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CYPLUS
CAPE YORK PENINSULA
LAND USE STRATEGY

NATURAL RESOURCES ANALYSIS PROGRAM
(NRAP)

# FRESHWATER FISH AND AQUATIC HABITAT SURVEY OF CAPE YORK PENINSULA

B.W. Herbert, J.A. Peeters, P.A. Graham and A.E. Hogan
Freshwater Fisheries and Aquaculture Centre
Queensland Department of Primary Industries
1995

CYPLUS is a joint initiative of the Queensland and Commonwealth Governments

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QUEENSLAND
DEPARTMENT OF
PRIMARY INDUSTRIES
NORTH REGION

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**(CYPLUS)**

**Natural Resources Analysis Program**

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Final report on project:

**NR10 - FISH FAUNA SURVEY**

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Note:

Due to the timing of publication, reports on other CYPLUS projects may not be fully cited in the REFERENCES section. However, they should be able to be located by author, agency or subject.

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## CAPE YORK PENINSULA LAND USE STRATEGY
## STAGE I

## PREFACE TO PROJECT REPORTS

Cape York Peninsula Land Use Strategy (CYPLUS) is an initiative to provide a basis for public participation in planning for the ecologically sustainable development of Cape York Peninsula. It is jointly funded by the Queensland and Commonwealth Governments and is being carried out in three stages:

- Stage I - information gathering;
- Stage II - development of principles, policies and processes; and
- Stage III - implementation and review.

The project dealt with in this report is a part of Stage I of CYPLUS. The main components of Stage I of CYPLUS consist of two data collection programs, the development of a Geographic Information System (GIS) and the establishment of processes for public participation.

The data collection and collation work was conducted within two broad programs, the Natural Resources Analysis Program (NRAP) and the Land Use Program (LUP). The project reported on here forms part of one of these programs.

The objectives of NRAP were to collect and interpret base data on the natural resources of Cape York Peninsula to provide input to:

- evaluation of the potential of those resources for a range of activities related to the use and management of land in line with economic, environmental and social values; and
- formulation of the land use policies, principles and processes of CYPLUS.

Projects examining both physical and biological resources were included in NRAP together with Geographic Information System (GIS) projects. NRAP projects are listed in the following Table.

| Physical Resource/GIS Projects | Biological Resource Projects |
|---|---|
| Bedrock geological data - digitising and integration (NR05) | Vegetation mapping (NR01) |
| Airborne geophysical survey (NR15) | Marine plant (seagrass/mangrove) distribution (NR06) |
| Coastal environment geoscience survey (NR14) | Insect fauna survey (NR17) |
| Mineral resource inventory (NR04) | Fish fauna survey (NR10) |
| Water resource investigation (groundwater) (NR16) | Terrestrial vertebrate fauna survey (NR03) |
| Regolith terrain mapping (NR12) | Wetland fauna survey (NR09) |

| Physical Resource/GIS Projects | Biological Resource Projects |
|---|---|
| Land resource inventory (NR02) | Flora data and modelling (NR18) |
| Environmental region analysis (NR11) | Fauna distribution modelling (NR19) |
| CYPLUS data into NRIC database FINDAR (NR20) | Golden-shouldered parrot conservation management (NR21) |
| Queensland GIS development and maintenance (NR08)* | |
| GIS creation/maintenance (NR07)* | |

* These projects are accumulating and storing all Stage I data that is submitted in GIS compatible formats.

Research priorities for the LUP were set through the public participation process with the objectives of:

- collecting information on a wide range of social, cultural, economic and environmental issues relevant to Cape York Peninsula; and
- highlighting interactions between people, land (resource use) and nature sectors.

Projects were undertaken within these sector areas and are listed in the following Table.

| People Projects | Land Projects | Nature Projects |
|---|---|---|
| Population | Current land use | Surface water resources |
| Transport services and infrastructure | Land tenure | Fire |
| Values, needs and aspirations | Indigenous management of land and sea | Feral and pest animals |
| Services and infrastructure | Pastoral industry | Weeds |
| Economic assessment | Primary industries (non-pastoral, non-forestry) | Land degradation and soil erosion |
| Secondary and tertiary industries | Forest resources | Conservation and natural heritage assessment |
| Traditional activities | Commercial and non commercial fisheries | Conservation and National Park management |
| Current administrative structures | Mineral resource potential and mining industry | |
| | Tourism industry | |

