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Kirke River Fisheries Resources Assessment August 1999

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ACRONYMS

ANSA	Australian National Sportsfishing Association
ANZECC	Australian and New Zealand Environment and Conservation Council
CFISH	Commercial Fishing Database
CYPLUS	Cape York Peninsula Land Use Strategy
DNR	Department of Natural Resources
DO	Dissolved oxygen
DPI	Department of Primary Industries, Queensland
EPA	Department of Environment Protection Agency
FHA	Fish Habitat Area
FNQ	Far North Queensland
GIS	Geographic Information System
NHT	Natural Heritage Trust
NRAP	Natural Resources Analysis Program
MAC	Management Advisory Committee
QBFP	Queensland Boating and Fisheries Patrol
QFMA	Queensland Fisheries Management Authority
QFS	Queensland Fisheries Service
RFISH	Recreational Fishing Database
RMRAC	Regional Marine Resource Advisory Committee
ZAC	Zonal Advisory Committee

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EXECUTIVE SUMMARY

Protection of coastal wetland environments is an important component of effective and sustainable fisheries management and conservation of habitats for the use of future generations.

The fisheries resources of the Kirke River Area were investigated in August 1999 as part of the ongoing commitment by the DPI Fisheries Group to declare Fish Habitat Areas in Queensland.

The fisheries resources assessment of the Kirke River Area included investigations of:

- Seagrass distribution and abundance
- Marine plants and riparian habitats
- Fish and crab stocks.

Seagrass resources

1. 7.6 ± 1.5 ha of seagrass was mapped in the Love River Lake. Seagrass distribution was restricted to six small meadows on the edges of intertidal mud and sand banks.
2. No seagrass was found in the Kirke River in this survey.
3. All seagrass meadows mapped were comprised of low biomass monospecific *Halodule pinifolia*.
4. Extensive flooding of the survey area for a prolonged period (>six months) prior to the survey was likely to have significantly reduced seagrass distribution and abundance in both the Kirke and Love River systems.
5. These meadows may be regionally important, as few seagrass meadows have been identified on the eastern coast of the Gulf of Carpentaria. These meadows may represent the only seagrass between Karumba in the south and Archer Bay to the north and are likely to provide food for dugong moving along the eastern coast of the Gulf.
6. Seagrass meadows are likely to provide habitat for several species of juvenile fish and prawns as well as prey species for larger commercial fish.

Marine plant and riparian habitat resources

1. A large variety of habitats occur within the Kirke River Area, including extensive areas of shallow saline waters, complex structural habitat along riverbanks and large areas of saltpans and grasslands. There is also a diverse range of vegetation types within the survey area including extensive mangrove communities.
2. Twelve species of mangrove were recorded in the Kirke River. *Avicennia marina*, *Lumnitzera* sp and *Rhizophora stylosa* has the widest distribution in the survey area and also tends to be the dominant mangrove species at the sites where they occur.
3. Mangroves typically form a narrow (<10 m) band of vegetation along the banks of the Kirke River, although wider stands of mangroves occur where large sand or mud banks are present.
4. The mangrove community is generally highly mixed with a lack of clear zonation.
5. Other vegetation recorded included marine succulents, marine grasses, terrestrial vine thicket, terrestrial grasses and terrestrial sclerophyll.

6. The survey area is largely undisturbed with few existing disturbances or structures and good water quality. The greatest threat to the habitat features of the area appears to be fire.
7. The complex and diverse vegetation and habitat features of the area are likely to be providing high quality fisheries habitat.

Fish and crab resources

1. Twenty-two fish species from 14 families were recorded during the research surveys.
2. Fifteen fish species of value to commercial, recreational and indigenous fishers were captured during the research surveys.
3. Barramundi (*Lates calcarifer*) was the most abundant species caught during the research netting at all sites surveyed.
4. The size of barramundi caught ranged from 164 mm to 830 mm total length.
5. Tagging information suggests Barramundi and threadfin move between the Kirke River and the Weipa region and the Love River to the north.
6. Thirty-six mud crabs (0.9 per pot lift) were caught during the research surveys.
7. Eight per cent of the crabs caught were legal sized males.
8. Between 10 and 25 commercial boats have operated in the Kirke and Love Rivers region since 1989.
9. Barramundi contributed nearly 50% (by weight) of the total commercial fish and crab catch in the Kirke and Love Rivers region between 1989 and 1999.
10. Barramundi made up over 70% of the recreational catch during the survey period, with one fish caught per angler per hour fished.
11. Only anecdotal information of the indigenous fishery information is available for the area.

Recommendations

The Kirke River Area meets all seven Fish Habitat Area criteria, supports a diversity of pristine environments that have high value as fisheries resources and is highly productive.

It is therefore recommended that:

1. The fisheries habitats from the mouth of the Kirke River to the eastern side of the lake and all adjoining wetland areas are considered for inclusion in a FHA. Protection of this area is recommended due to its current undisturbed condition.
2. The Love River and the associated coastal wetlands between the Love River and Archer River be further investigated for FHA nomination/declaration because of their importance for indigenous, commercial and recreational fishing.

CHAPTER 1 GENERAL INTRODUCTION

Background

Natural Heritage Trust Project

In 1999 the Queensland Fisheries Service received funding from the Cape York Natural Heritage Trust for a three-year project titled 'Assessment and Declaration of Fish Habitat Areas in Cape York Peninsula'. This project is based on recommendations in the CYPLUS, Natural Resource Analysis Program 'Marine Vegetation of Cape York Peninsula' Report (Danaher 1995) to investigate a number of areas for potential Fish Habitat Area declaration. Tidal areas throughout Cape York Peninsula were evaluated and three areas met all seven FHA criteria (Zeller and Beumer 1996). These areas were the:

1. Kirke River, south of Aurukun,
2. Starcke region, north of Cape Flattery,
3. Margaret Bay, eastern side of Cape York Peninsula.

The Department of Primary Industries NHT project focuses on these three areas over a three-year period. The first area investigated was the Kirke River.

What is a Fish Habitat Area?

Throughout Queensland, key areas of fisheries habitat have been identified by the Queensland Fisheries Service as having significant value to help enhance and sustain fisheries resources. These areas, known as Fish Habitat Areas, are afforded statutory protection to maintain and protect their important fisheries habitats and resources.

FHAs are declared by Regulation under Section 120 of the *Fisheries Act 1994* as part of the ongoing identification, management and protection of critical fisheries habitats in Queensland. The FHA concept focuses on the inclusion, linkage and management of all available habitat types within an area as a single unit, rather than simply protecting individual isolated habitat types. This approach has been developed in response to a better understanding of the manner in which aquatic ecosystems function. The maintenance of a diverse and abundant fish and crustacean community depends on an equally diverse, extensive and connected suite of quality fisheries habitats.

Fish Habitat Areas form an important component of the ongoing protection and management of fisheries resources and wetlands habitats in Queensland. FHAs are declared with the specific intent of ensuring the continuation of productive local and regional recreational, commercial and traditional fisheries.

Fish Habitat Area management does not restrict existing legal recreational, traditional or commercial fishing or affect legal existing day-to-day community use and enjoyment of the area. It does however restrict activities that may have negative impacts on the fisheries and habitat values of the area (e.g. dredging, reclamation, drainage etc). Since their inception during the late 1960s, 75 FHAs (previously referred to as Reserves for Fisheries Purposes) have been declared over nearly 700000 ha of Queensland's coastal and estuarine waterways.

Regulation of fisheries

In recognition of their importance to fisheries, all marine plants, including mangroves, seagrasses, saltcouch and samphire species are protected under Section 51 of the *Fisheries Act 1994*. A permit is required to remove, destroy or damage any marine plant.

Why the Kirke River?

The Kirke River was one of three areas that met all seven FHA selection criteria assessed through the CYPLUS, NRAP studies.

The criteria currently used for Fish Habitat Area declarations under the *Fisheries Act 1994* (after Danaher 1995) are:

1. Size (greater areas being seen as more viable in the long term)
2. Diversity of, or specific habitat features
3. Diversity of, or specific marine fauna and flora
4. Existing or potential fishing grounds
5. Level of existing and likely future disturbances
6. Unique Features
7. Protected species.

Site Description

The Kirke River is located on western Cape York Peninsula, approximately 55 km south south west of the Aboriginal Community of Aurukun (Figure 1.1). The river has a large saline lake that empties to the sea through a short lowland coastal riverine system and extensive seasonal wetlands are associated with the river system. During the wet season (January - May) these wetlands may extend continuously from south of the Kirke River mouth to Archer Bay in the north (personal observation, 1999). A mixture of mangroves, saltpans and terrestrial vegetation types line the river banks. Terrain surrounding the river is typically flat, allowing saline tidal influence to extend several kilometres upstream, especially in the dry season.

Climate

The study area experiences a tropical climate and has a tropical monsoon rainfall pattern, with a mean annual rainfall of 1674.7 mm, the greater part of which falls between December and March (Aurukun). Mean daily temperatures in the area range from a minimum 21.9 °C to a maximum of 32.5 °C (Weipa) (Bureau of Meteorology personal communication, 1999).

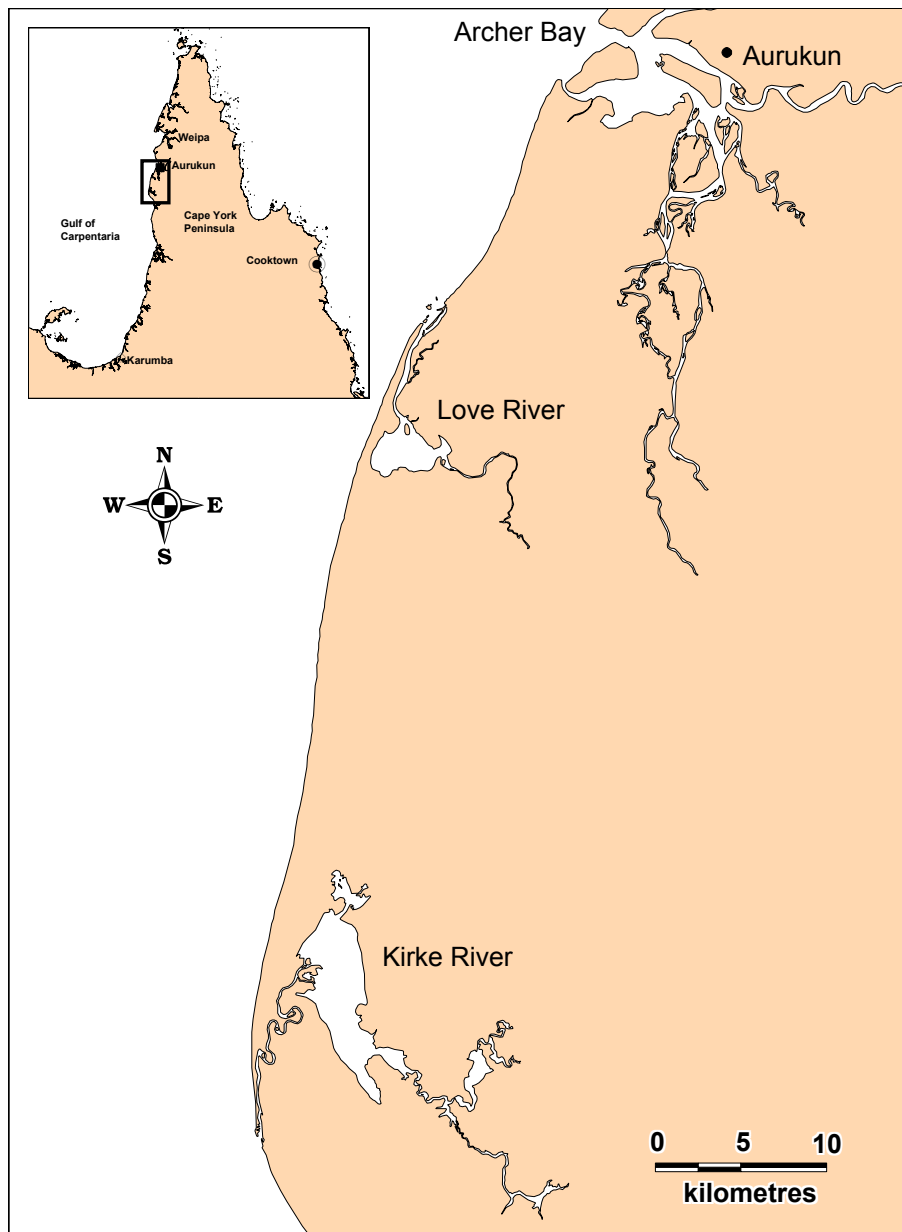


Figure 1.1. Location of survey area for the Kirke River Fish Habitat Area assessment, August 1999

Land use and tenure

The Kirke River and surrounding land is held as Aboriginal tenure, either Aboriginal Land Lease, Deed of Grant in Trust or Aboriginal Reserve (CYPLUS 1997). The entire river and catchment lies within lands that are managed by the Kirke River traditional owners.

The soils surrounding the Kirke River do not carry any horticultural or broad acre cropping potential (CYPLUS Stage 2 Report, 1996). Land surrounding the Kirke River is generally unsuitable for grazing. The area to the north of the Kirke River and the immediate land surrounding the lake system, has a carrying capacity of six to ten (average eight) hectares per head of cattle. The area to the immediate south has a carrying capacity of more than 61 (average 131) hectares per head of cattle (CYPLUS Stage 2 Report, 1996).

Known Marine Vegetation Types

Cape York Peninsula has one of the highest reported species diversities of marine vegetation in the world. It contains 36 mangrove species, compared to nine in south-east Queensland and one in Victoria (Bunt 1982; Dowling and McDonald 1979; Duke 1992). There are 13 species of seagrass found in the inshore waters of the Cape York region including Torres Strait (Poiner *et al.* 1989) compared to five species in south east Queensland (Coles *et al.* 1989).

Broad scale assessment of the tidal wetland vegetation of Cape York Peninsula was carried out between May 1993 and December 1994 as part of the CYPLUS program (Danaher 1995). Marine vegetation communities in the Kirke River, Love River and surrounding areas were mapped using remote imagery from the Landsat Thematic Mapper satellite and colour aerial photographs where available. Validation of vegetation maps by ground truthing and helicopter inspections were made for the Love River but not the Kirke River (Danaher, 1995).

Danaher (1995) identified several species of mangroves in the Love River including *Avicennia marina*, *Rhizophora stylosa* and *Ceriops tagal*. In the Kirke River ground truthing was not carried out and only small areas of *Avicennia marina* were identified. Large areas of saltpan were also mapped adjacent to both the Kirke and Love Rivers (Danaher 1995).

Seagrasses in the Love and Kirke rivers were mapped by DPI in October 1986 as part of a broadscale seagrass survey of the Gulf of Carpentaria (Coles *et al.* in prep.). Two species of seagrass, *Halodule pinifolia* and *Halophila ovalis* were identified in the saline lakes of both rivers at the time of the survey.

