 	
<p>Limited interaction with developments of major significance to the State</p>	<ol style="list-style-type: none"> 1. No developments of major significance to the state are present within or directly adjacent to the area; or 2. any adjacent developments of major significance to the state are in a location and can be appropriately buffered to ensure that they will have no existing or future impacts on the area. 	
<p>Compatible adjacent land and aquatic planning</p>	<p>Adjacent land and aquatic planning compatible with FHA 'B' management intent and will not lead to a reduction in habitat value through a proliferation of private structures</p>	<p>Adjacent land and aquatic planning compatible with the strict management intent of a FHA 'A'</p>
<p>Unique features</p>		
<p>Presence of regionally unique natural fish habitat features</p>	<p>Contains one or more regionally unique flora species, habitat type, spawning ground, nursery location or habitat assemblage</p>	

For a candidate area to be considered as a potential FHA it should:

- Contain one or more regionally unique features; **or**
- Meet 3 or more of the 4 Fisheries criteria; **and**
- Meet 6 or more of the 8 Habitat criteria

11.2 Assessment of Albatross Bay in relation to the FHA selection criteria

This report was prepared to assess the suitability of Albatross Bay for declaration as a Fish Habitat Area (Ch. 1.3). Below is a brief description of how Albatross Bay meets each of the selection criteria outlined in Table 11.1 above. Reference is provided to the relevant section(s) of the report for more detailed information relating to each of the criteria.

Fisheries criteria:

1. High fish species richness

Species richness of Albatross Bay and the adjacent estuaries exceeds other areas of the tropical Indo-Pacific (Blaber *et al.* 1995). Due to the extensive amount of study within this area, Albatross Bay and the Embley Estuary represent regional benchmarks for the Eastern Gulf of Carpentaria.

Fish species richness of Albatross Bay equivalent to other regional waterways (Chapter 3) – compatible with FHA.

2. High diversity and abundance of regionally targeted fish species

The ABSA supports a diverse range of species important to Indigenous communities and recreational and commercial fisheries. Common species which are targeted in the area include barramundi (*Lates calcarifer*), blue and king threadfin salmon (Polynemidae – 3 spp.), mullet (Mugilidae – 5 spp.), sharks (Carcharhinidae – various spp.), flathead (Platycephalidae – various spp.), estuary cod (*Epinephalus* spp.), whiting (*Sillago* spp.), trevally and queenfish (Carangidae – various spp.), mangrove jack, fingermark or golden snapper, red emperor and nannygai (*Lutjanus* spp.), grunter (*Pomadasys* spp.), bream (*Acanthopagrus berda*), jewfish (Sciaenidae), mackerel and tuna (Scombridae – several spp.), catfish (Ariidae – several spp.) and mudcrabs (*Scylla serrata*). Banana prawns (*Penaeus merguensis*) and tiger prawns (*Penaeus esculentus* and *P. semisulcatus*) are also common in the area and support major commercial fisheries.

>15 regionally targeted species in high abundance (Chapters 3 & 4) – compatible with FHA 'A'.
--

3. Supports existing fisheries

Albatross Bay is a major target area of banana prawn fishing within the NPF. Although effort has declined in recent years, coastal net, line and crab fisheries occur within the ABSA, targeting mackerel, barramundi, salmon and mud crabs. The rapidly growing recreational sportfishing industry at Weipa provides economic growth opportunities for the community outside of the

mining industry. There is subsistence fishing by Indigenous people from various local communities.

Major commercial, recreational and subsistence fisheries within the ABSA (Ch. 4) – **compatible with FHA 'A'**.

4. Supports external/regional fisheries

Seagrass beds and mangrove habitats within the area are critical nursery grounds for tiger and banana prawns which support the highly productive NPF.

Major commercial fishery adjacent to the ABSA (Northern Prawn Fishery) based on species that are directly reliant on habitats within the ABSA (Chapter 3) – **compatible with FHA 'A'**.

Habitat Criteria:

1. Large in size

The ABSA covers approximately 125 165 ha.

>500 ha (Chapter 2) – **compatible with FHA 'A'**.

2. Diverse habitat types

The ABSA contains 13 of the 14 habitat types recognised in the QDPI&F selection criteria. The only habitat type not represented within the CBSA is surf bars, owing to the sheltered nature of waters of the Gulf of Carpentaria and protection from SE trade winds provided by the westerly aspect of the Bay.

>7 habitat types represented (Chapter 5) – **compatible with FHA 'A'**

3. Presence of a functioning riparian buffer zone

Comalco mining operations retain a 200 m buffer around all mining operations. Outside of the townships and port infrastructure, the remainder of the lands adjacent to the ABSA are used for light cattle grazing. As such most of the riparian zone in the ABSA is in pristine or near pristine condition.

>80 % of the length of the riparian zone is adequately vegetated and functioning effectively – **compatible with FHA 'A'**

4. Limited disturbance from artificial in-stream structures

While there are extensive artificial in-stream structures located around the Weipa Peninsula associated with Port and Mine facilities, boat ramps, and the Mission Bridge, the remainder of ABSA has very few artificial in-stream structures.

>400 m between structures and <5 % of the shoreline altered by artificial structures (Ch. 9) – **compatible with FHA 'A'**

5. Good water quality

Baseline study in the mid-90's found water quality was good, generally meeting ANZECC guidelines. There are a few issues at specific sites immediately adjacent to port and mine infrastructure and sewerage plants which are amenable to improved management practices.

Water quality generally good, issues at specific sites should improve via improved environmental practices (Ch. 8) – **compatible with FHA**

6. Limited disturbance from water impoundment structures

There are no significant impoundment structures or major water storages within the ABSA (Chapter 7) – **compatible with FHA**

7. Limited interactions with developments of major significance to the State

Adjacent developments of major significance to the State include the existing Comalco bauxite mining operation and the proposed development of the Aurukun bauxite deposit. PCQ is also undertaking capital dredging works to widen and deepen the shipping channel to the Port of Weipa in addition to regular maintenance dredging. Dredging activities and spoil disposal are regulated by Federal and State legislation. Comalco's mining operations retain a 200 m buffer from adjacent waterways.

Developments of State significance adjacent to the ABSA are adequately buffered to ensure minimal impacts on the adjacent fisheries habitats, dredging operations are regulated (Chapter's 6 & 9) – **compatible with FHA**

8. Compatible adjacent land and aquatic planning

The region is recognised for its outstanding conservation value in a number of regional and State plans and policies. The majority of the area within and surrounding the ABSA is relatively undisturbed and in near pristine state. Comalco's operational policies show a strong awareness of the need for the protection of the surrounding environment and a commitment to continuously improve environmental practices.