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# 1.0 INTRODUCTION

**Summary**

1. There is a poor knowledge of tropical freshwater ecology in Australia, and particularly of the Cape York Peninsula region.
2. The CYPLUS study area extends from north of approximately 16° S, along the southern boundary of Cook Shire, north to Badu and Moa Islands in the Torres Strait.
3. West coast rivers are generally intermittent, have large catchment areas, and flow regimes are regulated by the monsoonal climate. East coast streams are generally perennial and have short courses.
4. There were four general habitat types covered in this study: savannah flood plains, wet tropics, dune fields, and perennial flood plain rivers.
5. Recreational fishing is popular and widespread. Almost all residents fish periodically, and many tourists fish the rivers and estuaries. Commercial fishermen periodically fish most estuaries, but rarely fish fresh water, although some does occur in Lakefield and the Archer River.
6. Previous surveys have covered the Jardine River, Weipa area, Lakefield, wet tropics area, Cape Flattery, and the Embley estuary.
7. The aims of this study were to document species distribution, habitat preferences, establish a database and GIS, and identify areas of particular biological significance.

## 1.1 Background

Cape York Peninsula has seen little of the intensive development and alteration which many other areas of Australia have been subject to. Biologically it is one of the richest and least disturbed large wilderness areas remaining in the country (Stanton, 1976). Activity has largely been restricted to transient tin and gold mining. Pastoral development has been slow due to the extremely low potential stocking rates of many areas (Holmes, 1990). Impacts have been limited due to the isolation from major population centres and, until recently, the difficulty of access. With current trend for off-road and wilderness recreation the area faces increasing tourist pressures each year. Fishing is a prime recreational activity of visitors and residents. It was with the increased development pressures upon a wilderness area that the need for the Cape York Peninsula Land Use Strategy (CYPLUS) was realised.

There is a severe lack of knowledge of Australian fish and limnology in general due to the low level of funding for this type of research (Williams, 1983). This is even more so for the flood-drought rivers of monsoonal Australia, due to the cost and problems of access. A notable exception is the Alligator Rivers region, due to uranium mining in the area. Australia is said to have a depauperate fish fauna (Allen, 1989). However, north

Queensland has the greatest number of freshwater fish species in Australia, even higher (in terms of number of species and basin catchment area) than overseas tropical flood plain rivers (see Bishop and Forbes, 1991). Australia has about 130 endemic freshwater species (Allen, 1989), of which about 60% are in the Cape York Peninsula region. Additionally, there are many marine species which can spend a significant proportion of their life in freshwater. The biology of many tropical species of fish is so poorly known that it is possible that some species usually regarded as marine vagrants may actually spend the majority of their life, and even breed successfully, in freshwater.

### 1.2 CYPLUS Study Area

The CYPLUS study area encompasses all of mainland Cape York Peninsula north of the southern boundary of the Cook Shire, and the Torres Strait islands immediately north to Badu Island inclusive. That is, in a line approximately from Bloomfield on the east coast, encompassing the Palmer River catchment and running along the Mitchell and the Nassau Rivers to the west. This is largely north of 16°S.

### 1.3 Watercourses

In an area the size of Cape York Peninsula it is difficult to generalise about conditions. There are a number of large catchment basins within the area, encompassing extensive flood plains and often linking with other rivers during the flood peaks. The south western area is dominated by large intermittent rivers with extensive flood plains. These rivers drain the comparatively flat savannah country. The Mitchell River is the largest of these, and in terms of average annual discharge is the second largest river in Australia. It has an average discharge of over 90% of that of the Murray Darling system, the largest river in Australia with a vast drainage area ( 265 000 km$^2$). Most of the Mitchell's runoff occurs during the wet season. To the north lies the Wenlock, a perennial stream downstream from its junction with Dry Creek. Near Cape York, the Jardine is Queensland's largest perennial stream in terms of base flow in the dry season.

The east coast rivers are generally much shorter and have more restricted catchment areas than the western flowing ones. The proximity of the Great Dividing Range to the coast limits catchment areas but is in part responsible for the larger number of perennial streams. The exception is the Princess Charlotte Bay area, where the divide is further inland. The Normanby River complex, Stewart River and the rivers on the Starcke coast are all intermittent. From Cape Flattery south are perennial clear water rivers. Rainfall here is higher due in part to orographic (mountain caused rainfall) effects.