Existing information on marine vegetation for the Kirke River area is all broad-scale and for mangroves was only determined by remote sensing. This existing database was not suitable for defining the FHA and collecting fine scale habitat information is a specific purpose of the NHT project.

Current fisheries information

There is little existing information on the history of fisheries in the Kirke River. The QFMA (1996) noted conflict between the commercial and indigenous fisheries in the region. The agency recommended that the area be closed to all forms of fishing, exclusive of traditional fishing, in an issues paper on the Gulf of Carpentaria inshore finfish fishery (QFMA, 1999). The outcomes of this issue paper are still to be finalised. (L. Gwynne, personal communication).

Fishing regulations exist for many of the fish and crab resources in the Gulf of Carpentaria. These restrictions help to maintain fish stocks at a sustainable level; to protect spawning target species; to minimise adverse effects of fishing on protected species; to provide a viable commercial and recreational fishery and to satisfy traditional or customary fishing needs of Aboriginal and Torres Strait Islanders. These regulations [Fisheries (Gulf of Carpentaria Inshore Fin Fish) Management Plan 1999] are regularly reviewed and the latest information can be obtained from the local Queensland Boating and Fishing Patrol Office.

Commercial fishing activities including gill netting and crabbing are conducted in the Kirke River during the open fishing season. Recreational fishing is permitted in the Kirke River region but permission must be sought from the Traditional Owners to visit the area. Indigenous fishers use the area throughout the year.

Aims of this assessment

This report describes the fisheries, fisheries habitat and cultural information on the Kirke River Area that are gathered to help assist its suitability for declaration as a Fish Habitat Area. The material will also help in defining the boundaries and management of the FHA if it is to be declared. Due to the lack of fine-scale information on fisheries, marine and riparian vegetation of the Kirke River, field assessments was considered necessary. The report is divided into the following chapters:

- Seagrass resources
- Marine plants and riparian habitat resources.
- Fish and Crab resources

The results presented in this report together with consultation with the community and traditional owners will be used to define the relative fish habitat values and determine suitable boundaries for FHA declaration.

CHAPTER 2. SEAGRASS RESOURCES

Michael Rasheed

Summary

1. An area of 7.6 ± 1.5 ha of seagrass was mapped in the Love River Lake. Seagrass distribution was restricted to six small meadows on the edges of intertidal mud/sand banks.
2. No seagrass was found in the Kirke River in this survey.
3. All seagrass meadows mapped were comprised of low biomass monospecific *Halodule pinifolia*.
4. Extensive flooding of the survey area for a prolonged period (>6 months) prior to the survey was likely to have significantly reduced seagrass distribution and abundance in both the Kirke and Love River systems.
5. These meadows may be regionally important, as few seagrass meadows have been identified on the eastern coast of the Gulf of Carpentaria. These meadows may represent the only seagrass between Karumba in the south and Archer Bay to the north and are likely to provide food for dugong moving along the east-coast of the Gulf.
6. Seagrass meadows are likely to provide habitat for several species of juvenile fish and prawns and prey species for larger commercial fish.

Introduction

Background

The only existing information on seagrass distribution in the Kirke and Love River region is from a broad scale seagrass survey of the Gulf of Carpentaria conducted in 1986 (Coles *et al.* in prep). Seagrass information in this early survey was based on a limited number of sites due to the nature of the survey and shallow water allowing only limited access to the extensive saline lakes in both the Kirke and Love Rivers. Despite access problems some sites were sampled within the lakes of both rivers and seagrass was found. A finer-scale survey of the area was considered necessary for assessment prior to FHA declaration. The following objectives were set:

- 1 map the distribution and abundance of seagrass meadows within the Kirke and Love River systems;
- 2 produce a detailed GIS on seagrass habitats;
- 3 provide advice on the fisheries habitat value of seagrass meadows in the study area.

General Seagrass Ecology

Seagrass meadows in northern Queensland support important populations of juvenile penaeid prawns and fish of commercial species (Coles *et al.* 1993; Watson *et al.* 1993). Seagrasses are essential food for dugong, *Dugong dugong* (Miller) and green turtles, *Chelonia mydas* (Linnaeus) (Lanyon *et al.* 1989) and act as 'nutrient and sediment sinks' (Short 1987). Seagrasses in coastal regions play important roles in maintaining sediment stability and water clarity. Coastal seagrass meadows are therefore an important economic and ecological resource.

The growth of seagrasses depends on several factors including the availability of light (Dennison 1987; Williams and Dennison 1990), nutrients (Orth 1977; Erftemeijer 1994), water temperature and salinity (Bulthuis 1987; Zieman 1975). Activities that lead to a change in these factors, such as runoff from agriculture and turbidity from dredging could potentially have a negative effect on seagrass growth and distribution. Seagrasses show measurable growth responses to changes in ambient water quality conditions and can therefore be used as effective indicators of environmental health (Dennison *et al.* 1993).

Tropical seagrass meadows are subject to temporal changes, varying seasonally and between years (Mellors *et al.* 1993; McKenzie 1994). The potential for widespread seagrass loss has been well documented and the causes of loss can be natural such as cyclones and floods (Poiner *et al.* 1989), or due to human influences such as agricultural runoff (Preen *et al.* 1995), industrial runoff (Shepherd *et al.* 1989), oil spills (Jackson *et al.* 1989) and dredging (Pringle 1989).

Seagrasses in the Kirke & Love Rivers

A CSIRO aerial seagrass survey of the Gulf of Carpentaria between 1982 and 1984 (using a fixed-wing aircraft) failed to locate any seagrass in the Love and Kirke Rivers (Poiner *et al.* 1987). Aerial surveys alone, however, are unlikely to reveal the full extent of seagrass meadows in this area as highly turbid water conditions limit the usefulness of aerial surveys to very low tides. Low density or patchy meadows of the fine-leaved *Halodule* species are also easily missed in aerial surveys, even at low tide. Subsequent finer scale surveys have revealed large seagrass meadows in some areas of the Gulf that were not described in this aerial survey (e.g. Rasheed *et al.* 1996).

Seagrasses in the Love and Kirke Rivers were mapped by DPI in October 1986 as part of a broad scale seagrass survey of the Gulf of Carpentaria (Coles *et al.* in Prep.). Two species of seagrass, *Halodule pinifolia* and *Halophila ovalis*, were recorded in the saline lakes of both rivers.

This survey is the first to examine the fine-scale distribution and abundance of seagrasses in the Kirke and Love River systems.

Methods

Seagrass survey

The area surveyed included the saline lakes and extended downstream to the mouth of both the Kirke and Love Rivers. The areas upstream of the lakes were not surveyed.

A helicopter was used to survey the Kirke and Love Rivers on 13 and 14 of August 1999. This allowed access to the shallow saline lakes at spring low tide, when all the banks likely to support seagrass growth were exposed or covered by very shallow water.

All meadows were identified by flying a grid pattern across both lakes at a height of approximately 5 – 15 m. Where an area of seagrass was discovered the boundaries were mapped using a differential Global Positioning System (dGPS) (± 5 metres).

Seagrass habitat characteristics, including seagrass species composition, above-ground biomass, percentage algae cover, sediment type, time and dGPS fixes were recorded at sampling sites located randomly within each seagrass meadow.

Seagrass biomass (above-ground) was determined using a modified 'visual estimates of biomass' technique (Mellors, 1991). This technique involved an observer ranking seagrass biomass in 3 replicate 0.25 m² quadrats at each sampling site in the field. The relative proportion of each seagrass species within each survey quadrat was also recorded. These ranks were then calibrated for the observer to produce above-ground biomass estimates in grams of dry weight per metre square (g DW m⁻²). To calibrate the rank estimates against biomass, the observer recorded estimates for a selection of seagrass quadrats, and the seagrass was harvested from those quadrats and measured for biomass (g DW m⁻²) in the Northern Fisheries Centre laboratory. The regression equations which describe the relationship between the observers ranks and actual seagrass biomass, were then used to convert field data (ranks) to biomass values.

Geographic Information System

All survey data was entered onto a GIS for presentation of seagrass species distribution. A GIS of seagrass distribution was created in Mapinfo[®] using the above survey information.

A mapping error of $\pm 5\text{m}$ was used for calculations of meadow area based on the range of mapping information available for each meadow. The sources of error included those associated with digitising and rectifying aerial photographs and with dGPS fixes for survey sites.

Results

Seagrass Species

One species of seagrass was identified in the survey area.

Family CYMODOCEACEAE Taylor

Halodule pinifolia (Forsk.) Aschers.

Seagrass Distribution

No seagrass was found in the Kirke River. Seagrass was confined to the edges of shallow intertidal banks in the Love River lake (Figure 2.1). There were six small distinct *Halodule pinifolia* meadows with a total area of 7.6 ± 1.5 hectares (Figure 2.1). Seagrass biomass within the meadows was low (mean biomass $1.03 \pm 0.36 \text{ gDWm}^{-2}$) (Plate 2.1).

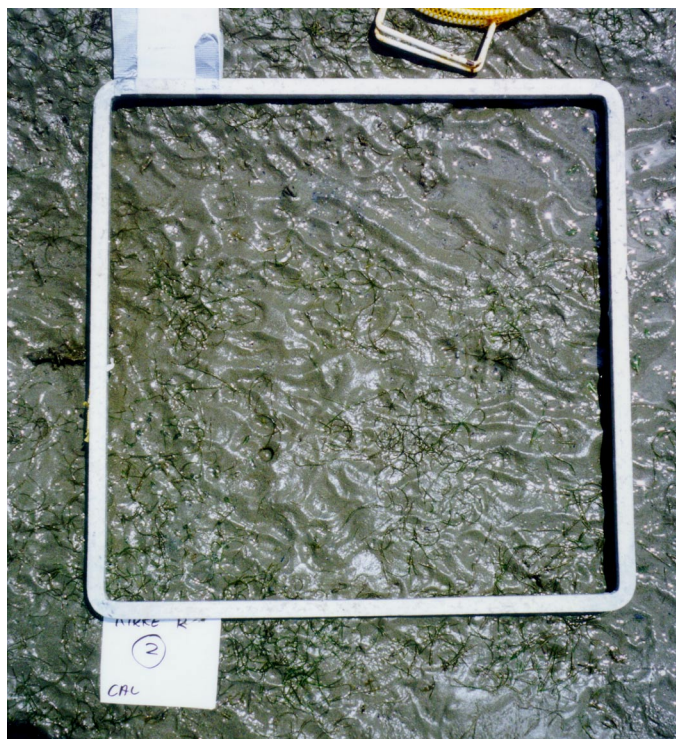


Plate 2.1. Typical *Halodule pinifolia* habitat in the Love River, August 1999

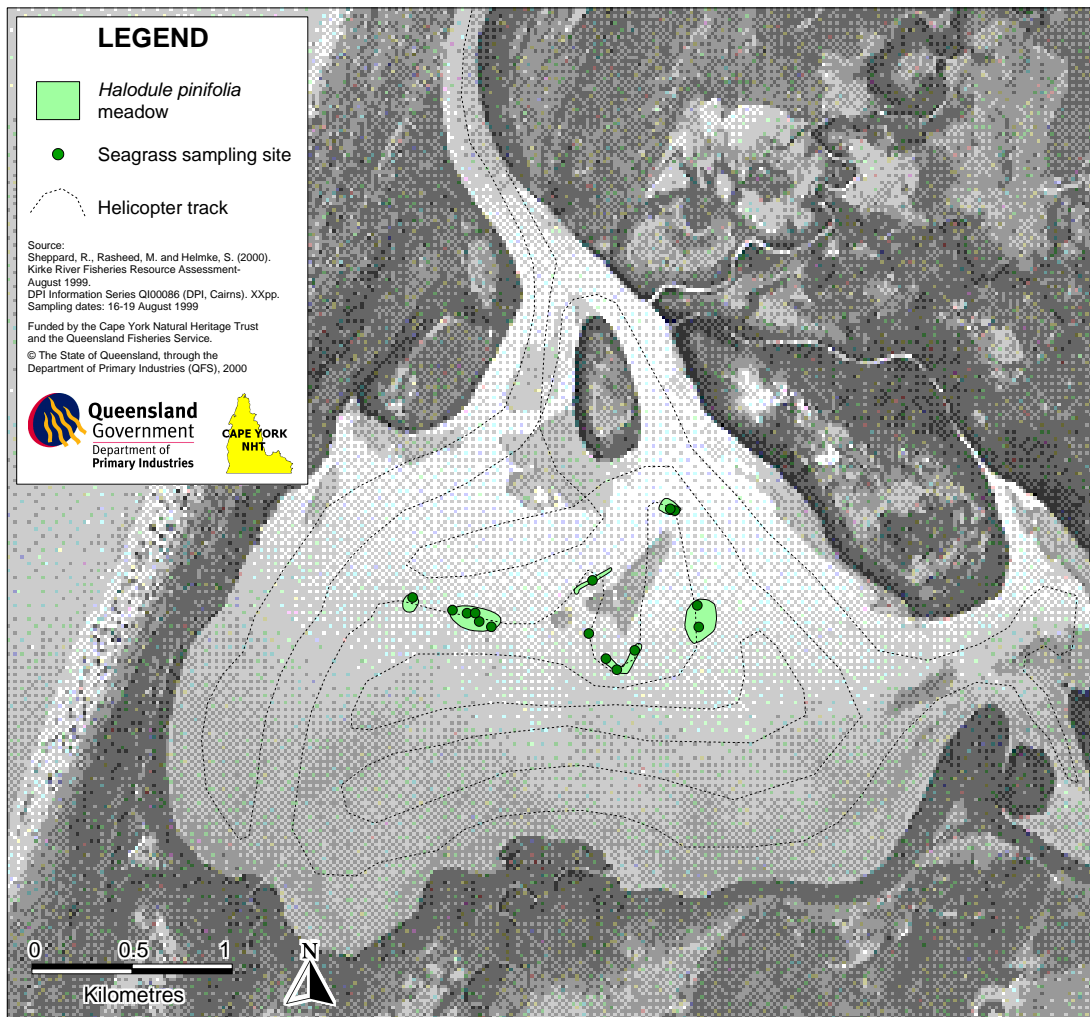


Figure 2.1. Seagrass meadows, sampling sites and helicopter flight path in the Love River, 13th August 1999

Discussion

The area of seagrass described in the survey area was small relative to other seagrass areas within the Gulf of Carpentaria (e.g. Karumba at approximately 1000 ha) (Rasheed *et al.* 1996). These meadows may be regionally important however, as there have been few seagrass meadows identified on the eastern coast of the Gulf (Coles *et al.* In Prep; Poiner *et al.* 1987). The meadows described here may represent the only seagrass between Karumba in the south and Archer Bay to the north and hence of high ecological importance.