A large proportion of the lands adjacent to the ABSA are near pristine . Mining operations show a commitment to sound environmental management (Chapter's 6 & 9) – **compatible with FHA**

Unique Features:

Presence of regionally unique natural fish habitat features

The ABSA is considered to have very high conservation value, and contains a number of unique habitat features. The shell middens in the area are of considerable cultural significance and show the importance and utilisation of fisheries resources in the past (Bailey *et al.* 1994). The Embley River has the only record on the western Cape for the river garfish *Zenarchopterus buffonis*. The freshwater swamps in depressions on the floodplain adjacent to the Pine River/Nomenade Creek system are considered a regionally unique feature, and may represent seasonally important fish habitat. The ABSA contains a diverse range of globally threatened and endangered species which utilise habitats of fisheries significance. The protection of these habitats for fisheries purposes would have considerable additional benefits in the conservation of these endangered species.

Contains one or more regionally unique feature (Chapter 5.3) – **compatible with FHA**

11.3 Conclusion

The ABSA contains several regionally unique features, exceeds all four fisheries criteria and meets or exceeds all eight habitat criteria. Future expansion of mining operations in the region, and the importance of fisheries resources to the economy and lifestyle of local residents make the management and protection of the ABSA's fisheries habitats a critical component in protecting these resources. The ABSA clearly qualifies as suitable for declaration as a Fish Habitat Area, and it is recommended the proposal proceed to public consultation with a view to declaring the area as an 'A' management FHA.

References

- Abrahams H, Mulvaney M, Glasco D, Bugg A (1995) Areas of Conservation Significance on Cape York Peninsula. Cape York Peninsula Land Use Strategy. Office of the Co-ordinator General of Queensland Australian Heritage Commission.
- ABS (2006) *2001 National Census Results*, Australian Bureau of Statistics, found at: <http://www.abs.gov.au/>
- AFMA (2004) Fishery Status Reviews: Northern Prawn Fishery. Australian Fisheries Management Authority.
- Alongi DM (1994) Zonation and seasonality of benthic primary production and community respiration in tropical mangrove forests. *Oecologia* 98:320-327
- Alongi DM (2002) Present state and future of the worlds mangrove forests. *Environ Conserv* 29:331-349
- ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1: The Guidelines*. Australian and New Zealand Environment and Conservation Council and the Agriculture and Resource Management Council of Australian and New Zealand
- Bailey G, Chappell J, Cribb R (1994) The origin of *Andara* shell mounds at Weipa, north Queensland, Australia. *Archaeol Oceania* 29:69-80
- Baker R, Sheppard R (2005) Fisheries resources of Cleveland Bay (Townsville). QDPIF Information Series, QI05021
- Bavins M, Couchman D, Beumer J (2000) *Fisheries guidelines for fish habitat buffer zones*. Department of Primary Industries, Queensland. Fish Habitat Guideline FHG 003, 39pp
- Blaber SJM (1980) Fish of the Trinity Inlet system of north Queensland with notes on the eology of fish faunas of tropical Indo-Pacific estuaries. *Aust J Mar Freshwat Res* 31:137-146
- Blaber SJM (1999) Assessment of biodiversity, threats, trends and emerging issues: estuarine ecosystems. In: Vidy G, Albaret JJ, Baran E (eds). IRD, Montpellier (France)
- Blaber SJM (2002) 'Fish in hot water': the challenges facing fish and fisheries research in tropical estuaries. *J Fish Biol* 61(A):1-20
- Blaber SJM, Brewer DT, Salini JP (1989) Species composition and biomasses of fishes in different habitats of a tropical northern Australian estuary: Their occurrence in the adjoining sea and estuarine dependence. *Estuary Coast Shelf Sci* 29:509-531

- Blaber SJM, Milton DA (1990) Species composition, community structure and zoogeography of fishes of mangrove estuaries in the Solomon Islands. *Mar Biol* 105:259-267
- Blaber SJM, Brewer DT, Salini JP, Kerr J (1990a) Biomasses, catch rates and abundances of demersal fishes, particularly predators of prawns, in a tropical bay in the Gulf of Carpentaria, Australia. *Mar Biol* 107:397-408
- Blaber SJM, Salini JP, Brewer DT (1990b) A checklist of the fishes of Albatross Bay and the Embley Estuary, north-eastern Gulf of Carpentaria. Report. CSIRO Marine Laboratories. 1990.
- Blaber SJM, Brewer DT, Harris AN (1994) Distribution, biomass and community structure of demersal fishes of the Gulf of Carpentaria, Australia. *Aust J Mar Freshwat Res* 45:375-396
- Blaber SJM, Brewer DT, Salini JP (1995) Fish communities and the nursery role of the shallow inshore waters of a tropical bay in the Gulf of Carpentaria, Australia. *Estuar Coast Shelf Sci* 40:177-193
- BoM (2006) Bureau of Meteorology data, accessed online at www.bom.gov.au
- Brewer DT, Blaber SJM, Salini JP (1991) Predation on penaeid prawns by fishes in Albatross Bay, Gulf of Carpentaria. *Mar Biol* 109:231-240
- CFISH (2006) Commercial Fishery Information System, Department of Primary Industries and Fisheries, Brisbane.
- Coles RG, Lee Long WJ, Helmke SA, Bennett RE, Miller KJ, Derbyshire KJ (1992) *Seagrass beds and juvenile prawn and fish nursery grounds: Cairns to Bowen*. QDPI Information Series. QDPI, Brisbane
- Comalco (2006) Comalco website, accessed May/June 2006, available at: <http://www.comalco.com/freedom.aspx?pid=204>
- CSIRO (1998) Northern Prawn Fishery, Information Leaflet. CSIRO Marine Research.
- CYPNRMP (2004) Cape York Peninsula Draft Natural resource Management Plan, 2004. Queensland Government and Natural Heritage Trust.
- Danaher KF (1995) Marine vegetation of Cape York Peninsula. Cape York Peninsula Land Use Strategy. Office of the Coordinator General of Queensland, Brisbane, Department of the Environment, Sport and Territories, Canberra, and Queensland Department of Primary Industries, Brisbane.