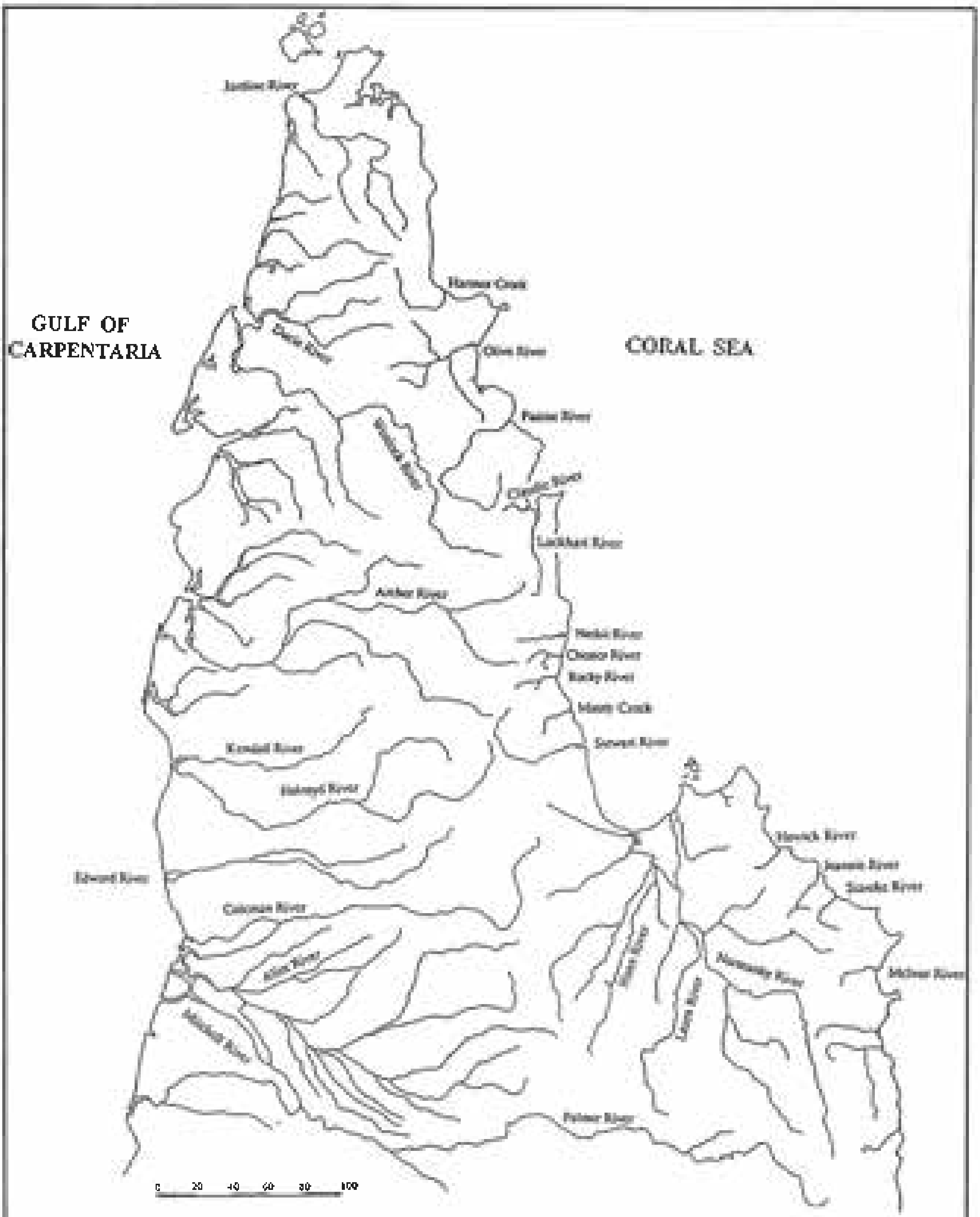


Figure 1. Cape York Peninsula indicating major rivers and creeks

All these rivers are subject to the monsoonal weather pattern, with a wet season when rivers may flood extensive areas. These flood peaks are generally short lived (usually less than a month). Nearly all the annual rainfall occurs in November to March, with showers through to July. This weather pattern provides an unstable environment, particularly in intermittent river systems, where vast changes may occur to flow regimes and water quality within hours.

## 1.4 Habitat Types

Due partly to the climatic regime and geography, the Peninsula region has a wide diversity of habitat types.