An extended period of freshwater flooding in the survey region for at least six months prior to the survey may have led to a significant decline in seagrass distribution and biomass. Changes in salinity and turbidity associated with prolonged flooding have been responsible for widespread losses of seagrass in other regions of Queensland (Preen *et al.* 1995). A broad scale survey in 1986 indicated that there were substantial seagrass meadows in both the Kirke and Love Rivers (Coles *et al.* in prep) and may reflect seagrass distribution in more optimal conditions.

Flooding in the Gulf of Carpentaria is a natural event and marine plants that survive in the area may be well adapted to endure this type of impact. *Halodule pinifolia* is known to be a rapid vegetative coloniser (Rasheed *et al.* 1996; Rasheed 2000) and the small isolated meadows mapped in the Love River may be capable of rapid expansion after a flood. Although seagrass was absent in the Kirke River during this survey, it may survive prolonged flooding as seeds within the sediment. *Halodule* species are known to produce large quantities of long-lived seeds in other areas of Queensland (Dennison *et al.* 1997; Inglis 1999) and germination of these seeds can be triggered by salinity changes (Inglis 1999).

Halodule pinifolia is known to be a preferred food species for dugong (Preen 1995; Rasheed *et al.* 1996) but the small regionally isolated meadows identified in this survey are unlikely to support a large dugong population. They may however, provide a food resource for dugongs moving along the east coast of the Gulf.

The seagrass meadows in the Love River are also likely to provide habitat for crustaceans and juvenile commercial fish and prawns. Similar *Halodule pinifolia* meadows near Karumba in the southern Gulf of Carpentaria are known to be habitat for a large variety of fish and crustacean species including low densities of commercially targeted tiger and endeavour prawns (Rasheed *et al.* 1996).

The large saline lakes of the Kirke and Love Rivers provide unique sheltered areas suitable for seagrass growth in the Gulf of Carpentaria. Further surveys in years with less extreme fresh water flooding are required to determine the maximum extent of seagrass distribution within these river systems and to gain a better appreciation of their ecological role. Seagrass meadows are particularly vulnerable to changes in water quality and turbidity associated with developments. A FHA would help to preserve these seagrass meadows by limiting development activities that have the potential to create a negative impact.

CHAPTER 3. MARINE PLANT AND RIPARIAN HABITAT RESOURCES

Rebecca Sheppard
Michael Rasheed

Summary

1. There are a variety of habitats within the Kirke River Area, including extensive areas of shallow saline waters, complex structural habitat along riverbanks and large areas of salt pans and grasslands. There is also a diverse range of vegetation types within the survey area including extensive mangrove communities.
2. Twelve species of mangrove were recorded in the Kirke River. *Avicennia marina*, *Lumnitzera* sp and *Rhizophora stylosa* has the widest distribution in the survey area and also tends to be the dominant mangrove species at sites where they occurred.
3. Mangroves typically form a narrow (<10 m) band of vegetation along the banks of the Kirke River, although wider stands of mangroves occur where large sand or mud banks were present.
4. The mangrove community is generally highly mixed with a lack of clear zonation.
5. Other vegetation includes marine succulents, marine grasses, terrestrial vine thicket, terrestrial grasses and terrestrial sclerophyll.
6. The survey area is largely 'pristine' with few existing disturbances or structures and has good water quality. The greatest threat to the habitat features of the area appears to be from fire.
7. The complex and diverse vegetation and habitat features of the area are likely to provide high quality fisheries habitat.

Introduction

Background

The only existing information on marine vegetation types and fisheries habitats of the Kirke River region is from a broad-scale marine vegetation survey of Cape York Peninsula in 1995 (Danaher 1995). Marine vegetation information in this survey was collected using remote satellite imagery. Detailed information was not collected for the Kirke River and no ground truthing of the information was undertaken in the area. A finer-scale survey of the area was considered necessary for assessment prior to FHA declaration.

The objectives were:

1. To identify and map the mangroves and riparian vegetation.
2. To document habitat features and values.
3. To document and record disturbances.

Seagrasses are discussed separately in chapter 2 of this document.

Fisheries habitat values

Queensland's extensive coastline and inland waterways support commercial and recreational fishing industries estimated to be valued at more than \$800 million per annum (Williams 1997). Ensuring the long-term sustainability of Queensland's fisheries resources is a primary objective of the *Fisheries Act 1994*.

Mangroves and seagrass communities have long been recognised for their value to fisheries production (Bruinsma *et al.* 1999). Previous Departmental research (Quinn 1995) has estimated that approximately 75% (by weight) of all seafood landed commercially in Queensland is from species dependent on estuarine habitats during part of their life cycle. Similarly, a high proportion of species targeted by the recreational fishing sector and indigenous fishers is dependent on estuarine and freshwater habitats during part or all of their life cycles (Beumer *et al.* 1997). Mangroves, saltmarshes and seagrasses directly support local and offshore fisheries through the provision of food, shelter, breeding and nursery grounds (Danaher 1995).

Mangroves are a taxonomically diverse group of predominantly tropical shrubs and trees growing in the marine tidal zone (Duke 1992). Mangrove forests form the interface between marine and terrestrial environments (Lovelock 1993). They are fundamentally important in that they offer a habitat and shelter for other plants and animals (Claridge and Burnett 1993). Mangroves also provide physical protection of the coastal fringe from erosion and provide habitat for wildlife such as birds and crocodiles (Claridge and Burnett 1993).

Structural features of a waterway other than marine vegetation e.g. mudbanks, rocky outcrops, deep holes, sand bars and sediment type, all help determine its value as a fisheries habitat (McKinnon personal communication). Consequently a large variety of habitat types may be considered as valuable to fisheries diversity and productivity.

Existing development or development pressure within an area also affects its value as fisheries habitat. Knowledge of these developments may also assist in determining appropriate locations for Fish Habitat Area exclusion zones and in future management, should an area be declared as a FHA.

Fisheries Habitat in the Kirke River

Habitat types around the Kirke River were identified in a broad-scale study of tidal wetland vegetation of western Cape York Peninsula, using remote satellite imagery (Danaher and Stevens 1995). Assessments from this mapping exercise indicate that the Kirke River area has flat, low-lying terrain within intertidal areas leading to low variation in tidal inundation. The authors found that such flat terrain has led to a lack of distinct vegetation zones, with plant communities tending to be mixed. Saltpans mixed with grasslands extend for kilometres inland. Mangrove communities were generally not as tall as those further north due to lower freshwater input (from rain and runoff), with lower basal areas but higher stem density. The only mangroves identified in the Kirke River using these remote sensing techniques (Danaher 1995) were small areas of *Avicennia marina*.

A broad scale survey of non-tidal vegetation of Cape York identified the major vegetation types around Cape Keerweer and the Kirke River as tussock grassland, closed tussock grassland, sedgeland, herblands, lake and lagoons (Neldner and Clarkson 1994). In the upper catchment of the Kirke River the dominant vegetation was classified as woodland and low woodland (Neldner and Clarkson 1994)

This survey is the first to examine the distribution of mangrove and riparian vegetation and other fisheries habitat features by field-based surveys in the Kirke River.

Methods

Habitat Survey

An assessment of the habitat features, mangroves and riparian vegetation of the Kirke River was conducted between 16 and 19 August 1999 using a mixture of boat and foot surveys. The survey area included the river from the mouth to the lake and the western section of the lake (Map 3.1). Other areas of the lake were not surveyed, as they were inaccessible at the time by boat or foot. Sampling sites were selected on both banks of the Kirke River approximately every 300 metres or where a significant change in the vegetation occurred. This site-selection method allowed observers to map and describe a large variety of vegetation species, types and habitat features.

Due to cultural constraints some areas of the Kirke River, such as the lake system, could not be traversed and so sites in this region and beyond were not surveyed.

A differential GPS (dGPS) was used to locate each survey site for mapping purposes. Each sampling site incorporated a 10 m section of riverbank. All mangroves, marine grasses and succulents within this 10 m frontage were identified to species level in the field. Where positive identifications could not be made samples were collected for later identification. Voucher specimens of species were also collected to confirm field identifications. Other vegetation types present such as sclerophyll, terrestrial grasses and terrestrial vine thicket were described. The percentage of the site comprised by each species or vegetation type was estimated and recorded for each site. The percent of each site comprised of other features such as open unvegetated bank was also estimated.

At each site data on bank sediment, height and angle, snags, structural habitat features (mudbanks, rocky outcrops, deep holes, sand-bars) and disturbances were recorded. A description of the zonation of vegetation and general site characteristics was recorded and a photographic record taken of each site. All site information was recorded on a habitat assessment form (eg. Sheppard and Helmke 1999).

Disturbances

The location of existing man-made structures or disturbances was recorded using the dGPS, and a brief description (including approximate dimensions), with photographs made of each structure.

Water Quality

Water quality was sampled at three locations in the river, at the mouth, mid-river and lake entrance (Map 3.1). One set of three replicate measurements at each location for pH, water temperature (°C), dissolved oxygen (mg/L), conductivity, salinity (%) and turbidity (NTU) was collected using a Horiba U-10 water quality meter.

Geographic Information System

All survey data was entered into a GIS for presentation of marine and riparian vegetation distribution and location of habitat features. A habitat GIS was created in Mapinfo[®] using the above survey information.

Results

Mangroves and riparian vegetation

Ninety-four sites were sampled in the Kirke River between 16 and 19 August 1999 (Map 3.1). Twelve species of mangrove were recorded in the survey area (Table 3.1). *Avicennia marina*, *Lumnitzera* sp and *Rhizophora stylosa* had the widest distribution in the survey area (Table 3.1; Map 3.2). Where they occurred they also tended to be the dominant species (Map 3.2). *Aegiceras corniculatum*, *Aegialitis annulata*, *Excoecaria agallocha* and *Hibiscus tiliaceus* were also widely distributed but made up a smaller component of the sites where they occurred (Table 3.1; Maps 3.1 & 3.2). Other species were more narrowly distributed with *Ceriops tagal* and *Bruguiera parviflora* restricted to downstream areas of the river (Map 3.3) and *Scyphiphora hydrophylacea*, *Clerodendrum inerme* and *Camptostemon schultzei* only occurred at a few sites (Map 3.4).

Generally mangroves formed a narrow band (<10 m) along the banks of the Kirke River and creeks (Plate 3.1). The width of mangrove vegetation was greater where large mud banks or islands occurred in the river (Plate 3.2). The mangrove community was generally highly mixed with a lack of clear zonation (Plate 3.3). *Rhizophora stylosa* and *Avicennia marina* tended to occur at the shoreward margin with *Hibiscus tiliaceus* usually at the rear.



Plate 3.1. Typical narrow mangrove distribution in the Kirke River



Plate 3.2 Wider area of mangroves on mudbanks in the Kirke River.



Plate 3.3. Typical mixed species mangrove community in the Kirke River.

Table 3.1. Mangrove species, percentage of sites where they occurred and percentage cover at sites where they occur in the Kirke River, August 1999.

Mangrove species	% of sites where species occurred	Average % cover at sites where species occurred (\pm SE)
<i>Avicennia marina</i>	62	20.6% \pm 1.5
<i>Lumnitzera sp.</i>	56	20.7% \pm 5.2
<i>Rhizophora stylosa</i>	55	37.6% \pm 4.5
<i>Hibiscus tiliaceus</i>	38	13.5% \pm 3.3
<i>Aegiceras corniculatum</i>	30	9.9% \pm 1.2
<i>Aegialitis annulata</i>	29	14.2% \pm 0.8
<i>Excoecaria agallocha</i>	29	8.9% \pm 2.4
<i>Bruguiera parviflora</i>	11	10.0% \pm 2.3
<i>Ceriops tagal</i>	7	10.0% \pm 3.4
<i>Scyphiphora hydrophyllacea</i>	6	29.2% \pm 13.9
<i>Clerodendrum inerme</i>	4	28.8% \pm 4.2
<i>Camptostemon schultzei</i>	2	7.5% \pm 1.3

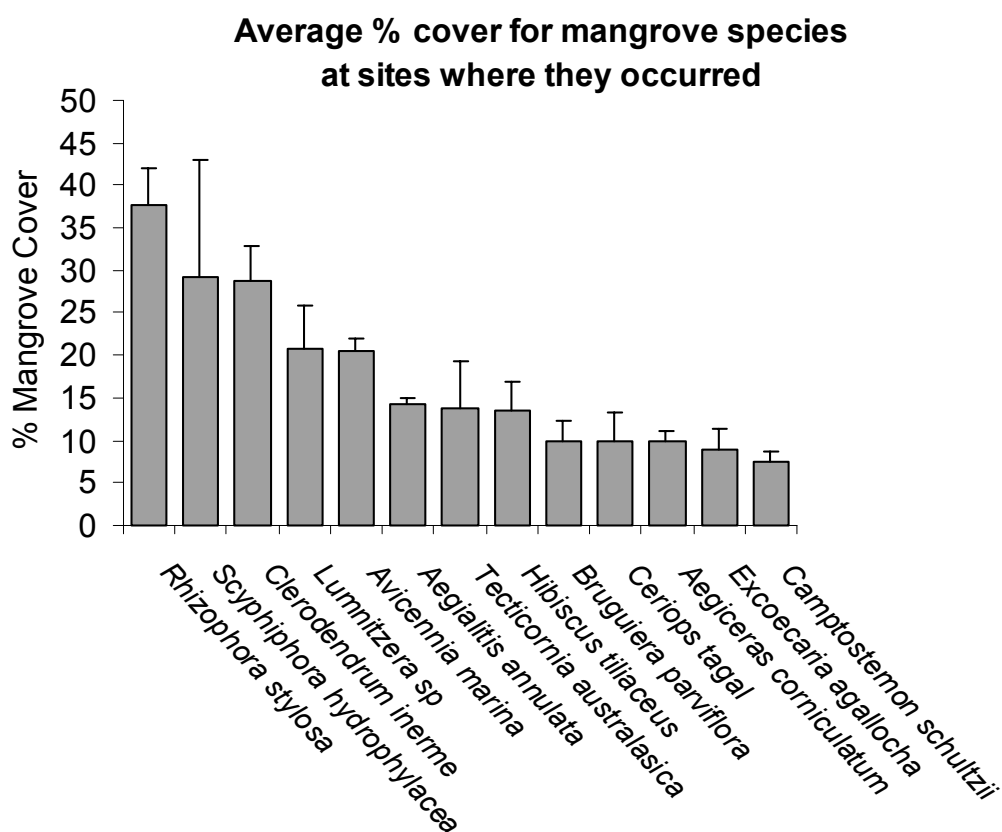


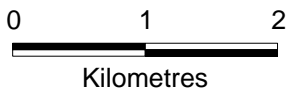
Figure 3.1. Average percentage cover (\pm Standard Error) for Kirke River mangrove species for sites where they occurred.

MAP 3.1.

Survey sites for marine plant habitat in the Kirke River, August 1999.