- Devlin M, Brodie J (2005) Terrestrial discharge into the Great Barrier Reef lagoon: nutrient behaviour in coastal waters. *Marine Pollution Bulletin* 51:9-22
- DPI&F (2004) A guide to releasing sawfish. Gulf of Carpentaria inshore and offshore set net fishery. Department of Primary Industries and Fisheries, Brisbane.
- DPI&F (2005) Annual status report 2005, Queensland mud crab fishery. Department of Primary Industries and Fisheries, Brisbane.
- Duke NC (1992) Mangrove floristics and biogeography. In: Tropical Mangrove Ecosystems. Robertson AI, Alongi D, (eds.) American Geophysical Union, Washington DC
- Duke NC (2006) Australia's Mangroves. The authoritative guide to Australia's mangrove plants. University of Queensland, Brisbane.
- EPA (2001) Audit of environmental conditions: The Commonwealth Aluminium Corporation Pty Limited Agreement Act, Weipa Bauxite Mine, Comalco Aluminium Limited: 12-15 June 2001. Queensland Environmental Protection Agency, Brisbane
- EPA (2004) epa bulletin, 6:21 Dec 2004, Qld Government.
- EPA (2006), at http://www.epa.qld.gov.au/nature_conservation/wildlife/threatened_plants_and_animals/ accessed 20/6/06.
- GHD Pty. Ltd. (2005) Port of Weipa Capital Dredging draft environmental impact statement. GHD Brisbane.
- Haynes D, Michalek-Wagner K (2000) Water quality in the Great Barrier Reef World Heritage Area: past perspectives, current issues and new research directions. *Marine Pollution Bulletin* 41:428-434
- Haywood MDE, Heales DS, Kenyon RA, Loneragan NR, Vance DJ (1998) Predation of juvenile tiger prawns in a tropical Australian estuary. *Mar Ecol Prog Ser* 162:201-214
- Hill BJ (1982) *The Queensland Mud Crab Fishery*. Queensland Fisheries Information Series (F18201). Queensland Department of Primary Industries, Brisbane
- Hoedt FE, Choat JH, Cruz JJ, Neil KM, Collins J (2001) Survey of the Port of Weipa: Port marine baseline surveys and surveys for introduced marine pests. Final report. Prepared for the Ports Corporation of Queensland. CRC Reef & School of Marine Biology and Aquaculture, JCU.

- Hutchings PA, Saenger P (1987) *The ecology of mangroves*. University of Queensland Press, Brisbane
- IUCN (2006) 2006 IUCN Red List of Threatened Species. The World Conservation Union Species Survival Commission. Accessed at: www.redlist.org
- Jones G (1987) Surficial sediments of the western Gulf of Carpentaria, Australia. *Aust J Mar Freshwat Res* 38:151-167
- Larcombe P, Taylor J (1997) Port of Weipa water and sediment quality monitoring baseline surveys, January 1995 - February 1996. *Ecoports Monograph Series No. 8*, Ports Corporation of Queensland, Brisbane.
- Long PE, McKinnon SG (2002) *Habitats and Fisheries Resources of the Fitzroy River Estuary (Central Queensland)*. Information Series (Q102104). Queensland Department of Primary Industries, Brisbane, 104pp
- Mapoon Aboriginal Shire Council (2006) Council website at: www.mapoon.com accessed March 2006.
- Martin TJ, Brewer DT, Blaber SJM (1995) Factors affecting distribution and abundance of small demersal fishes in the Gulf of Carpentaria, Australia. *Mar Freshwat Res* 46:909-920
- Marsh H, Penrose H, Eros C, Hugues J (2001) Dugong status report and action plans for countries and territories. United Nations Environment Programme
- McKinnon S, Sheppard R (2001) *Fish Habitat Area Declaration and Review: Departmental Consultation Procedures*, Queensland Department of Primary Industries, Fish Habitat Management Operational Policy FHMOP 006, 27pp
- McKinnon S, Sheppard R, Beumer J (2003) *Fish Habitat Area selection and assessment: Departmental procedures*. Queensland Department of Primary Industries, Fish Habitat Management Operational Policy FHMOP 007, 22pp
- Milton DA (2001) Assessing the susceptibility to fishing of populations of rare trawl bycatch: sea snakes caught by Australia's Northern Prawn Fishery. *Biol Cons* 101:281-290
- National Land and Water Resources Audit (2002) *Australian Natural Resources Atlas*. Natural Heritage Trust, Commonwealth Government, accessed at <http://audit.ea.gov.au/ANRA/>

- NPFMAC (2003) Northern Prawn Fishery bycatch action plan 2003. NPF Management Advisory Committee and Australian Fisheries Management Authority.
- Okey TA (Editor) (2006). An Ecopath model of Albatross Bay, Gulf of Carpentaria, Australia, for the period 1986-1992: A contribution to the FRDC 2004/024 project Variation in banana prawn catches at Weipa: a comprehensive regional study. CSIRO Marine and Atmospheric Research, Cleveland, Queensland
- Pedrau MG, Garvey JR (2005) Northern Prawn Fishery Data Summary 2004. Logbook Program, Australian Fisheries Management Authority, Canberra.
- Poiner IR, Staples DJ, Kenyon R (1987) Seagrass communities of the Gulf of Carpentaria, Australia. *Aust J Mar Freshwat Res* 38:121-131
- PCQ (2005) PCQ Sustainability Report 2004-05. Ports Corporation of Queensland, Brisbane. Accessed at <http://www.pcq.com.au/>
- Qld Government (1999) Fisheries (Gulf of Carpentaria inshore finfish) Management Plan 1999. Queensland Government Legislation.
- Qld Government (2001) State Coastal Management Plan, 2001. Queensland Government, Brisbane.
- Quinn RH (1992) *Fisheries resources of the Moreton Bay region*. Queensland Fish Management Authority
- Ridd P, Sandstrom MW, Wolanski E (1988) Outwelling from tropical tidal salt flats. *Estuar Coast Shelf Sci* 26:243-253
- Robertson AI (1988) Abundance, diet and predators of juvenile banana prawns, *Penaeus merguensis*, in a tropical mangrove estuary. *Australian Journal of Marine and Freshwater Research*, 39: 467-478
- Robertson AI, Duke NC (1987) Mangroves as nursery sites: comparisons of the abundance and species composition of fish and crustaceans in mangroves and other nearshore habitats in tropical Australia. *Mar Biol* 96:193-205
- Robertson AI, Duke NC (1990) Mangrove fish communities in tropical Queensland, Australia: spatial and temporal patterns in densities, biomass and community structure. *Mar Biol* 104:369-379
- Robins CM, Goodspeed AM, Poiner IR, Harch BD (2002) Monitoring the catch of turtle in the Northern Prawn Fishery. Fisheries Research and Development Corporation Final Report, Canberra.