### *1.4.1 Savannah flood plains*

The savannah flood plain rivers are intermittent streams, often with many channels and anabranches. The surrounding extensive flood plains usually have ox-bow lakes and waterholes, lagoons or melon holes (depressions filled with runoff or flood water). These rivers drain extensive flood plain areas. Flow periods are brief, as the geology (clayey or metamorphic substrates) and topography (flat country) do not permit extensive infiltration of water. What does penetrate feeds deeper artesian basins and does not contribute much to river flows. The head waters or tributaries of some rivers rise in sandy country (eg. Pretender Creek on the Holroyd) and hence do flow year round. Once the main river bed is reached this flow becomes sub-sand. The rivers provide a wide diversity of habitats while flowing, with riffles, pools, rocky areas and large, shallow sandy areas of gentle flow. When the flow stops, pools in deeper sections remain. There may be limited sub surface flow during the dry season. Some of these pools are permanent water bodies during the dry season, and thus are important refuges for those riverine species which do not live in lagoons. These pools may be extensive, particularly in the lower reaches of large rivers, and may extend for several kilometres. They appear to be particularly important for very large fish such as saw fish, stingrays and sharks. These riverine habitats are characterised by the absence of aquatic vegetation, sand substrate, and have undercut banks and usually considerable amounts of tree debris and leaf litter. The flood plain water holes (and to a lesser extent ox-bow lakes) usually have abundant littoral and submerged aquatic vegetation, few snags, and have muddy or clay substrates. They are generally fairly shallow (2-3 m deep), although some may be up to 7 m deep. Depending on depth, rainfall and weather, a proportion of these lagoons may dry out or become so shallow that all fish in them perish from heat stress.

### *1.4.2 Wet tropics*

Wet tropics area (Bloomfield to Hope Vale) and Iron Range rivers are predominantly clean, perennial streams. Rivers in the north are fed from fractured rock areas in the mountains, and local rainfall contributes substantially to base flow. The southern rivers are fed from sandstone areas and rainfall. The McIvor River stopped flowing in 1991, as the result of the drought, but usually flows throughout the year. The rainforest surrounding many rivers in this area assists in maintenance of perennial flow. The flood plains of these rivers are restricted to coastal areas and there are few lagoons. Flooding in these streams is normally swift, with a rapid fall to base flow once rains cease. The substrate in natural areas is rock or gravel. In areas cleared for agriculture, pools and lower reaches have a mud substrate. Extensive rocky areas and deep pools are present in the lower reaches. Aquatic vegetation in the rivers consists of marginal *Aponogeton*, which may be quite dense, and sparse hornwort (*Chara)* growth on sandy areas of slow flow. The few lagoons are dominated by water lilies (*Nymphaea* spp) and water snowflake (*Nymphoides* spp), with sub surface vegetation largely comprised of waternymph (*Najas tenuifolia*)and hornwort.

### *1.4.3 Dune fields*

Sand-dune heath country provides habitats in the form of perched lakes and small, shallow streams. Sand is the predominant substrate. Most streams have little vegetation, although some hornwort and eelgrass (*Blyxa*) may be present on the margins. Additional cover is at the margins in the form of roots, undercuts and fallen timber. Perched lakes in the sand dune country may be extensive and deep. Dune fields with abundant lakes extend from Hope Vale to Cape Flattery, and Temple Bay to Cape York. Lakes and streams in these areas are usually stained brown due to the presence of humic materials (tannins) and the waters are usually slightly acidic, with little or no alkalinity. Most creeks and lakes in these areas are perennial.

### *1.4.4 Perennial flood plain rivers*

Perennial rivers towards the north of Cape York Peninsula are similar to the intermittent streams in most aspects. Feeder streams from sandstone country keep them flowing year round. Lagoons are present in the flood plain in upper reaches, and swamps and lagoons present in the downstream sections. Permanent flow in the main channel ensures that riffle and gentle flow areas over sand substrates exist year round. Long, shallow pools, and deeper pools at bends, predominate. Substantial quantities of instream cover in the form of timber may be present. The Jardine River is an exception in that extensive beds of aquatic vegetation are present along the margins, whereas in other streams aquatic vegetation is limited or absent.

## 1.5 Recreational and Commercial Fisheries

### *1.5.1 Recreational fisheries*

Recreational fishing both by locals and tourists is widespread. Virtually all landholders met during the course of this study fished rivers and waterholes regularly, mainly to provide a welcome dietary change from beef. Neighbours on properties without permanent surface water often visited those nearby with permanent water for fishing. Target species were anything large enough to eat (usually barramundi, saratoga, black bream, jewfish, fork tailed catfish and sleepy cod were favoured, but anything would be eaten). Quantities taken were generally enough for immediate consumption.