LEGEND

● Survey Sites

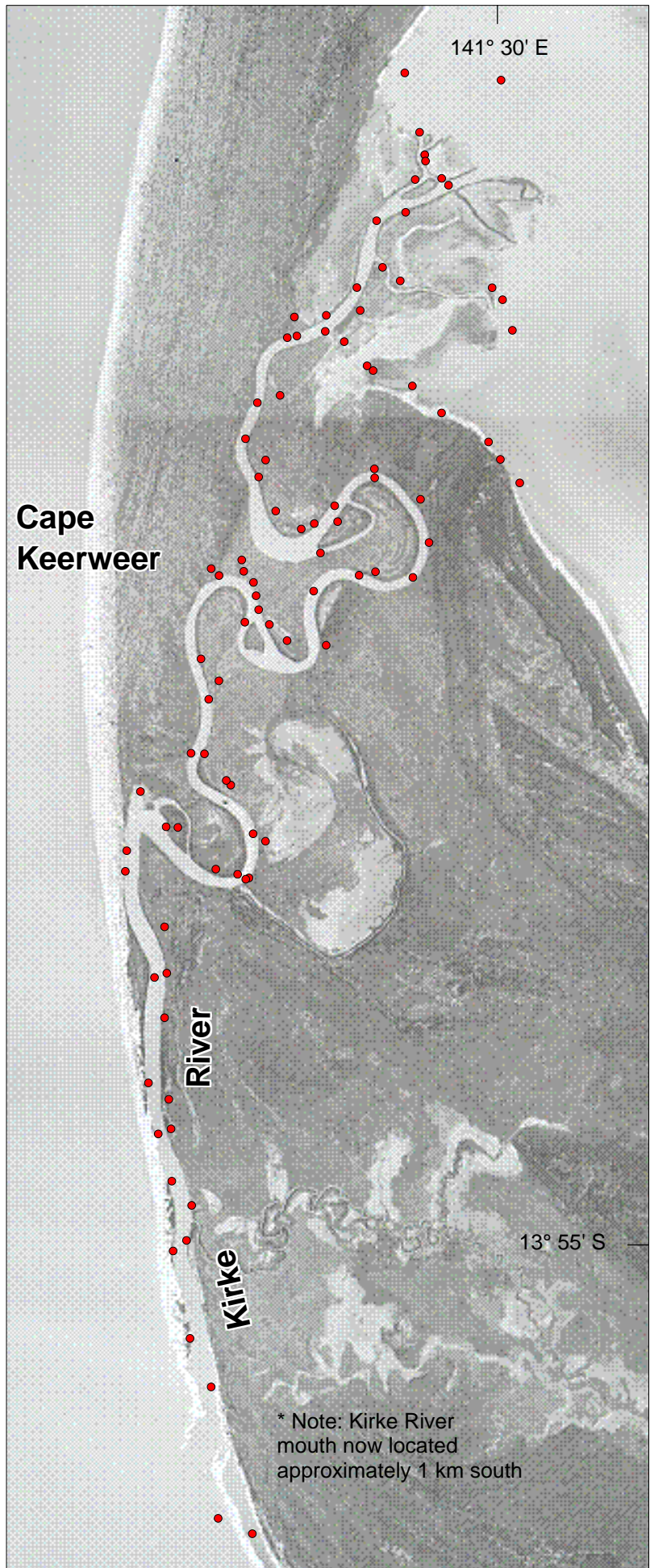


Source:
Sheppard, R. Rasheed, M and Helmke, S. (2000).
Kirke River Fisheries Resource Assessment -
August 1999.
DPI Information Series QI00086 (DPI, Cairns). 59 pp.

Sampling dates: 16 - 19 August 1999.

Funded by the Cape York Natural Heritage Trust
and the Queensland Fisheries Service.

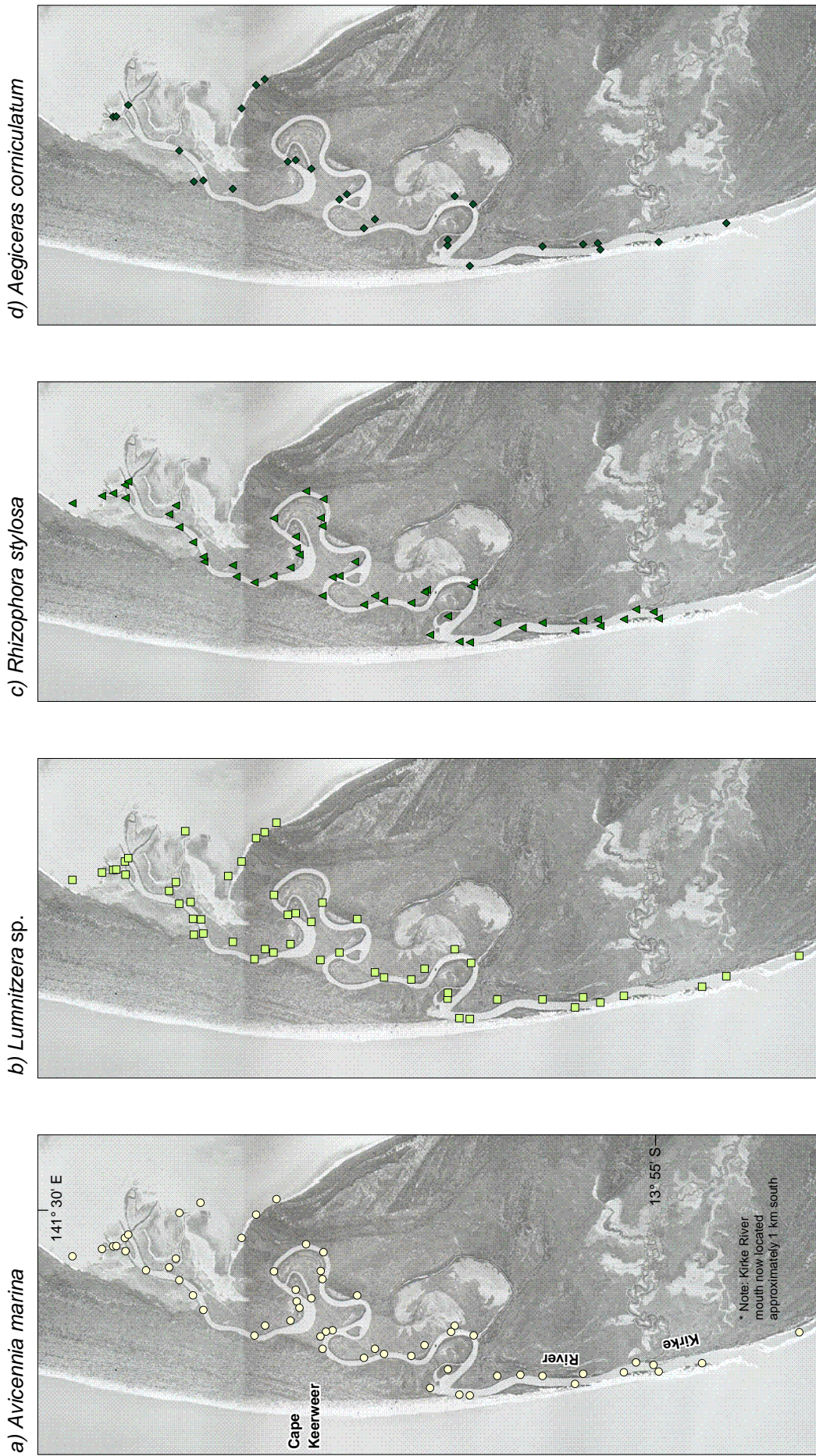
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Department of
Primary Industries



MAP 3.2. Sites with *Avicennia marina*, *Lumnitzera* sp., *Rhizophora stylosa* and *Aegiceras corniculatum* in the Kirke River, August 1999.



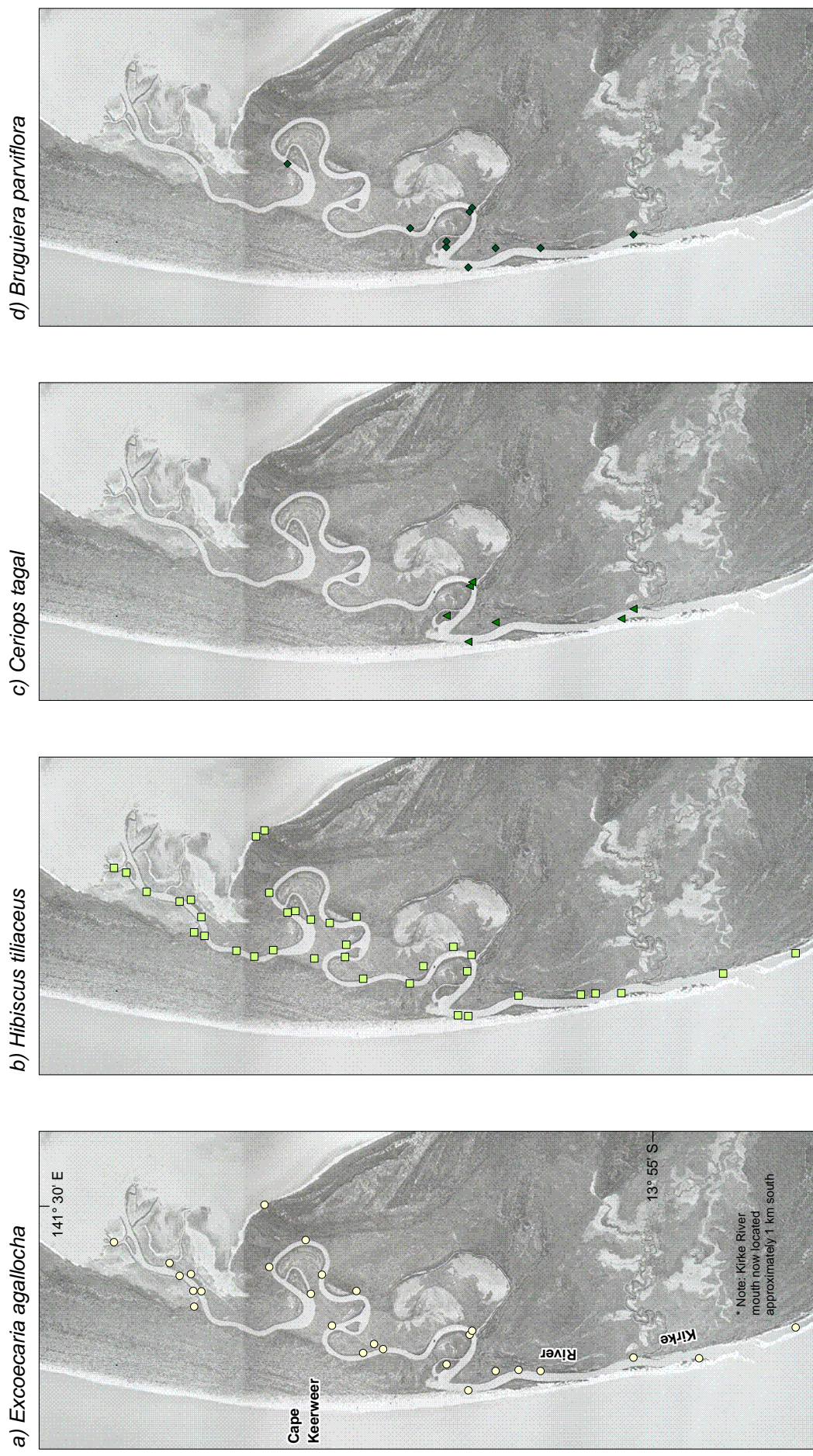
LEGEND

- *Avicennia marina*
- *Lumnitzera* sp.
- ▲ *Rhizophora stylosa*
- ◆ *Aegiceras corniculatum*



Source: Sheppard, R., Rasheed, M. and Helmke, S. (2000). Kirke River Fisheries Resource Assessment - August 1999. DPI Information Series Q100086 (DPI, Cairns). 59 pp. Sampling dates: 16 - 19 August 1999. Funded by the Cape York Natural Heritage Trust and the Queensland Fisheries Service. © The State of Queensland, through the Department of Primary Industries (QFS), 2000.

MAP 3.3. Sites with *Excoecaria agallocha*, *Hibiscus tiliaceus*, *Cerriops tagal* and *Bruguiera parviflora* in the Kirke River, August 1999.



LEGEND

- *Excoecaria agallocha*
- *Hibiscus tiliaceus*
- ▲ *Cerriops tagal*
- ◆ *Bruguiera parviflora*

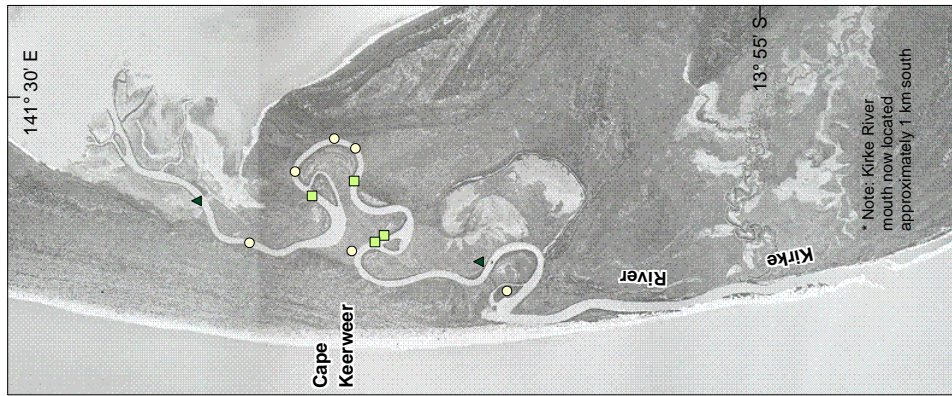


Source: Sheppard, R., Rasheed, M. and Helmke, S. (2000). Kirke River Fisheries Resource Assessment - August 1999. DPI Information Series Q100086 (DPI, Cairns). 89 pp. Sampling dates: 16 - 19 August 1999. Funded by the Cape York Natural Heritage Trust and the Queensland Fisheries Service. © The State of Queensland, through the Department of Primary Industries (QFS), 2000.

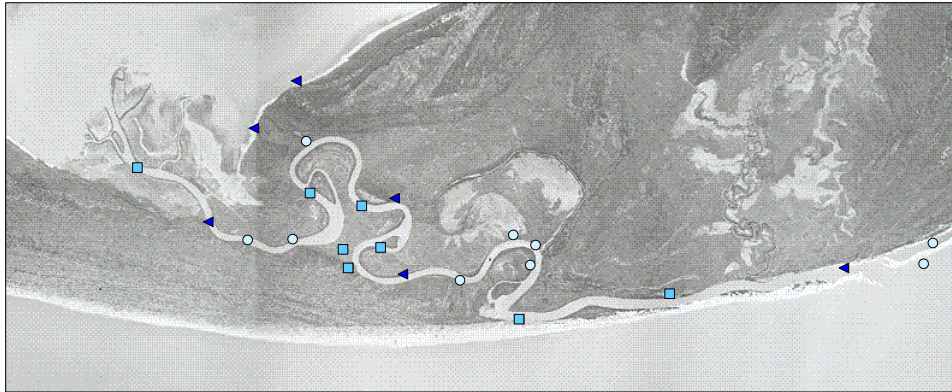


MAP 3.4. Sites with *Scyphiphora hydrophyllacea*, *Clerodendrum inerme*, *Camptostemum schultizii*, terrestrial plants, marine succulents and marine grasses in the Kirke River, August 1999.