- Roelofs AJ, Rasheed MA, Thomas R (2003) Port of Weipa seagrass monitoring, 2000 – 2002. Ports Corporation of Queensland, Brisbane
- Roelofs, A, Coles, R and Smit, N (2005a). A survey of intertidal seagrass from Van Diemen Gulf to Castlereagh Bay, Northern Territory, and from Gove to Horn Island, Queensland. Report to the National Oceans Office. Cairns, Queensland Department of Primary Industries & Fisheries: 27pp.
- Roelofs AJ, Rasheed MA, Thomas R (2005b) Port of Weipa long-term seagrass monitoring, progress report – September 2004. Report to Ports Corporation of Queensland. QDPIF Cairns.
- Roelofs AJ, Rasheed MA, Thomas R, McKenna S, Taylor H (2006) Port of Weipa long-term seagrass monitoring, 2003-2005. Ecoports Monograph Series No. 23. Ports Corporation of Queensland.
- Russell DJ, Garrett RN (1985) Early life history of barramundi, *Lates calcarifer* (Bloch), in north-eastern Queensland. Aust J Mar Freshwat Res 36:191-201
- Russell DJ, McDougall AJ (2005) Movement and juvenile recruitment of mangrove jack, *Lutjanus argentimaculatus* (Forsskal), in northern Australia. Mar Freshwat Res 56:465-475
- Sheaves M (1995) Large lutjanid and serranid fishes in tropical estuaries: Are they adults or juveniles? Mar Ecol Prog Ser 129: 31-40
- Sheaves M (2005) Nature and consequences of biological connectivity in mangrove systems. Mar Ecol Prog Ser 302:293-305
- Sheppard R, Rasheed M, Helmke S (2001) Kirke River Fisheries Resource Assessment – August 1999. DPI Information Series QI00086
- Staples DJ, Vance DJ (1987) Comparative recruitment of the banana prawn *Penaeus merguensis* in five estuaries of the south east Gulf of Carpentaria, Australia. Aust J Mar Freshwat Res 38:29-35
- Staples DJ, Vance DJ, Heales DS (1985) Habitat requirements of juvenile penaeid prawns and their relationship to offshore fisheries. In: Rothlisberg PC, Hill BJ, Staples DJ (eds) Second Australian National Prawn Seminar, Cleveland, Australia
- Staunton-Smith J, Blaber SJM, Greenwood JG (1999) Interspecific differences in the distribution of adult and juvenile ponyfish (Leiognathidae) in the Gulf of Carpentaria, Australia. Mar Freshwat Res 50:643-653
- Staunton-Smith J, Robbins JB, Mayer DG, Sellin MJ, Halliday IA (2004) Does the quantity and timing of freshwater flowing into a dry-tropical estuary

affect the year-class strength of barramundi (*Lates calcarifer*)? Mar Freshwat Res 55:787-797

Stobutzki IC, Miller MJ, Jones P, Salini JP (2001) Bycatch diversity and variation in a tropical Australian penaeid fishery; the implications for monitoring. Fish Res 53:283-301

Vance DJ, Haywood MDE, Staples DJ (1990) Use of a mangrove estuary as a nursery area by postlarval and juvenile banana prawns, *Penaeus merguensis* de Man, in northern Australia. Estuar Coast Shelf Sci 31:689-701

Vance DJ, Haywood MDE, Heales DS, Kenyon RA, Loneragan NR, Pendrey RC (2002) Distribution of juvenile penaeid prawns in mangrove forests in a tropical Australian estuary, with particular reference to *Penaeus merguensis*. Mar Ecol Prog Ser 228:165-177

Williams LE (2002) *Queensland's Fisheries Resources: Current Conditions and Recent Trends 1988-2000*. Information Series (QI02012). Queensland Department of Primary Industries, Brisbane, 180pp

www.seagrasswatch.org Seagrass Watch website, accessed in March 2006.

Appendix A: Species list of teleost and elasmobranch fishes from Albatross Bay and Embley Estuary.

List from:

Blaber SJM, Salini JP, Brewer DT (1990) A checklist of the fishes of Albatross Bay and the Embley Estuary, north-eastern Gulf of Carpentaria. CSIRO Marine Laboratories Report No. 210;

and

Blaber SJM, Brewer DT, Salini JP (1995) Fish communities and the nursery role of shallow inshore waters of a tropical bay in the Gulf of Carpentaria, Australia. *Estuar Coast Shelf Sci* 40:177-193

and

Shane Griffiths, CSIRO, unpublished data.

Family, species, genus and common names follow those of Fishbase (www.fishbase.org) as at 4 April 2006 (Froese & Pauly 2006). As such, some names may not match those in the original published species lists.

Family	Species	Common name
Ginglymostomatidae (Nurse sharks)	<i>Nebrius ferrugineus</i>	Tawny Nurse Shark
Stegostomatidae (Zebra sharks)	<i>Stegostoma fasciatum</i>	Zebra Shark
Carcharhinidae (Requiem sharks)	<i>Carcharhinus amblyrhynchoides</i>	Graceful Shark
	<i>Carcharhinus amblyrhynchos</i>	Grey Reef Shark
	<i>Carcharhinus brevipinna</i>	Spinner Shark
	<i>Carcharhinus cautus</i>	Nervous Shark
	<i>Carcharhinus dussumieri</i>	Whitecheek Shark
	<i>Carcharhinus fitzroyensis</i>	Creek Whaler
	<i>Carcharhinus leucas</i>	Bull Shark
	<i>Carcharhinus limbatus</i>	Blacktip Shark
	<i>Carcharhinus macloti</i>	Hardnose Shark
	<i>Carcharhinus melanopterus</i>	Blacktip Reef Shark
	<i>Carcharhinus sorrah</i>	Spottail Shark
	<i>Carcharhinus tilstoni</i>	Australian Blacktip
	<i>Galeocerdo cuvieri</i>	Tiger Shark
	<i>Hemigaleus microstoma</i>	Sicklefin weasel shark
	<i>Hemipristis elongate</i>	Snaggletooth shark
	<i>Negaprion acutidens</i>	Sicklefin lemon shark
	<i>Rhizoprionodon acutus</i>	Milk shark
	<i>Rhizoprionodon taylori</i>	Sharpnose shark
Sphyrnidae (Hammerhead sharks)	<i>Sphyrna lewini</i>	Scalloped hammerhead

<i>Sphyrna mokarran</i>	Great hammerhead
<i>Eusphyrna blochii</i>	Winghead shark
Pristidae (Sawfish)	
<i>Anoxypristis cuspidata</i>	Knifetooth sawfish
<i>Pristis pectinata</i>	Smalltooth sawfish
<i>Pristis pristis</i>	Common sawfish
<i>Pristis zijsron</i>	Longcomb sawfish
Rhinobatidae (Guitarfishes)	
<i>Rhina ancylostoma</i>	Bowmouth guitarfish
<i>Rhinobatos</i> sp. 1 (Sainsbury <i>et al.</i> 1985)	Shovelnose shark
<i>Rhynchobatus djiddensis</i>	Giant shovelnose shark
Dasyatididae	
<i>Dasyatis annotata</i>	Plain maskray
<i>Dasyatis kuhlii</i>	Bluespotted stingray
<i>Dasyatis leylandi</i>	Painted maskray
<i>Dasyatis thetidis</i>	Thorntail stingray
<i>Himantura granulata</i>	Mangrove whipray
<i>Himantura toshi</i>	Black-spotted whipray
<i>Himantura uarnak</i>	Honeycomb stingray
<i>Pastinachus sephen</i>	Cowtail stingray
<i>Taeniura lymma</i>	Bluespotted ribbontail ray
Gymnuridae (Butterfly rays)	
<i>Gymnura australis</i>	Australian butterfly ray
Myliobatidae (Eagle rays)	
<i>Aetobatus narinari</i>	Spotted eagle ray
<i>Aetomylaeus nichofii</i>	Banded eagle ray
Rhinopteridae (Eagle and manta rays)	
<i>Rhinoptera</i> sp. cf <i>adspersa</i>	Rough cownose ray
Elopidae	
<i>Elops machnata</i>	Giant herring
Megalopidae (Tarpon)	
<i>Megalops cyprinoides</i>	Tarpon
Muraenesocidae (Pike congers)	
<i>Muraenesox cinereus</i>	Daggertooth pike conger
Ophichthidae (Worm eels)	
<i>Moringua microchir</i>	Lesser thrush eel
<i>Ophichthus</i> sp. (of Castle)	Snake eel
Clupeidae (Herring)	