Indigenous fishing is usually by handline or spear in freshwater. Target species are the same as above, although jewfish/eeltailed catfish (*Neosilurus ater* and *Anodontiglanis dahli*) in particular are caught in some areas. Effort may be quite intensive, with large numbers of people fishing on almost a daily basis at various times. Again, generally only enough for personal consumption is caught.

Redclaw crayfish (*Cherax quadricarinatus)* and giant freshwater prawn (*Macrobrachium rosenbergii*) (where present) are caught in various ingenious designs of wire traps, although bait nets (seines) and spears are used in some areas where topography and crocodiles permit. Freshwater mussels (*Velesunio* sp.) and turtles are also eaten, usually by aboriginals.

Tourists in ever increasing numbers are visiting the area, and fishing is a prime objective. In early February up to 70% of vehicles observed on the Byerstown range have boats. The majority of these head for Lakefield National Park and Port Stewart, primarily fishing estuarine areas. Annually, 4 000 campers visit Lakefield National Park, and about three quarters of these come primarily to fish (Russell and Hales, 1993). Although access to many rivers is restricted, some cattle stations are now regulating access to freshwater fishing locations where it is practical to do so. Target species for tourists are barramundi (*Lates calcarifer*), saratoga (*Scleropages jardinii*), and black bream/sooty grunter (*Hephaestus fuliginosus*). Generally tourists fishing freshwater only take enough fish for immediate consumption, although cases of tourists equipped with freezers and nets have been mentioned by landholders. Certainly those chasing estuarine fish are generally well equipped to handle large amounts of fish, with generators and freezers.

### *1.5.2 Commercial fisheries*

The main commercial fisheries around Cape York Peninsula are estuary or open water based. Commercial gill net fishermen fish the tidal reaches of most rivers for barramundi, threadfin salmon, grunter and other fin fish. The Gulf of Carpentaria fishery is monitored in a grid system, and 40% of the barramundi and 30% of threadfin salmon in the Gulf fishery are caught in the grid between Aurukun and the Nassau River. We know of no commercial food fish or crustacean fishermen operating in the freshwater reaches of Peninsula rivers in the CYPLUS area. There is a total ban on net fishing in the Watson River, Chapman River, Moonkin Creek and Pine Creek on the west coast. On the east coast the Endeavour, most of the Annan, and the Bloomfield River are closed to commercial fishermen. Very few rivers are closed at their mouths, most are closed from an identifiable geographical point (usually a road crossing or bridge where they exist) upstream. The west coast supports a large number of full time net fishermen. The east coast fishery is very limited, and only the Princess Charlotte Bay area supports full time fishermen (R. Garrett, personal communication).

Ornamental fish are collected for the aquarium trade by licensed fish collectors. Generally they target high value species (such as saratoga) as broodstock for captive breeding, unusual species (eg. lake grunter, *Varichthys lacustris;* river sawfish, *Pristis pristis*) for scientific or public aquarium use, or attractive smaller fish (eg. threadfin rainbows, *Iriatherina werneri;* banded rainbows, *Melanotaenia trifasciata*) for domestic aquariums. It is not clear how much is collected from the wild and exported or sold to retail outlets domestically, and how much is bred in the Cairns area from broodstock collected in the wild. Permits for collection of wild caught fish only allow for collection of up to 30 individuals of one species for breeding. Wild caught fish are not permitted to be exported without special permission. There are about 12 fish collectors operating in the area at present.

Aquaculture at present has not been successful although attempts at farming barramundi have been made in the Weipa area. There is a high potential for culture of barramundi and redclaw crayfish due to the extended growing period compared to more southerly locations. However, problems of isolation and transport to markets, and crocodiles (destroying barramundi cages) inhibit development for the present.

## 1.6 Previous Surveys

### *1.6.1 Introduction*

There has been a general tendency for researchers to visit the `top' (the Jardine and its tributaries) (Byron and Blake, 1991). Also, the majority of previous studies have only surveyed a particular point on a river system (usually a convenient road crossing or homestead site). The following river systems or areas were omitted from this study as previous work had been sufficient to document the majority of fish species present. Most studies included ecological data on habitat and biology. Species lists obtained from these surveys are presented in Appendix 1.

Prior to the 1970s, very little information about the freshwater fishes of the region was documented. Macleay (1882) received collections of fish from the Palmer River. The Archibald Expedition (1948) collected a few fishes from scattered locations in the Peninsula.