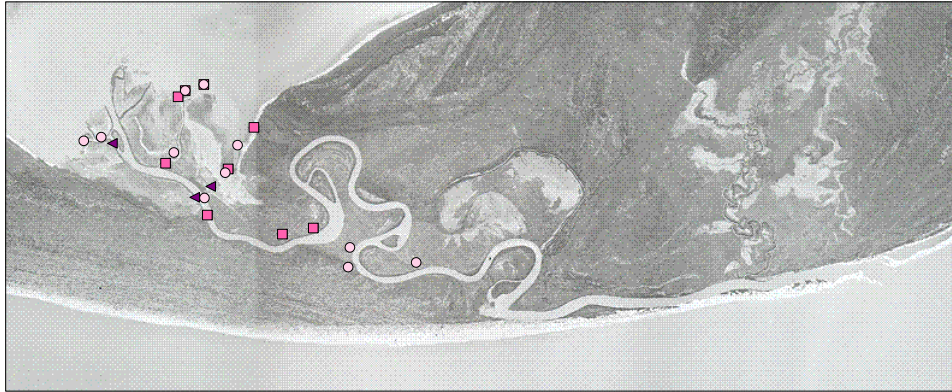
a) *Scyphiphora hydrophyllacea*
Clerodendrum inerme
Camptostemum schultizii



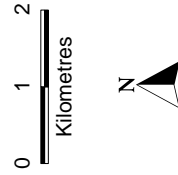
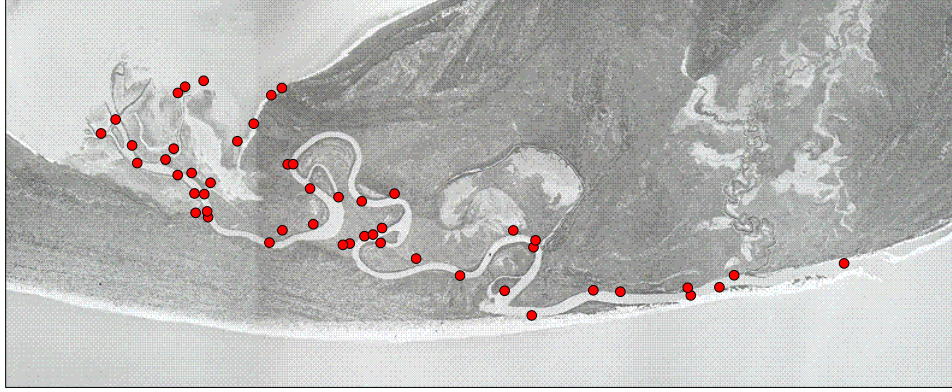
b) Terrestrial plants



c) Marine succulents



d) Marine grasses



LEGEND

- *Scyphiphora hydrophyllacea*
- *Clerodendrum inerme*
- ▲ *Camptostemum schultizii*
- Terrestrial vine thicket
- Terrestrial grasses
- ▲ Terrestrial sclerophyll
- *Sesuvium portulacastrum*
- *Cressa cretica*
- ▲ *Tecticornia australasica*
- Marine grasses

Source: Sheppard, R., Rasheed, M. and Helmke, S. (2000). Kirke River Fisheries Resource Assessment - August 1999. DPI Information Series QI00086 (DPI, Cairns), 59 pp. Sampling dates: 16 - 19 August 1999. Funded by the Cape York Natural Heritage Trust and the Queensland Fisheries Service. © The State of Queensland, through the Department of Primary Industries (QFS), 2000

Other Vegetation

Non-mangrove vegetation was also recorded adjacent to the Kirke River. Terrestrial vegetation often extended to the edge of high banks in patches (Plate 3.4) or mixed with marine vegetation. Terrestrial vegetation was not identified to species, but classified into three broad categories. These were vine thicket, sclerophyll and grasses (Map 3.4; Table 3.2). Plants from these terrestrial categories were found in 9 – 10% of sites and tended to comprise a significant percentage of the vegetation at sites where they occurred (Table 3.2).



Plate 3.4. Terrestrial vine thicket on bank of Kirke River

Table 3.2. Non-mangrove vegetation types and species, percentage of sites where they occurred and percentage cover at sites where they occur in the Kirke River, August 1999.

Non-mangrove species	% of sites where species occurred	Average % cover at sites where species occurred (\pm SE)
Marine grasses	53	23.2 \pm 3.0
Open/bare bank	22	27.5 \pm 5.6
<i>Sesuvium portulacastrum</i>	12	11.4 \pm 3.1
<i>Tecticornia australasica</i>	12	13.9 \pm 6.0
<i>Cressa cretica</i>	10	8.1 \pm 2.8
Terrestrial vine thicket	10	52.8 \pm 11.7
Terrestrial grasses	9	24.1 \pm 5.7
Terrestrial sclerophyll	9	36.9 \pm 12.4
<i>Fimbristylis</i> sp.	2	42.5 \pm 37.5
<i>Sesbania cannabina</i>	2	27.5 \pm 17.5

Marine succulents including *Sesuvium portulacastrum*, *Tecticornia australasica* and *Cressa cretica* generally occurred at the landward edge of the mangroves. They were widely distributed around the lake area as well as in the upper reaches of the Kirke River (Map 3.4; Plate 3.5). At the sites where marine succulents occurred generally they were the only vegetation present (Table 3.2).



Plate 3.5. Marine succulents growing in the Kirke River Lake

Marine grasses (not seagrasses) were widely distributed throughout the survey area (Table 3.2; Map 3.4). With the exception of *Fimbristylis* sp and *Sesbania cannabina* (Map 3.4) marine grasses were not identified to species level but were pooled. Marine grasses tended to occur in the landward zone and were strongly represented around the lake system.

Many sites also contained areas of open or bare bank where no vegetation was recorded (Table 3.2).

Habitat Features

Habitat features of the Kirke River included a large variety of complex structural features along the banks (e.g. Plate 3.6) as well as extensive areas of shallow saline waters in the lake that are likely to be important fisheries habitats. Snags were found at 43% of sites.



Plate 3.6. Complex structural habitat on the banks of the Kirke River

Bank type varied considerably throughout the survey area with a mixture of shallow mud/sand banks, steep rocky banks and undercut and eroded areas (Plates 3.7, 3.8 and 3.9)



Plate 3.7. Shallow mud bank on the Kirke River



Plate 3.8. High rocky bank on the Kirke River



Plate 3.9. Undercut bank on the Kirke River

The most common sediment types for banks in the survey area were mud (53% of sites), a mixture of mud and sand (28%), or sand (10%) (Figure 3.16).

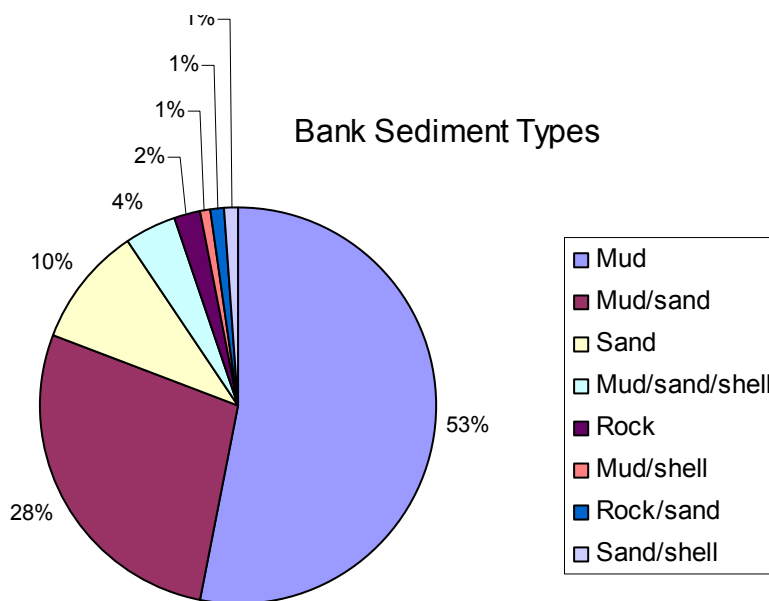


Figure 3.2. Bank Sediment Types

The slope of the majority of banks was shallow by sloping between 0° and 15° (52% of sites). Steep banks, 60° – 90° made up 20% of all sites (Figure 3.17). Shallow to medium (15° –30°), medium (30°–45°) and (45°–60°) medium-steep banks were each found at less than 10% of sites (Figure 3.17).

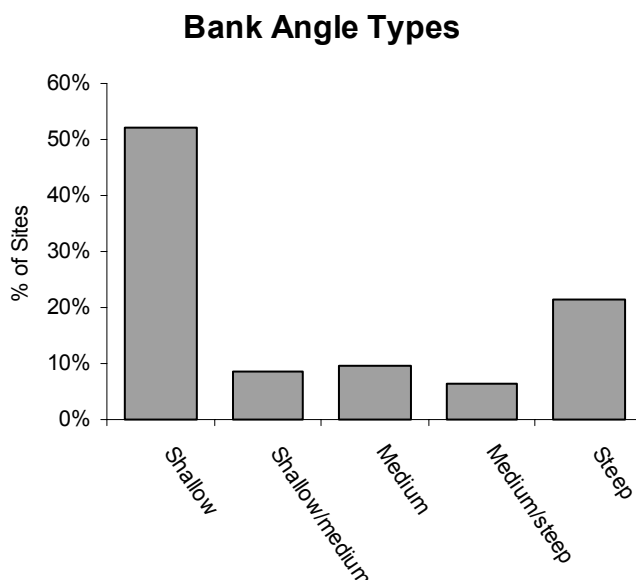


Figure 3.3. Bank Angle Types

Disturbances

Existing human structures

Two permanent structures are located in the Kirke River. A jetty and shed was located approximately 16 km upstream from the river mouth (Plate 3.10; Figure 3.18). The jetty was built to service a fishing vessel that is used for commercial fishing within the Kirke River. The shed was erected as a temporary structure to provide living and working quarters for the fishers.



Plate 3.10. Jetty on the Kirke River.

Several outstations used by the local Aboriginal community are located in the vicinity of the Kirke River and lake system (e.g. Plate 3.11; Figure 3.18).



Plate 3.11. Tea Tree Outstation near the Kirke River

Other human disturbances

There was evidence of fire damage to some mangrove areas within the survey area (Plate 3.12). During the survey, traditional owners lit a fire in the grasslands, which subsequently burnt to the shores of the river and damaged riparian vegetation (Plate 3.13). There was also evidence of previous fire damage to the mangroves, although the nature of the fire could not be determined.



Plate 3.12. Fire-damaged mangroves, Kirke River



Plate 3.13. Fire burning in the riparian zone, Kirke River

Water Quality

Water quality was generally good for the measured parameters when compared with the ANZECC guidelines (Table 3.3). Salinity and conductivity decreased at sites upstream of the river mouth. Water temperature and pH were similar at all three locations in the river (Table 3.3). Dissolved oxygen was lowest at the mouth of the river (Table 3.3).

Table 3.3. Mean water-quality measurements for the Kirke River overall and at mouth, mid river and Lake entrance (\pm standard error)

Water quality parameters	Overall (all sites)	Mouth	Mid-River	Lake entrance
pH	8.17 \pm 0.03	8.13 \pm 0.04	8.27 \pm 0.02	8.10 \pm 0.07
Water temp ($^{\circ}$ C)	25.43 \pm 0.30	24.30 \pm 0.20	25.56 \pm 0.37	26.48 \pm 0.21
Dissolved O ₂ (mg/L)	8.40 \pm 0.19	7.83 \pm 0.38	8.76 \pm 0.08	8.62 \pm 0.29
Conductivity	40.23 \pm 1.16	45.35 \pm 0.95	37.70 \pm 0.04	37.62 \pm 0.92
Salinity (‰)	2.59 \pm 0.08	2.95 \pm 0.07	2.41 \pm 0.004	2.40 \pm 0.07
Turbidity (NTU)	119.67 \pm 20.62	153.75 \pm 36.26	42.25 \pm 2.59	163 \pm 18.52

Discussion

The general trend in the zonation of mangroves along the Kirke River was for closed *Rhizophora stylosa* dominated communities along the banks of the river with a mix of *Avicennia marina* and *Lumnitzera* sp. within and behind. *Hibiscus tiliaceus* was widely distributed behind the mangrove fringe with marine grasslands, marine succulents and terrestrial grasslands also commonly found behind the mangroves.

The distribution of *Rhizophora stylosa* in the Kirke River area was similar to other mangrove communities in tropical North Queensland. In general, *Rhizophora* sp. is a pioneering species that is often found in monospecific stands on mud flats and on islands in tidal estuaries (Claridge and Burnett 1993). *Rhizophora* sp are also found in a variety of other tidal situations in association with a range of mangroves, especially *Avicennia*, *Ceriops* and *Bruguiera* (Claridge and Burnett 1993). In the Kirke River *Rhizophora* was mostly associated with *Avicennia marina* and *Lumnitzera* sp.

Avicennia species are found in a wide range of environments, from the upper reaches of tidal influences to newly emerging mud banks (Claridge and Burnett 1993). Within the Kirke River *Avicennia marina* was the most widely distributed species, occurring at the most number of sampling sites. *Avicennia* was found from the mouth to the upper reaches of the river and in the lake system.

Lumnitzera sp. is found in muddy substrates near the landward edge of the littoral zone, and is commonly associated with *Ceriops*, *Aegialitis* and *Avicennia* (Claridge and Burnett 1993). Within the Kirke River *Lumnitzera* sp. was very common and widely distributed. At most sites *Lumnitzera* sp. was associated with *Avicennia marina* and occurred towards the outer edge of the mangrove communities, but behind *Rhizophora stylosa* communities. In the lower reaches it was more commonly associated with *Aegialitis annulata*.

Ceriops is known to be intolerant of lengthy freshwater flooding and is usually found on clayey soils which form extensive flats near the upper limits of mangrove shores (Claridge and Burnett 1993). In the Kirke River *Ceriops tagal* was found only near the mouth of the Kirke River. This may be due to freshwater inundation of the lake system and upper reaches of the Kirke River, especially in the wet months. During the wet the lake system links up with other tidal and freshwater wetlands.