<i>Amblygaster sirm</i>	Spotted sardinella
<i>Anodontostoma chacunda</i>	Chacunda gizzard shad
<i>Dussumieria acuta</i>	Rainbow sardine
<i>Herklotsichthys koningsbergeri</i>	Koningsbergers herring
<i>Herklotsichthys lippa</i>	Australian spotted herring
<i>Hyperlophus vittatus</i>	Sandy sprat
<i>Nematalosa come</i>	Gizzard shad
<i>Nematalosa erebi</i>	River gizzard shad
<i>Sardinella albella</i>	White sardine
<i>Sardinella gibbosa</i>	Goldstripe sardine
<i>Spratteloides delecatulus</i>	Delicate round herring
Pristigasteridae (Herrings)	
<i>Pellona ditchela</i>	Indian pellona
Engraulidae (Anchovies)	
<i>Stolephorus andhraensis</i>	Andhra anchovy
<i>Stolephorus carpentariae</i>	Gulf of Carpentaria anchovy
<i>Stolephorus indicus</i>	Indian anchovy
<i>Thryssa hamiltonii</i>	Hamilton's thyrssa
<i>Thryssa setirostris</i>	Longjaw thryssa
Chirocentridae (Wolf herring)	
<i>Chirocentrus dorab</i>	Dorab Wolf Herring
<i>Chirocentris nudus</i>	Whitefin Wolf Herring
Chanidae (Milkfish)	
<i>Chanos chanos</i>	Milkfish
Synodontidae (Lizardfishes)	
<i>Saurida longimanus</i>	Longfin lizardfish
<i>Saurida micropectoralis</i>	Shortfin lizardfish
<i>Saurida</i> sp. 2 (Sainsbury <i>et al.</i> 1985)	Lizardfish
<i>Saurida</i> sp. 4 (Sainsbury <i>et al.</i> 1985)	Lizardfish
<i>Saurida undosquamis</i>	Brushtooth lizardfish
Ariidae (Sea catfishes)	
<i>Arius bilineatus</i>	Bronze catfish
<i>Arius graeffei</i>	Lesser salmon catfish
<i>Arius leptaspis</i>	Salmon catfish
<i>Arius macrocephalus</i>	Large-scaled catfish
<i>Arius mastersi</i>	Master's catfish
<i>Arius proximus</i>	Catfish
<i>Arius</i> sp. 2 (of Kaiola)	Catfish
<i>Arius</i> sp. 4 (of Kaiola)	Catfish
<i>Arius thalassinus</i>	Giant catfish
Plotosidae (Eeltailed catfishes)	
<i>Euristhmus nudiceps</i>	Naked-head catfish
<i>Plotosus lineatus</i>	Striped eel catfish

Bregmacerotidae (Codlets) <i>Bregmaceros</i> sp.	Codlet
Batrachoididae (Frogfishes) <i>Batrachomoeus trispinosus</i>	Three-spined frogfish
Exocoetidae (Flyingfishes) <i>Parexocoetus mento</i>	African sailfin flyingfish
Hemiramphidae (Garfishes or halfbeaks) <i>Arrhamphus sclerolepis</i> <i>Hemiramphus far</i> <i>Hyporhamphus affinis</i> <i>Hyporhamphus dussumieri</i> <i>Hyporhamphus quoyi</i> <i>Zenarchopterus buffonis</i> <i>Zenarchopterus dispar</i>	Snub-nosed garfish Blackbarred garfish Tropical garfish Dussumiers garfish Quoys garfish Buffon's river garfish Feathered river garfish
Belonidae (Longtoms) <i>Ablennes hians</i> <i>Strongylura incisa</i> <i>Strongylura leiura</i> <i>Strongylura strongylura</i> <i>Tylosurus crocodilus</i> <i>Tylosurus gavioloides</i> <i>Tylosurus punctulatus</i>	Flat needlefish Reef longtom Banded longtom Spottail longtom Hound longtom Longtom Spotted longtom
Atherinidae (Hardyheads or Silversides) <i>Atherinomorus duodecimalis</i> <i>Atherinomorus endrachtensis</i> <i>Stenatherina panatela</i>	Tropical silverside Endracht land silverside Panatella silverside
Melanotaeniidae (Blue eyes) <i>Pseudomugil gertrudae</i>	Spotted blue-eye
Veliferidae (Velifers) <i>Velifer hypselopterus</i>	Sailfin velifer
Fistularidae (Cornetfishes, flutemouths) <i>Fistularia commersonii</i> <i>Fistularia petimba</i>	Bluespotted cornetfish Red cornetfish
Centriscidae <i>Centriscus scutatus</i>	Grooved razor-fish
Syngnathidae (Seahorses) <i>Hippichthys heptagonus</i>	Belly pipefish

<i>Hippocampus kuda</i>	Spotted seahorse
<i>Hippocampus whitei</i>	White's seahorse
Scorpaenidae (Scorpionfishes)	
<i>Pterois volitans</i>	Red lion fish
Apistidae (Waspfishes)	
<i>Apistus carinatus</i>	Ocellated waspfish
Synanceiidae (Stonefishes)	
<i>Synanceia horrida</i>	Estuarine stonefish
Triglidae (Searobins)	
<i>Lepidotrigla spiloptera</i>	Spotwing gurnard
Platycephalidae (Flathead)	
<i>Cymbacephalus nematophthalmus</i>	Finge-eyed flathead
<i>Elates ransonnetii</i>	Dwarf flathead
<i>Inegocia japonica</i>	Japanese flathead
<i>Platycephalus arenarius</i>	Sand flathead
<i>Platycephalus endrachtensis</i>	Bar-tailed flathead
<i>Platycephalus indicus</i>	Bar-tailed flathead
<i>Suggrundus macracanthus</i>	Large-spined flathead
Centropomidae (Sea perches)	
<i>Lates calcarifer</i>	Barramundi
<i>Psammoperca waigensis</i>	Sand-bass
Ambassidae (Glassperch)	
<i>Ambassis dussumieri</i>	Malabar perchlet
<i>Ambassis gymnocephalus</i>	Bald glassperch
<i>Ambassis nalua</i>	Scalloped perchlet
Centrogeniidae	
<i>Centrogenys vaigiensis</i>	False scorpionfish
Serranidae (Cods and groupers)	
<i>Epinephelus areolatus</i>	Areolate grouper
<i>Epinephelus coioides</i>	Goldspot cod
<i>Epinephelus malabaricus</i>	Malabar grouper
<i>Epinephelus merra</i>	Honeycomb grouper
<i>Epinephelus sexfasciatus</i>	Sixbar grouper
Pseudochromidae (Dottybacks)	
<i>Pseudochromis quinquedentatus</i>	Spiny dottyback
Terapontidae (Grunters)	
<i>Amniataba caudivittata</i>	Yellowtailed grunter