Claridge and Burnett (1993) document that *Scyphiphora* occurs at landward edge of mangrove zones and along the banks of tidal waterways. It tends to occur on mud or rock substrates in areas that are flooded only on spring tides. In the Kirke River system *Scyphiphora hydrophylacea* occurred at six sites. At these sites *Scyphiphora hydrophylacea* occurred on the seaward edge of the mangroves and usually formed a dense hedge. The species tended to be established on shallow mud banks.

Hibiscus tiliaceus was common and widely distributed in the Kirke River and usually found at the landward edge of the mangroves. The findings of Claridge and Burnett (1993) confirm that this distribution is quite typical of *Hibiscus* species. They reported that *Hibiscus* species are regularly seen above the high tide mark on sandy beaches. *Hibiscus* also grows below high tide, and is regularly associated with *Avicennia* (Claridge and Burnett 1993).

Generally, the width of the mangrove community was quite thin, usually between five to ten metres. In a small number of sites where shallow mud banks were exposed, dense mangrove communities were apparent. In these areas the mangrove width was

greater than 50 m. The typical mangrove zonation that is apparent on the east-coast of Queensland was only apparent in a limited number of sites within the Kirke River.

Open grassland and bare banks were also common throughout the Kirke River area.

Comparison of the mangrove communities in the Kirke River to other areas

We recorded twelve mangrove species in the Kirke River, compared to thirty-six mangrove species on the eastern side of Cape York Peninsula, twenty on the western side of Cape York Peninsula (Duke 1992) and nine species in south-east Queensland (Duke, 1992).

Smith and Duke (1987) found that the following factors affected mangrove species richness in north-eastern Australia:

- increasing temperatures lead to greater species richness;
- species richness decreases with tidal amplitude;
- estuaries which are long and have large catchments tend to have more species than estuaries which are shorter and have small catchments;
- high inter-annual rainfall variability and frequency of cyclones tends to decrease species richness.

Smith (1992) confirmed that the mangrove communities on the south-western side of the Peninsula were generally not as tall, with lower basal areas but higher stem density than those elsewhere. Results of mapping by Danaher (1995) show that saltpans tend to be more abundant in areas of level terrain.

The Kirke River assessment supports the majority of these findings in that the terrain was relatively level and mangrove species richness was less than is found on the east-coast of Cape York Peninsula.

Existing structures

The only physical structure along the banks of the Kirke River is a jetty and shed built by a local commercial fisherman. The appropriate tenure (i.e. permit to occupy) for the jetty or shed has not been granted. No approvals from government agencies or the local aboriginal community have been considered. In terms of FHA declaration these disturbances are considered minimal.

A large variety of habitats occurred within the Kirke River Area, including extensive areas of shallow saline waters, complex structural habitat along riverbanks and large areas of saltpans and grasslands. There was also a diverse range of vegetation types within the survey area including extensive mangrove communities. The complex and diverse range of habitats, marine plants and riparian vegetation communities associated with the Kirke River are worthy of consideration for further protection as a FHA under Fisheries legislation.

CHAPTER 4. FISH AND CRAB RESOURCES

Sue Helmke

Summary

1. Twenty-two fish species from 14 families were recorded during the research surveys.
2. Fifteen fish species of value to commercial, recreational and indigenous fishers were captured during the research surveys.
3. Barramundi (*Lates calcarifer*) was the most abundant species caught during the research netting at all sites surveyed.
4. The size of barramundi caught ranged from 164 mm to 830 mm total length.
5. Barramundi and threadfin have moved into the Kirke River from either the Weipa region or the Love River.
6. Thirty-six mud crabs (0.9 per pot lift) were caught during the research surveys.
7. Eight per cent of the crabs caught were legal-size males.
8. Between 10 and 25 commercial boats have operated in the Kirke and Love Rivers region each year since 1989.
9. Barramundi made up nearly 50% (by weight) of the total commercial fish and crab catch in the Kirke and Love Rivers region between 1989 and 1999.
10. Barramundi contributed to over 70% of the recreational catch during the survey period, with one fish caught per angler per hour fished.
11. Only anecdotal information on the indigenous fishery is available for the area.

Introduction

Background

The study reported in this document is the first fishery-independent survey of the estuarine fisheries resources in the Kirke River. The objectives of the study were:

1. Determine the estuarine fish species composition in the Kirke River;
2. Determine the population size structure for the species most often caught during the survey; and
3. Collate existing commercial, recreational and indigenous catch and effort data in the region.

Ecology of estuarine fisheries resources

Many economically important fish species targeted by Queensland fishers are found in estuaries at some stage of their lifecycle (Zeller 1998). Species such as male mud crabs (*Scylla serrata*) rely heavily on mangrove throughout their entire lifecycle. Female mud crabs on the other hand migrate to offshore spawning areas when mature (Hill 1994)., species such as mangrove jack (*Lutjanus argentimaculatus*) spend their first 5 years in estuaries before migrating to reefal waters (McPherson, DPI, unpublished data). Catadromous species such as barramundi (*Lates calcarifer*) spawn in coastal waters, and the juveniles migrate to freshwaters and then adults move back into estuarine waters (Russell and Garrett 1983). Mangrove jack (*Lutjanus argentimaculatus*) only spend the first 5 years of their lifecycle in estuaries before migrating to reefal waters (McPherson, unpublished data).

Fish distribute throughout estuaries according to their specific habitat requirements for food and shelter and where appropriate, for reproduction. For example, snappers (family Lutjanidae) aggregate around snags and mangrove prop roots, whilst catfish are found mainly in the mid-channel habitats (Zeller 1998). It is therefore important to maintain a variety of habitats within estuaries so that a wide range of species are supported.

Whilst there are some natural disturbances of estuarine habitats, human disturbances has placed additional pressure on the resources that may be unsustainable and affect fisheries production in these areas (Zeller, 1998). Protection of estuarine habitats is vital for the sustainability of the fisheries they support (Zeller, 1998).

Fisheries resources in the Kirke River

This is the first fishery-independent survey of estuarine fisheries resources in the Kirke River. Therefore, all existing information on the fisheries resources is from the fishing industry.

Commercial fishers spend much of the inshore net fishing season in the region catching species such as barramundi and threadfin (Polynemidae spp) (Kailola *et al.* 1993). Whilst net fishing, fishers also diversify into pot fishing for mud crabs, and can move offshore to fish for mackerel (Scombridae spp.) and shark (Carcharhinidae spp.).

Indigenous fishers also frequent the area, and occasionally there is conflict between commercial fishers and traditional owners about access to the fisheries resources. All stakeholders agree that this issue must be resolved and a satisfactory solution is negotiated between the fishers and traditional owners.

To resolve this conflict between the various fishing sectors, it is important to have information on the catch and effort associated with each fishing sector.

This chapter documents the results of the fishery-independent surveys and collates the available fishery-dependent information for the Kirke and Love Rivers region.

Methods

Fishery-independent surveys

The methods used in this survey are identical to those used by DPI staff in assessing fisheries resources in other coastal streams (Sheppard and Helmke, 1999, Helmke *et al.* in press)

Site selection

Survey sites in the Kirke River were selected with input from the traditional owners and commercial fishers. These fishers have an expert knowledge of the distribution of economically and culturally significant fish species throughout the river system, and also of hazards that might affect the catching performance of sampling gear (e.g. nets and crab pots).

Other factors considered in site selection included the need to sample as many habitat types (such as beach foreshores, creeks, main river system, rock walls, rocky substrata and sandy substrata) as possible throughout the system. Due to cultural constraints, some reaches of the Kirke River, such as the lake system, could not be traversed by the research team, and so the fisheries resources there were not surveyed.

The survey sites selected needed to be workable for both set-netting and crab-potting at various tidal stages. Criteria for selection of these sites included:

- accessibility by boat.
- being free from snags so that nets did not get entangled and that the pots were sitting evenly on the bottom.
- a site located such that researchers did not need to traverse areas closed due to cultural reasons.

Three survey sites were selected in the Kirke River (Figure 4.1). Gill-netting and potting surveys were conducted for one night at each of these sites between 16 August and 19 August 1999.

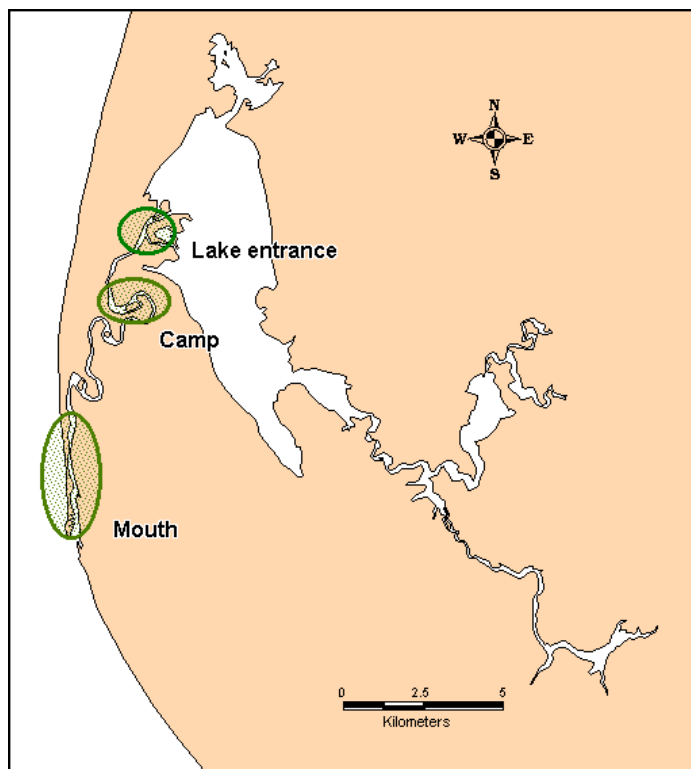


Figure 4.1. Fish and crab survey sites in the Kirke River, August 1999.

Research gill netting

Two 100 mm (one x 33 m and one x 45 m long, 3 m drop), one 50 mm (33 m long, 2.4 m drop) and one 150 mm (45 m long, 4.5 m drop) stretched mesh size monofilament gill nets were set to catch fish at each designated netting site. These net mesh sizes were selected to target a range of fish species and fish sizes.

Each net was set at right angles to the bank up to 1.5 hours before dusk in order to target fish moving with the fall of darkness. Net catches were checked hourly and where possible fished until after the tide changed or the water level became too low to access the nets in that area.

The soak time (period that the net was fishing) varied from 3.45 hours to 6.95 hours among sites and nets depending on the tidal regime and site topography. In some cases shallow sandbars forced the research team to retrieve the nets about three hours following the high tide.

Fish caught were measured using a Limnoterra® electronic fish measuring board that recorded the total fish length or fork length to the nearest mm. The electronic data was downloaded each evening, after the last net was retrieved, and imported into Microsoft Excel using a Limnoterra® parsing program.

The nets were cut to remove fish quickly from the net and ensure they were released with minimal net damage. Net-damaged fish were euthanased, identified to species and measured before they were used as crab bait the following day.

Crab surveys

Ten collapsible Munyana® crab pots were set at each of the three study sites (Figure 4.1). Pots were baited with whole fish and set in the morning and checked approximately every 12 hours, over a 24-hour period. The pots were rebaited at the 12-hour check, if there was no bait left in the pots.

All mud crabs caught were sexed, their carapace width measured to the nearest millimetre and inspected for injury, deformity or obvious parasites before release. Crabs were categorised as juvenile, sub-adult or adult.

Fish movement and growth

Fish tag and recapture information for the Kirke River region was also obtained from the Suntag database, coordinated by InfoFish Services, Rockhampton (Sawynok 1998). The tag and recapture information for species targeted by Suntag between 1987 and 1998 includes the:

- date fished
- fishing location
- species caught
- total fish length (cm)

Analysis

Crab data were entered into Microsoft Access for further analysis, whilst the fish data were exported from Microsoft Excel into Access.

Catch per unit effort (CPUE) was calculated for fish species using the total number of fish caught and the total effort (total soak time for all nets). Crab CPUE was calculated from the total number of crabs caught and the number of pot lifts.

The Shannon diversity index (Zar 1984) was calculated for fish species and fish families caught using the research nets. The index is calculated using

Equation 1 and explains the distribution of fish between species and families.

$$H = \sum p(i) * \ln p(i)$$

Equation 1. Shannon Diversity Index

Fishery-dependent information

Commercial fishing information is available through compulsory logbook information that is stored on the QFS CFISH database. The QFS and Australian National Sports Fishing Association (ANSA) have collected information on commercial and/or recreational catch and effort since the late 1980's in Queensland waters. No fishing catch and effort information was available for indigenous fishers.

Commercial fishery

Summarised historic catch records for the commercial net, crab and line fishery were extracted from the CFISH database for 1 January 1988 to 30 December 1999. The database contains information recorded by commercial fishers into a compulsory logbook. Summaries of total catch (species and weight), effort (boats, days and boat days) and catch per unit effort (CPUE in kg/boat day) data were extracted for the 30' grids bounded by latitude 13.5°S to 14.0°S and longitude 141.0°E and 142.0°E (Figure 4.2). The data provided in this summary therefore refer not only to the Kirke River, but also to the surrounding area from south of Cape Keerweer to just north of the Love River. This area will now be referred to as the Kirke River region.

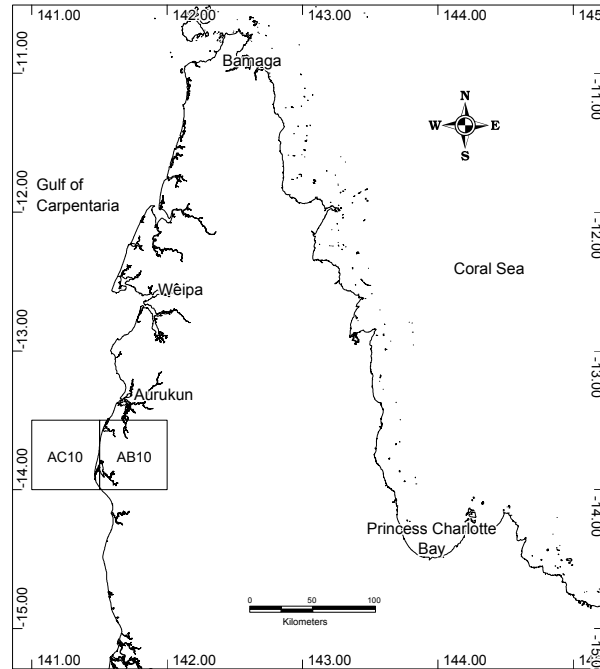


Figure 4.2. Commercial logbook grids in the Kirke River region

The logbook section of the FAU maintains a five-boat minimum data release policy is to keep the confidentiality of the commercial fishers in the region. Therefore, no monthly or annual CPUE information was available for the Kirke River region from CFISH as fewer than 5 vessels fished in this area on some occasions.

Recreational fishery

Recreational fishing information for the Kirke River was obtained from the RFISH database, the ANSA Suntag database (see page 43) and from recreational catch logs completed by fishers on site whilst fishery-independent surveys were being conducted.

Information in RFISH is based on logbooks obtained from recreational fishers that volunteered in a telephone survey (Higgs 1999).

Information available from these logbooks includes:

- date fished
- fishing location
- species caught
- number of fish kept
- number of fish released
- hours spent fishing
- the environment fished (i.e. freshwater, estuary etc)
- fishing gear used (i.e. two rods, four crab pots etc)
- platform fished from (i.e. land, boat etc).

Recreational fishers in the Kirke River during the time of the survey were requested to fill in recreational catch logs that recorded information similar to that being collected by the RFISH program. These data were collated and summarised using Microsoft Excel.

Recreational catch is also reported in the ANSA tagging database. The information recorded is described on page 43.

Results

Fish

Survey species list

During the research netting surveys, 22 fish species from 14 families was captured (Table 4.1) in 66.37 hours. Barramundi (*Lates calcarifer*) was the most abundant species caught at all sites surveyed, making up 38% of the total fish catch. Other commonly caught species were catfish (*Arius* sp.), mullet (*Liza subviridis*) and bony bream (*Nematalosa* sp.).

Table 4.1. Number and catch rates (fish caught per hour fished) of fish species caught in the Kirke River during September 1999 in order of abundance.

Species	Common name	Number	Catch rate (number caught per hour fished)			Value
			Mouth	Camp	Lake entrance	
<i>Lates calcarifer</i>	barramundi	210	2.49	2.30	4.62	SRCAq
<i>Arius</i> sp.	catfish	76	2.43	0.09	1.12	S
<i>Liza subviridis</i>	greenback mullet	55	1.52	1.02	0.04	CS
<i>Nematalosa</i> sp.	bony bream	54	0.25	1.36	0.73	
<i>Arius graeffei</i>	sea catfish	51	1.52	0.17	0.73	S
<i>Polydactylus machorir</i>	king threadfin	23	0.56	0.17	0.35	CRS
<i>Nibea soldada</i>	silver jewfish	21	0.10	0.60	0.22	CRS
Tetraodontidae spp.	pufferfish, toadfish	11	0.25	0.17	0.09	
<i>Arius macrocephalus</i>	sea catfish	10	0.10	0.30	0.04	S
<i>Scomberoides commersonianus</i>	queenfish	8	0.25	0.09	0.04	CRS
<i>Elops australis</i>	giant herring	7		0.17	0.13	
<i>Arius</i> sp2	catfish	5			0.22	S
<i>Eleutheronema tetradactylum</i>	blue threadfin	3	0.10		0.04	CRS
<i>Leptobrama muelleri</i>	beach salmon	3	0.15			R
<i>Selenotoca multifasciata</i>	scat	3	0.05	0.04	0.04	A
<i>Thryssa hamiltoni</i>	Hamilton's anchovy	3		0.13		
<i>Arius thalassinus</i>	giant salmon catfish	2		0.09		
<i>Pomadasyd kaakan</i>	banded grunter	2	0.10			CRS
<i>Scatophagus argus</i>	spotted scat	2		0.04	0.04	A
<i>Plotosidae</i> sp.	eel-tailed catfish	1			0.04	
<i>Rhinomugil nasutus</i>	popeye mullet	1	0.05			

Note: The value of each species was obtained from Froese (1995) and Coles *et al.* (1992). C=commercial value, R=recreational value, S=subsistence value, A=aquarium value, Aq=aquaculture value.

As Table 4.1 shows, fifteen fish species of value to the commercial, recreational and indigenous fishers were captured during the research surveys.

Catch rates were highest at the Kirke River mouth, with nearly 10 fish caught per hour fished (Table 4.2). The dominant species, in terms of catch number, at this site were barramundi, catfish and mullet (Table 4.1). Although the catch rate of fish surveyed at the upstream Lake Entrance site was nearly as high, the species diversity was lower than at the mouth (Table 4.2). This can be attributed to the large number of barramundi and very few other species that were caught at this site.

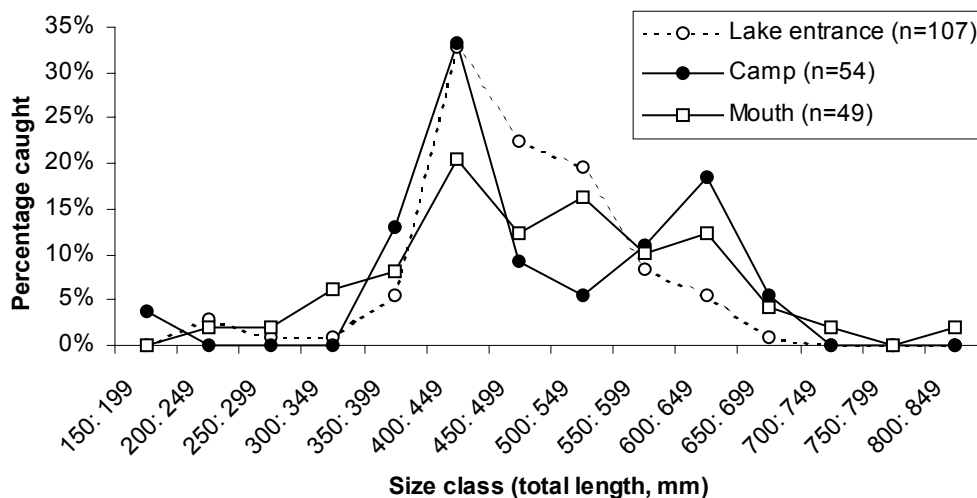
Table 4.2. Number of species and catch rate (number caught per hour fished) of fish caught in the Kirke River.

Site	Family diversity	Species diversity	Number of Species	Total number of fish	CPUE (number caught per hour)
Lake Entrance	1.36	1.66	17	198	8.55
Camp	1.88	2.03	16	159	6.77
Mouth	1.65	2.01	15	196	9.94

Barramundi

Barramundi made up 52% of the research catch of fish and was the most caught species at all three netting sites (Table 4.1). The catch rate of barramundi was almost twice as high at the Lake entrance site than at the Camp or the Mouth (Table 4.1).

The size of barramundi caught ranged from 164 mm to 830 mm with the majority (30%) of fish being between 400mm and 449 mm total length (Figure 4.3). Fish much larger than 840 mm were unlikely to be caught during our surveys as the largest net we used was only 150 mm stretch mesh and targets fish between 520 mm and 840 mm (Hall *et al.* 1998).

**Figure 4.3.** Size frequency (mm) of barramundi caught at the three fish survey sites in the Kirke River.

Movement and growth

Movement data on five fish recaptured in the Kirke River was obtained from the Suntag database. These individuals moved into the Kirke River from either the Weipa region or the Love River (Table 4.3). Two king threadfin had moved from the Weipa region (approximately 170km north) and three barramundi had moved from the Love River (exact distance unknown as it joins with the Kirke River during the wet season).

A total of 38 fish have been reported as tagged and released by one recreational fisher in the Kirke River. All of these fish were barramundi and none have reportedly been recaptured.

Table 4.3. Tag and recapture data for fish recaptured in the Kirke River between 1987 and 1998. Source: Queensland AUSTAG information.

Species		King threadfin		Barramundi		
Date	Tagged	17-Sep-89	01-Mar-90	25-Sep-94	20-Sep-93	26-Sep-94
	Recaptured	20-Aug-90	19-Apr-90	22-Feb-96	10-Mar-94	25-Oct-94
Period at liberty		337	49	515	171	29
Length (mm)	Tagged	590	700	540	600	730
	Recaptured	660	690	680	660	740
Growth (mm)		70	-10	140	60	10
Growth rate (mm per day)		0.21	-0.20	0.27	0.35	0.34
Tag Location		Hey River, Weipa	Mission River, Weipa	Love River	Love River	Love River
Movement		170 km South	170 km South			

Crabs

Mud crabs (*Scylla serrata*) were caught in the crab pots at all three sites during the survey (Figure 4.4). The total catch rate for all sites was 36 crabs or 0.9 crabs per pot lift. Most crabs (n = 23; 64%) were caught at Lake entrance, whilst relatively few were caught at the downstream sites.

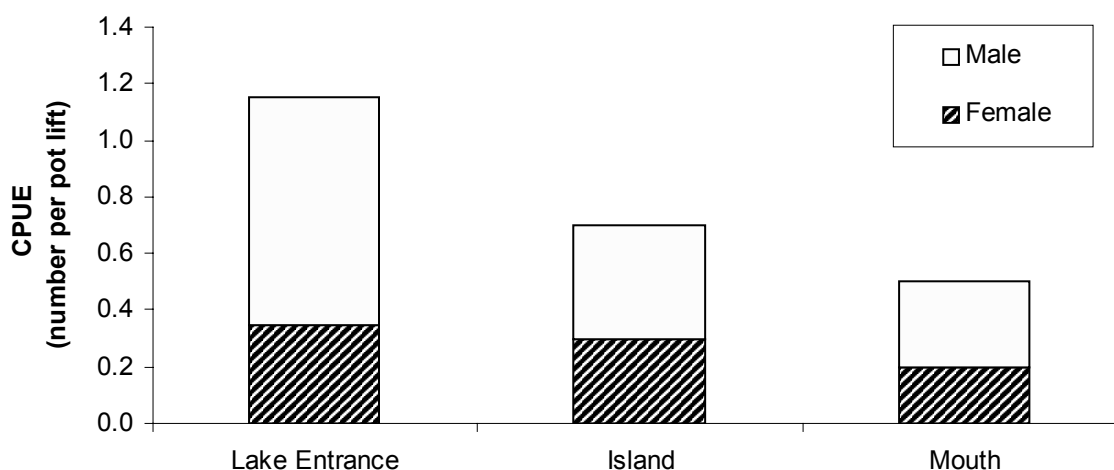


Figure 4.4. Catch rate (number of crabs per pot lift) of male and female crabs during August 1999 in research crabbing operations.

Only three (8% or 0.08 crabs per pot lift) of the 36 crabs caught were males of legal size (Figure 4.5). Males were the dominant sex captured in the 120 mm to 150 mm size range and females dominated the smaller and larger sizes. The size frequency distribution of mud crabs reported in this study may not be a true reflection of the local population as crab pots primarily target male crabs above 140 mm and female crabs above 150 mm (Williams and Hill 1982). The large numbers of crabs less than 140 mm carapace width in our catches may therefore reflect high recruitment into the area or a relatively low abundance of larger crabs compared to recruits. The around the Kirke River area is not acknowledged as prime crabbing habitat with commercial

catches ranging from 1.2 kg/pot (approximately 1.2 crabs per pot lift) in 1991 to 0.4 kg/pot (approximately 0.4 crabs per pot lift) in 1994 (Magro *et al.* 1996).

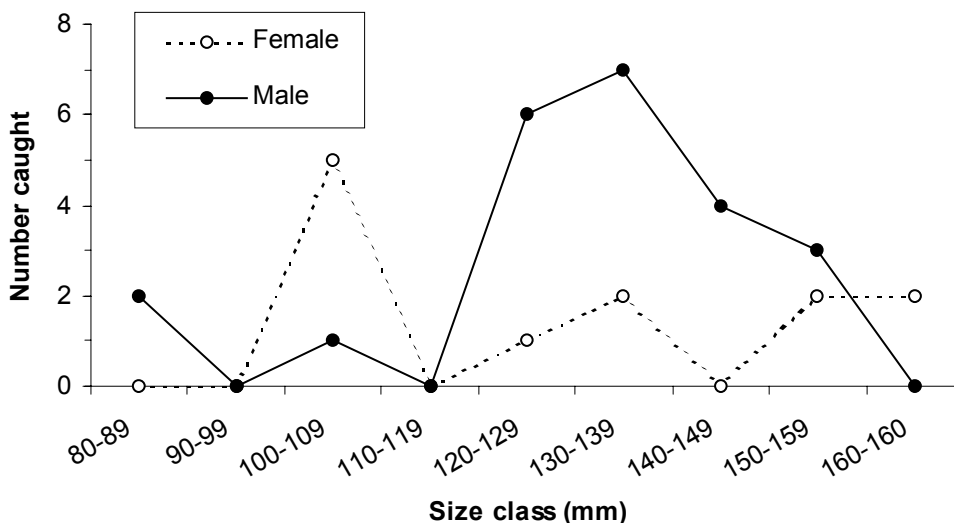


Figure 4.5. Size frequency of male, female and all crabs caught at all three fish survey sites.

Fishery-dependent catch

Commercial fishery

According to CFISH data records, between 10 and 25 boats have operated in the Kirke River region each year since 1989, fishing an average of 1 867 boat days per year.

The number of boats working inshore (Grid AB10) ranged from 6 to 12 boats per year and offshore (AC10) from 5 to 19 boats per year (Figure 4.6).

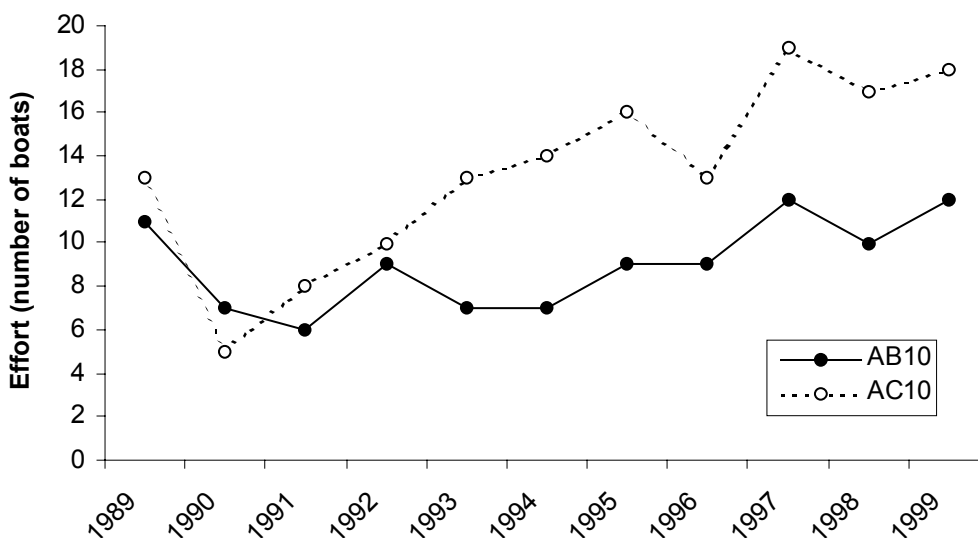


Figure 4.6. Fishing effort expressed as total number of boats working inshore (AB10) and offshore (AC10) in the Kirke River region. Source: CFISH database, 17 July 2000.

The total CPUE (kg/boat day) from the trawl, line, net and crab fishery followed a trend similar to that of the number of days fished (Figure 4.7). The highest CPUE were reported in 1995 and the lowest in 1989.