<i>Pelates quadrilineatus</i>	Four-lined terapon
<i>Pelates sexlineatus</i>	Six-lined terapon
<i>Terapon jarbua</i>	Jarbua terapon
<i>Terapon puta</i>	Smallscaled terapon
<i>Terapon theraps</i>	Largescale terapon
Priacanthidae (Bigeyes)	
<i>Priacanthus tayenus</i>	Purple-spotted bigeye
Apogonidae (Cardinalfishes)	
<i>Apogon cookii</i>	Cook's cardinalfish
<i>Apogon ellioti</i>	Flag-in cardinal fish
<i>Apogon hyalosoma</i>	Humpbacked cardinalfish
<i>Apogon poecilopterus</i>	Pearly-finned cardinalfish
<i>Apogon quadrifasciatus</i>	Twostripe cardinal
<i>Apogon rueppellii</i>	Gobbleguts
<i>Apogon sangiensis</i>	Sangi cardinalfish
<i>Siphamia roseigaster</i>	Pink-breasted siphon fish
Acropomatidae (Lanternbellies)	
<i>Acropoma japonicum</i>	Glowbelly
Sillaginidae (Whiting)	
<i>Sillago analis</i>	Golden-lined whiting
<i>Sillago ingenuua</i>	Bay whiting
<i>Sillago lutea</i>	Mud whiting
<i>Sillago maculata</i>	Trumpeter whiting
<i>Sillago sihama</i>	Silver whiting
Lactaridae (False trevallys)	
<i>Lactarius lactarius</i>	False trevally
Rachycentridae (Cobia)	
<i>Rachycentron canadus</i>	Cobia
Echeneididae (remoras)	
<i>Echeneis naucrates</i>	Remora
Carangidae (Jacks and trevallys)	
<i>Pantolabus radiatus</i>	Fringe-finned trevally
<i>Alectis indicus</i>	Indian threadfish
<i>Alepes djedaba</i>	Shrimp scad
<i>Alepes kleinii</i>	Razorbelly scad
<i>Alepes</i> sp. (Sainsbury et al. 1985)	Scad
<i>Atule mate</i>	Yellowtail scad
<i>Carangoides chrysophrys</i>	Longnose trevally
<i>Carangoides coeruleopinnatus</i>	Coastal trevally
<i>Carangoides fulvoguttatus</i>	Yellowspotted trevally
<i>Carangoides hedlandensis</i>	Bumpnose trevally
<i>Carangoides humerosus</i>	Duskyshoulder trevally

<i>Carangoides malabaricus</i>	Malabar trevally
<i>Carangoides talamparoides</i>	Imposter Trevally
<i>Caranx bucculentus</i>	Bluespotted trevally
<i>Caranx ignobilis</i>	Giant trevally
<i>Caranx papuensis</i>	Brassy trevally
<i>Caranx sexfasciatus</i>	Bigeye trevally
<i>Caranx tille</i>	Tille trevally
<i>Decapterus russelli</i>	Indian scad
<i>Elegatis bipinnulata</i>	Rainbow Runner
<i>Gnathanodon speciosus</i>	Golden trevally
<i>Megalaspis cordyla</i>	Finnyscad
<i>Parastromateus niger</i>	Black pomfret
<i>Scomberoides commersonianus</i>	Talang Queenfish
<i>Scomberoides tala</i>	Barred queenfish
<i>Scomberoides tol</i>	Needle-scaled queenfish
<i>Selar boops</i>	Oxeye scad
<i>Selar crumenophthalmus</i>	Bigeye scad
<i>Selaroides leptolepis</i>	Yellowstripe scad
<i>Seriolina nigrofasciata</i>	Blackbanded trevally
<i>Trachinotus baillonii</i>	Small spotted dart
<i>Trachinotus blochii</i>	Snub-nosed dart
<i>Trachinotus</i> sp. cf <i>mookalee</i>	Indian Snub-nosed dart
<i>Ulua aurochs</i>	Silvermouth trevally
<i>Uraspis uraspis</i>	Whitetongue trevally
Menidae (Moonfish)	
<i>Mene maculata</i>	Moonfish
Leiognathidae (Ponyfishes)	
<i>Gazza minuta</i>	Toothpony
<i>Leiognathus bindus</i>	Orange-fin ponyfish
<i>Leiognathus decorus</i>	Decorated ponyfish
<i>Leiognathus elongatus</i>	Slender ponyfish
<i>Leiognathus equulus</i>	Common ponyfish
<i>Leiognathus fasciatus</i>	Striped ponyfish
<i>Leiognathus leuciscus</i>	Whipfin ponyfish
<i>Leiognathus moretoniensis</i>	Moreton Bay ponyfish
<i>Leiognathus smithursti</i>	Smithurst's ponyfish
<i>Leiognathus</i> sp. 2 (Jones 1985)	Ponyfish
<i>Leiognathus splendens</i>	Splendid ponyfish
<i>Secutor insidiator</i>	Pugnose ponyfish
<i>Secutor ruconius</i>	Deep pugnose ponyfish
Lutjanidae (Tropical snappers)	
<i>Lutjanus argentimaculatus</i>	Mangrove Jack
<i>Lutjanus carponotatus</i>	Stripey
<i>Lutjanus erythropterus</i>	Small-mouthed nannygai
<i>Lutjanus johnii</i>	Fingermark
<i>Lutjanus lutjanus</i>	Bigeye snapper
<i>Lutjanus malabaricus</i>	Large-mouthed nannygai

<i>Lutjanus russelli</i>	Moses perch
<i>Lutjanus sebae</i>	Red emperor
<i>Lutjanus vitta</i>	Brownstripe red snapper
Nemipteridae (Threadfin breams)	
<i>Nemipterus celebicus</i>	Celebe's threadfin
<i>Nemipterus furcosus</i>	Fork-tailed threadfin
<i>Nemipterus hexodon</i>	Ornate threadfin
<i>Nemipterus nematopus</i>	Yellow-tipped threadfin
<i>Nemipterus peronii</i>	Notchedfin threadfin
<i>Nemipterus tambuloides</i>	Five-lined threadfin
<i>Pentapodus porosus</i>	NW Australian whiptail
<i>Scolopsis monogramma</i>	Monogrammed monocle bream
<i>Scolopsis taenioptera</i>	Lattice monocle bream
Gerreidae (Biddies, mojarras)	
<i>Gerres erythrourus</i>	Deep-bodied majorra
<i>Gerres filamentosus</i>	Whipfin silverbiddy
<i>Gerres longirostris</i>	Longtail silverbiddy
<i>Gerres oyena</i>	Common silverbiddy
<i>Gerres subfasciatus</i>	Common silverbelly
<i>Pentaprion longimanus</i>	Longfin mojarra
Haemulidae (Grunts)	
<i>Diagramma pictum</i>	Painted sweetlip
<i>Plectorhinchus flavomaculatus</i>	Lemon sweetlip
<i>Plectorhinchus gibosus</i>	Brown grunt
<i>Plectorhinchus sordidus</i>	Sordid blubberlip
<i>Pomadasys argenteus</i>	Silver grunter
<i>Pomadasys kaakan</i>	Javelin grunter
<i>Pomadasys maculatus</i>	Saddle grunter
<i>Pomadasys trifasciatus</i>	Grunt
Lethrinidae	
<i>Lethrinus choerorynchus</i>	WA Spangled emperor
<i>Lethrinus lentjan</i>	Pink-ear emperor
<i>Lethrinus nebulosus</i>	Spangled emperor
<i>Lethrinus</i> sp. (unidentified)	Emperor
Sparidae (Porgies)	
<i>Acanthopagrus berda</i>	Pikey bream
<i>Argyrops spinifer</i>	King soldierbream
Sciaenidae (Drums or Croakers)	
<i>Austronibeia oedogenys</i>	Yellowtail croaker
<i>Johnius amblycephalus</i>	Bearded croaker
<i>Johnius borneensis</i>	Sharpnose croaker
<i>Nibea soldado</i>	Soldier croaker
<i>Nibea</i> sp. (of McKay)	Croaker
<i>Otolithes ruber</i>	Tiger-ttother croaker

<i>Protonibea diacanthus</i>	Black jewfish
Mullidae (Goatfishes)	
<i>Parupeneus heptacanthus</i>	Cinnabar goatfish
<i>Upeneus asymmetricus</i>	Asymmetrical goatfish
<i>Upeneus luzonius</i>	Dark-barred goatfish
<i>Upeneus sulphureus</i>	Sulphur goatfish
<i>Upeneus sundaicus</i>	Ochre-banded goatfish
<i>Upeneus tragula</i>	Freckled goatfish
Monodactylidae (Moonyfishes)	
<i>Monodactylus argenteus</i>	Silver moony
Toxotidae (Archerfish)	
<i>Toxotes chartareus</i>	Largescale archerfish
Ephippididae (Batfishes)	
<i>Drepane punctata</i>	Spotted sicklefish
<i>Platax teira</i>	Teira batfish
<i>Zabidius noveamaculatus</i>	Ninespined batfish
Scatophagidae (Scats)	
<i>Scatophagus argus</i>	Spotted scat
<i>Selenotoca multifasciatus</i>	Spotbanded scat
Chaetodontidae (Butterfly fishes)	
<i>Chaetodontoplus duboulayi</i>	Scribbled angelfish
<i>Chelmon muelleri</i>	Blackfin coralfish
<i>Coradion chrysozonus</i>	Goldengirdled coralfish
<i>Parachaetodon ocellatus</i>	Sixspine butterflyfish
Pomacentridae (Damsel fishes)	
<i>Pristotis obtusirostris</i>	Giant damselfish
Mugilidae (Mullet)	
<i>Liza subviridis</i>	Greenback mullet
<i>Liza vaigiensis</i>	Diamond-scaled mullet
<i>Valamugil buehanani</i>	Bluetail mullet
<i>Valamugil cunnesius</i>	Longarm mullet
<i>Valamugil georgii</i>	Silver mullet
Sphyraenidae (Barracudas)	
<i>Sphyraena barracuda</i>	Great barracuda
<i>Sphyraena flavicauda</i>	Yellowtail barracuda
<i>Sphyraena forsteri</i>	Bigeye barracuda
<i>Sphyraena jello</i>	Pickhandle barracuda
<i>Sphyraena obtusata</i>	Obtuse barracuda
<i>Sphyraena putnamae</i>	Sawtooth barracuda
<i>Sphyraena qenie</i>	Blackfin barracuda

Polynemidae (Threadfin salmon)	
<i>Eleutheronema tetradactylum</i>	Fourfinger threadfin
<i>Polydactylus multiradiatus</i>	Australian threadfin
<i>Polydactylus macrochir</i>	King threadfin
Labridae (Wrasses)	
<i>Choerodon monostigma</i>	Darkspot tuskfish
<i>Choerodon schoenleinii</i>	Blackspot tuskfish
<i>Halichoeres nigrescens</i>	Bubblefin wrasse
Blenniidae (Blennys)	
<i>Omobranchus rotundiceps</i>	Combtooth blenny
Callionymidae (Dragonettes)	
<i>Callionymus</i> sp. (juveniles)	Dragonette
Gobiidae (Gobies)	
<i>Acentrogobius caninus</i>	Tropical sand goby
<i>Acentrogobius janthinopterus</i>	Goby
<i>Acentrogobius viridipunctatus</i>	Spotted green goby
<i>Amoya gracilis</i>	Goby
<i>Amoya</i> sp. (of Hoese)	Goby
<i>Cryptocentrus</i> sp. (of Hoese)	Hiddensting gobies
<i>Drombus globiceps</i>	Goby
<i>Drombus ocyurus</i>	Goby
<i>Drombus palackyi</i>	Goby
<i>Favonogobius melanobranchus</i>	Blackthroat goby
<i>Glossogobius biocellatus</i>	Sleepy goby
<i>Glossogobius celebius</i>	Celebes goby
<i>Glossogobius circumspectus</i>	Goby
<i>Pandaka rouxi</i>	Goby
<i>Pseudogobius</i> sp. (of Hoese)	Goby
<i>Pseudogobius</i> sp. 5 (of Hoese)	Goby
Eleotridae (Gudgeons)	
<i>Butis butis</i>	Flathead gudgeon
<i>Ophieleotris aporos</i>	Snakehead gudgeon
<i>Ophiocara porocephala</i>	Northern mud gudgeon
<i>Oxyeleotris</i> sp. (of Larson)	Gudgeon
Siganidae (Rabbitfishes)	
<i>Siganus canaliculatus</i>	White-spotted spinefoot
<i>Siganus fuscescens</i>	Mottled spinefoot
<i>Siganus javus</i>	Streaked spinefoot
<i>Siganus vermiculatus</i>	Vermiculated spinefoot
Trichiuridae (Hairtails)	
<i>Trichiurus lepturus</i>	Largehead hairtail