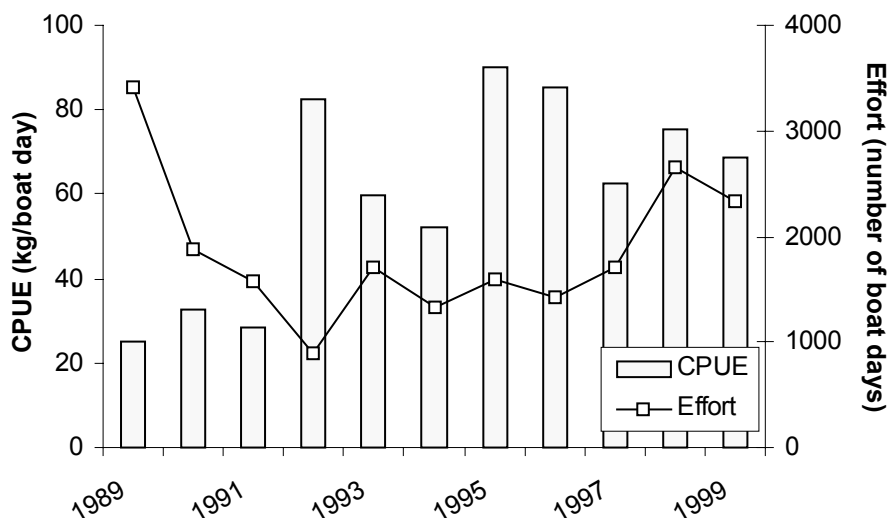


Figure 4.7. Total CPUE (kg/boat day) and fishing effort (number of boat days) fished in Kirke and Love Rivers region (Grid AB10 and AC10) between 1989 and 1999. Source: CFISH database, 17 July 2000.

As there is little trawling and line fishing in the inshore grid (AB10) (Peverell, S.C. QFS observer, Pers. Comm. July 2000), it can be assumed that most of the CPUE and effort in this grid is from the set net and crab fishery (Figure 4.8). Catch rates in this grid were highest in 1992 and the lowest in 1991.

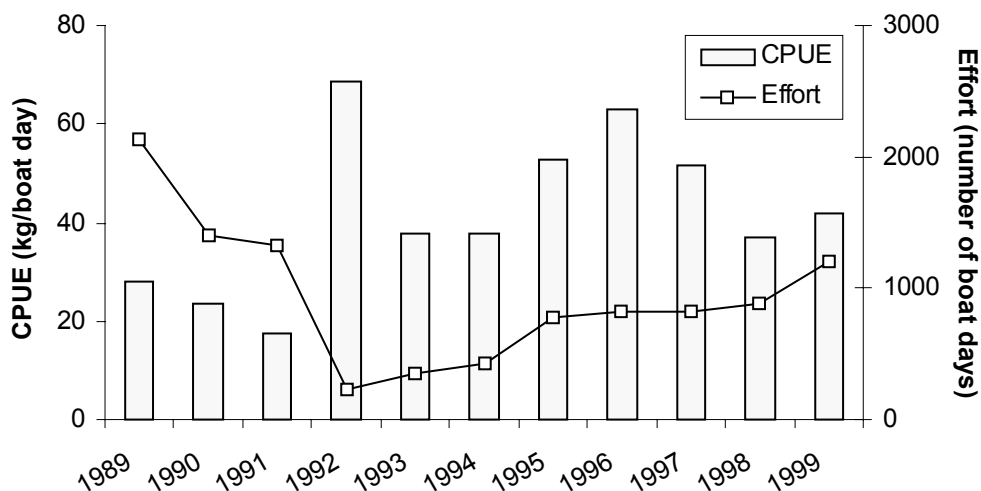


Figure 4.8. Total CPUE (kg/boat day) and fishing effort (number of boat days) in inshore Kirke and Love Rivers region (Grid AB10) between 1989 and 1998. Source: CFISH database, 17 July 2000.

Barramundi contributed nearly 50% (by weight) of the total fish and crab catch in the Kirke River region between 1989 and 1999 (Table 4.5). In Grid AB10, which is

mainly a set net and crab fishery of inshore waters, barramundi comprised over 75% of the total catch.

Table 4.4. Total fish and crab catch (kg), ranked by total weight, and percentage of total catch of fish and crabs caught in the trawl, line, net and crab fishery in the grid AB10 and AC10 between 1 January 1988 and 30 December 1999. Source: CFISH database, 17 July 2000.

Common Name	Species name	AB10		AC10		Total	
		kg	%	kg	%	kg	%
Barramundi	<i>Lates calcarifer</i>	306 653	76.61	300 530	36.92	607 182	49.92
Grey mackerel	<i>Scomberomorus semifasciatus</i>	1 940	0.48	256 980	31.57	258 920	21.29
Shark	Carcharhinidae spp.	7 061	1.76	122 572	15.06	129 633	10.66
King threadfin	<i>Polydactylus machorir</i>	43 806	10.94	60 053	7.38	103 858	8.54
Spanish mackerel	<i>Scomberomorus commerson</i>			29 812	3.66	30 162	2.48
Mixed fish		12 422	3.10	8 379	1.03	20 801	1.71
Blue threadfin	<i>Eleutheromeme tetradactylum</i>	7 470	1.87	12 162	1.49	19 632	1.61
Mud crab	<i>Scylla serrat, S. olivacea</i>	7 663	1.91	3 217	0.40	10 880	0.89
Jewel fish	<i>Nibea squamosa</i>	2 191	0.55	5 785	0.71	7 976	0.66
Grunter	<i>Pomadasys spp.</i>	4 468	1.12	1 915	0.24	6 384	0.52
Queenfish	<i>Scomberoides spp.</i>	1 130	0.28	3 533	0.43	4 663	0.38
Mixed reef fish		1 370	0.34	2 436	0.30	3 806	0.31
Mackerel	<i>Scomberomorus spp.</i>	2 225	0.56	637	0.08	2 862	0.24
Pomfret	<i>Stromatoeides sinensis</i>			1 964	0.24	2 012	0.17
Jew Fish (Mulloway)	<i>Argyrosomus holoepidotus</i>			1 591	0.20	1 921	0.16
Black Jew Fish	<i>Protonibea diacanthus</i>	940	0.23	613	0.08	1 553	0.13
Dart	<i>Trachinotus spp.</i>			1 378	0.17	1 408	0.12
Unspecified others		760	0.19			1 160	0.10
Tripletail	<i>Lobotes surinamensis</i>	170	0.04	506	0.06	676	0.06
Mullet	Mugilidae spp.					384	0.03
Banjo ray						296	0.02
Jew Fish	Scianidae spp.					155	0.01

Note: No weight information is available where less than 5 fishers caught a particular species.

Species for which no weight data is available, but were reported in the catch were Black bream, (*Acanthopagarus berda*), Black kingfish (*Rachycentron canauds*), Black trevally (Carangidae spp.), Bream (*Lutjanus russelli*), Bream (Sparidae spp.), Cod (Serranidae spp.), Coral trout (*Plectropomus spp.* and *Variola spp.*), Emperor (*Lethrinus spp./Lethrinidae*), Endeavour prawn (*Metapenaeus endeavouri, M. ensis*), Fantail mullet (*Valamugil georgii*), Fish wings, King prawn (*Penaeus longistylus, P. latisulcatus*), Long tail tuna (*Thunnus tonggol*), Lutjanid (Lutjanidae spp.), Mangrove jack (*Lutjanus argentimaculatus*), Moreton bay bugs (*Thenus spp.*), Samson fish (*Seriola hippos*), Sawfish (Pristidae spp.), Silver jew fish (*Nibea soldado*), Stingray (Dasyatidae spp.), Tiger prawn (*Penaeus esculentus, P. semisulcatus*), Trevally (*Caranx spp.*), Tuna (Scombridae spp.). The total landed weight for these species could not be determined as less than five fishers caught each of these particular species.

Commercial charter fishery

The absence of data in the charter fishery database suggests that no charter fishers operate in the Kirke river region.

Recreational fishery

Recreational fishing information for the Kirke River was limited. Reports from fisheries observers that frequent the area state that there is limited recreational fishing in the area (S. Peverell, QFS observer, Pers. Comm.). There were no reports of recreational fishing in the Kirke River in the RFISH database.

Only one fisher reported tagging in the Suntag database. He tagged and released 3 barramundi in 1994, 28 in 1996 and 5 in 1997. These barramundi ranged from 440 mm to 1 250 mm total length.

Additional information from the recreational fishery was collected on site we were conducting the fishery-independent surveys in the Kirke River. Anglers spent 16.5 hours fishing in the Kirke River between the 16 August 1999 and 18 August 1999. Fishers caught 21 fish from four fish species using rods with lures during this period (Table 4.5). Barramundi comprised over 70% of the catch, with nearly one fish caught per angler per hour fished (Table 4.5).

Table 4.5. Recreational catch and effort (number of fish caught per angler per hour) during the August 1999 fishery-independent surveys in the Kirke River.

Common name	Species name	Catch	CPUE
Barramundi	<i>Lates calcarifer</i>	15	0.92
Beach salmon	<i>Leptobrama muelleri</i>	1	0.06
Catfish	<i>Arius</i> spp.	3	0.18
Mangrove jack	<i>Lutjanus argentimaculatus</i>	2	0.12

Indigenous fishery

Only anecdotal information is available for the indigenous fishery in the area. Based on discussions with traditional owners who accompanied us during the surveys the area is of great importance and provides a food source when they are resident in the area.

Discussion

The Kirke River region appears to be a productive fisheries area, particularly for barramundi. Barramundi is a highly sought after recreational and commercial target species and, based on available information is the species most often taken in these fisheries. The Kirke River region also harbours species such as catfish, queenfish, threadfin and jewfish, which are of value to the commercial, recreational and the indigenous fishery.

The barramundi catch rates (3.16 fish per hour fished) reported during this survey are high compared to catches of 0.1 - 0.15 fish per hour fished in Trinity Inlet near Cairns (Helmke *et al.* in press), 0.33 per hour fished in the Bohle River near Townsville (Lunow in preparation) and 0.18 per hour fished in the Norman River, Gulf of Carpentaria (Helmke *et al.* in preparation) for the same season.

Data from the fishery-independent netting exercise suggest that the lake on the Kirke River may function as a nursery area for fish species such as barramundi. Most of the smaller barramundi caught during the survey were recorded at this site. The Lake

entrance site also had the highest barramundi catch rate of sites surveyed in the Kirke River system.

The commercial fishery in the Kirke River is based mainly on barramundi. Recreational fishing in the region is limited, with no reports of charter fishers operating the region, no information from recreational fishers in the RFISH database and limited information in the AUSTAG database. Whilst there is limited documented information on indigenous fishing in the region, the Kirke River is recognised as an important area for traditional owners and as such the fisheries resources provide a food source when they are visiting the area.

The results of this study contribute to, and extend the available fishery-dependent and fishery-independent database on the fisheries resources of the Kirke region. The review given provides a baseline against which future assessments of the status of the fisheries resources of the area can be compared. It also provides information from which the stakeholders and resource managers can assess the suitability of declaring the Kirke River region a Fish Habitat Area.

CHAPTER 5. CONCLUSIONS

Application of the data to FHA planning

Fish Habitat Areas are part of the on-going management of fisheries resources within Queensland and declared with the specific intent to ensure continuation of productive recreational, indigenous and commercial fisheries in a region.

The declaration generally follows the following process:

1. Nomination of an area as a candidate for declaration as a Fish Habitat Area.
2. Review of nomination and assessment of its priority for further investigation
3. Site investigation/field habitat surveys, literature searches and reviews, assessment of fish catch records and preliminary discussions with user groups (e.g. commercial fishers, recreational fishers, indigenous groups, local authority, other community groups) to determine if the nominated area meets Fish Habitat Area declaration criteria.
4. Preparation of an Area of Interest Plan and draft of known management issues.
5. Initial consultation with interested parties and relevant agencies.
6. Revision of information gathered during the initial consultation phase, preparation of a draft Fish Habitat Area Plan and a draft management strategy with recommendation of an appropriate management level (either 'A' or 'B', and use of a location-specific management plan).
7. Second round of consultation with interested parties and relevant agencies.
8. Revision of information gathered during the second round of consultation.
9. Preparation of a Declaration Plan of Fish Habitat Area Boundaries and a submission of proposal for declaration
10. Provision of Plan and submission to the Department of Primary Industries legal section.
11. Provision of Plan and submission to the Minister for Primary Industries.
12. Provision of Plan and submission to the Governor in Council for declaration under *Fisheries Regulation*.

The suitability of various coastal wetlands for nomination as candidate areas for FHA declaration is assessed on the following criteria:

- Size (greater areas being seen as more viable in the long - term);
- Diversity of, or specific habitat features;
- Diversity of, or specific marine fauna or flora;
- Existing or potential fishing grounds;
- Level of existing and likely future disturbances
- Unique features;
- Protected species.

Based on the data that has been collected as part of this survey, the Kirke River area meets all seven Fish Habitat Area criteria. The area supports a diversity of pristine environments and habitats that have high value as fisheries habitat and is highly productive.

Potential closures/fish sanctuary

The QFMA released an Issues Paper in 1999 seeking public comment on fisheries matters in the Gulf of Carpentaria, in addition to those included in the Management

Plan for the Gulf of Carpentaria Inshore Finfish Fishery. The Issues Paper, developed by the MAC, dealt with questions that had not been through the consultative process. The Issues Paper covered four points including a proposal to close the Kirke River and lake system to all non-indigenous fishing. The proposed closure would take effect when commercial fishing licenses are reduced to 65. The proposal would also contribute to the National System of Marine Protected areas (QFMA, Issues Paper September 1999).

Responses are currently being considered by the QFMA and recommendations will be made in the near future.

It should be noted that nothing in the FHA process conflicts with the proposed fisheries management initiatives such as the Kirke River closure.

FHA declaration in the Kirke River area

Knowledge of the fisheries resources and environment of the Kirke River is critical for sustainable fisheries management. The information collected as part of the fisheries resource assessment will be integrated with information on land tenure, management issues and traditional uses. This knowledge base, along with community consultation and support, will be required to determine suitable boundaries for the area of interest plan for a FHA. Investigations for FHA declaration have commenced.

Recommendations

The Kirke River Area meets all seven Fish Habitat Area criteria, supports a diversity of pristine environments that have high value as fisheries habitat and is highly productive. The coastal wetland communities within this river are near pristine and their associated catchments are virtually untouched by human development.

It is therefore recommended that:

- The fisheries habitats from the mouth of the Kirke River to the eastern side of the lake and all adjoining wetland areas are considered for inclusion in a FHA. Protection of this area is recommended due to its pristine status.
- The Love River and the associated coastal wetlands between the Love River and Archer River are important for indigenous, commercial and recreational fishing. On this basis further investigation for FHA nomination/declaration may be warranted.

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