Scombridae (Mackerels, tunas, bonitos)	
<i>Acanthocybium solandri</i>	Wahoo
<i>Auxis rochei</i>	Bullet tuna
<i>Auxis thazard</i>	Frigate tuna
<i>Euthynnus affinis</i>	Mack-tuna
<i>Cybiosarda elegans</i>	Leaping bonito
<i>Grammatorcynus bicarinatus</i>	Shark Mackerel
<i>Grammatorcynus bilineatus</i>	Double-lined mackerel
<i>Gymnosarda unicolor</i>	Dog-tooth tuna
<i>Istiophorus platypterus</i>	Sailfish
<i>Katsuwonus pelamis</i>	Skipjack tuna
<i>Rastrelliger brachysoma</i>	Short mackerel
<i>Rastrelliger kanagurta</i>	Indian mackerel
<i>Sarda australis</i>	Australian bonito
<i>Sarda orientalis</i>	Striped bonito
<i>Scomberomorus commerson</i>	Spanish mackerel
<i>Scomberomorus munroi</i>	Spotted mackerel
<i>Scomberomorus queenslandicus</i>	School mackerel
<i>Scomberomorus semifasciatus</i>	Grey mackerel
<i>Thunnus tonggol</i>	Long-tail tuna
Istiophoridae	
<i>Makaira indica</i>	Black marlin
Coryphaenidae (Dolphinfishes)	
<i>Coryphaena hippurus</i>	Common dolphinfish
Centrolophidae (Medusafishes)	
<i>Psenopsis humerosus</i>	Blackspot butterfish
Psettodidae (Turbot)	
<i>Psettodes erumei</i>	Indian spiny turbot
Bothidae (Left-eye Flounders)	
<i>Engyprosopon grandisquama</i>	Largescale flounder
<i>Grammatobothus polyopthalmus</i>	Threespot flounder
Paralichthyidae (Large-toothed flounders)	
<i>Pseudorhombus argus</i>	Peacock flounder
<i>Pseudorhombus arsius</i>	Large-toothed flounder
<i>Pseudorhombus diplospilus</i>	Four twinspace flounder
<i>Pseudorhombus elevatus</i>	Deep flounder
<i>Pseudorhombus spinosus</i>	Spiny flounder
Cynoglossidae (Tongue soles)	
<i>Cynoglossus bilineatus</i>	Fourlined tongue-sole
<i>Cynoglossus macrophthalmus</i>	Big-eyed tongue-sole
Soleidae (Sole)	

<i>Brachirus muelleri</i>	Tufted sole
Triacanthodidae (Triplespines)	
<i>Triacanthus biaculeatus</i>	Shortnosed tripodfish
<i>Tripodichthys oxycephalus</i>	Short-tail tripodfish
<i>Triphichthys weberi</i>	Blacktip tripodfish
Balistidae (Triggerfishes)	
<i>Abalistes stellaris</i>	Starry triggerfish
Monacanthidae (Filefishes, leatherjackets)	
<i>Acreichthys tomentosus</i>	Bristle-tail file fish
<i>Aluterus monoceros</i>	Unicorn leatherjacket
<i>Monacanthus chinensis</i>	Fanbellied leatherjacket
<i>Paramonacanthus filicauda</i>	Threadfin leatherjacket
<i>Paramonacanthus japonicus</i>	Hairfinned leatherjacket
<i>Pardicula setifer</i>	not listed on Fishbase
Ostraciidae (Boxfishes)	
<i>Ostracion nasus</i>	Shortnose boxfish
Tetraodontidae (Toadfishes, puffers)	
<i>Arothron immaculatus</i>	Immaculate puffer
<i>Arothron stellatus</i>	Starry toadfish
<i>Chelonodon patoca</i>	Milkspotted toadfish
<i>Lagocephalus lunaris</i>	Green rough-back puffer
<i>Lagocephalus scleratus</i>	Silverstripe puffer
<i>Lagocephalus spadiceus</i>	Halfsmooth golden puffer
<i>Marilyna darwinii</i>	Toadfish
<i>Tetraodon erythrotaenia</i>	Red-striped toadfish
<i>Torquigener hicksi</i>	Hick's toadfish
<i>Torquigener whitleyi</i>	Whitley's toadfish
Diodontidae (Porcupine fishes)	
<i>Cyclichthys hardenbergi</i>	Hardenburgs burrfish
<i>Tragulichthys jaculiferus</i>	Longspine burrfish

Appendix B: Mangrove plants from the Albatross Bay region of western Cape York.

List from: Duke NC (2006) Australia's Mangroves. The authoritative guide to Australia's mangrove plants. University of Queensland, Brisbane.

Species	Common name
<i>Acanthus ebracteatus ebarbatus</i>	White-flowered holly mangrove
<i>Acanthus ilicifolius</i>	Spiny holly mangrove
<i>Acrostichum speciosum</i>	Mangrove fern
<i>Aegialitis annulata</i>	Club mangrove
<i>Aegiceras corniculatum</i>	River mangrove
<i>Avicennia marina eucalyptifolia</i>	Grey mangrove
<i>Bruguiera cylindrica</i>	Reflexed orange mangrove
<i>Bruguiera exaristata</i>	Rib-fruited orange mangrove
<i>Bruguiera gymnorhiza</i>	Large-leafed orange mangrove
<i>Bruguiera parviflora</i>	Small-leafed orange mangrove
<i>Bruguiera sexangula</i>	Upriver orange mangrove
<i>Camptostemon schultzei</i>	Kapok mangrove
<i>Ceriops australis</i>	Smooth-fruited yellow mangrove
<i>Ceriops decandra</i>	Clumped yellow mangrove
<i>Ceriops tagal</i>	Rib-fruited yellow mangrove
<i>Cynometra iripa</i>	Wrinkle-pod mangrove
<i>Diospyros littorea</i>	Ebony mangrove
<i>Exoecaria agallocha agallocha</i>	Milky mangrove
<i>Lumnitzera littorea</i>	Red-flowered black mangrove
<i>Lumnitzera racemosa</i>	White-flowered black mangrove

Species	Common name
<i>Nypa fruticans</i>	Mangrove palm
<i>Osbornia octodonta</i>	Myrtle mangrove
<i>Pemphis acidula</i>	Reef barrier mangrove
<i>Rhizophora apiculata</i>	Corky stilt mangrove
<i>Rhizophora x lamarckii</i>	Hybrid stilt mangrove
<i>Rhizophora stylosa</i>	Long-style stilt mangrove
<i>Scyphiphora hydrophylacea</i>	Yamstick mangrove
<i>Sonneratia alba</i>	White-flowered apple mangrove
<i>Xylocarpus granatum</i>	Cannonball mangrove
<i>Xylocarpus moluccensis</i>	Cedar mangrove