### *1.6.2 Jardine River*

In the 1970s and 1980s, collecting activity on the Jardine River and tributaries was considerable. Collections by Allen and Hoese in 1978 and 1979, Leggett in 1980 and 1985, Midgley in 1988, and Byron and Blake in 1991 have been deposited in museums around the country. Observations by Australian and New Guinea Fishes Association (ANGFA) members in 1988 (Hansen) and 1991 (Lewis and Lewis) add to the volume of literature on the area.

### *1.6.3 Weipa area*

In the Weipa area, a survey was conducted as part of environmental assessment information necessary prior to the construction of an airforce base. Tait and Pearson conducted a survey of 6 sites in the vicinity of Weipa in 1988. Most of these were small streams in the vicinity of Weipa town. Seasonal effects on four lagoons and a kaolin mining void are currently being studied as part of the CYPLUS project and are discussed later.

### *1.6.4 Lakefield*

An ecological study of lagoons in the Lakefield area was carried out over 1991-1992, with previous site selection trips. This study by Mark Kennard of Griffith University was for a Masters' thesis. Fish species, their habitat requirements and ecology were documented. Although the study centred on lagoons, river sites were sampled. As the Morehead, Hann, Kennedy and Normanby Rivers form a huge contiguous flood plain in the wet season, fish faunas over the area should be similar. Midgley (1988) also collected on the Normanby River.

### *1.6.5 Wet Tropics*

The Wet Tropics Authority commissioned a study of streams draining the World Heritage listed rainforests between Townsville and Cooktown. This is currently (1993-1994) being done by Dr B. Pusey of Griffith University. Major rivers in the CYPLUS study area and in the Wet Tropics area are the Bloomfield and Annan Rivers. Additional surveys on the Annan were done by Hortle and Pearson (1990) in regard to tin mining, and by Barlow *et al.* (1987) in regard to effects on fish of weir construction. The area therefore has been well studied. A few sites on the Annan were studied by us to look at the fish present in the weir, and to determine if sooty grunter/black bream (*Hephaestus fuliginosus*) introduced in 1979 had established.

### *1.6.6 Cape Flattery*

R. Mackay of Queensland museum had sampled fish from several sand dune lakes in the dune field at Cape Flattery. The results of this study were not published but data on the species present is available. B Timms studied the limnology of sand dune lakes in the Cape Flattery, Cape Bedford, Somerset and Ussher Point areas (Timms, 1986).

### *1.6.7 Estuaries*

Estuarine areas were unable to be studied due to the short study period and the large area to be surveyed. However, some comprehensive work has been done on the Embley estuary near Weipa (Blaber *et al.*, 1989; Cyrus and Blaber, 1992). Trawl bycatch studies in both the Gulf of Carpentaria and the coast of north Queensland by CSIRO and Qld DPI Fisheries should give indication of what species are likely to be in estuaries. In addition, considerable unpublished information on commercial fishing in the Gulf of Carpentaria and the east coast is held by the Queensland Fish Management Authority.

### *1.6.8 Other Studies*

Most of the rivers in Cape York Peninsula have been surveyed at one time or another. Most of these surveys remain unpublished. Midgley and Midgley conducted surveys of all the major rivers in the area in 1985 and 1988, and will do more in 1994. In most cases one or two sites on a river have been surveyed, and lagoons have been sampled where possible.

Leggett sampled rivers at crossings on the main road (the Peninsula Developmental Road) in 1980 and the Iron Range area in 1988.

Pusey (unpublished to date) has done surveys on rivers including the Stewart and Pascoe.

ANGFA members have published records of their observations, usually at road crossings, on most of the major rivers. Bruce Hansen (1987, 1988, 1989) visited the Edward, Claudie, Pascoe, Hann, Archer, Wenlock and Jardine Rivers; Polo and Cowal Creeks; and Lake Wicheura. Lewis and Lewis (1991) published observations on *Melanotaenia trifasciata* and other species from Eliot Creek. Armstrong (1985, 1987) collected fishes in the vicinity of Weipa (Tentpole Creek), and Coen (Pascoe and Wenlock Rivers).

Most of these observations will be discussed later in the appropriate sections. Many of these surveys were conducted at river crossings, which may be `atypical' sections of the river subject to disturbance. In some cases, confirmation of species identification was not able to be done. Most surveys were also of one site on any particular river, which may not be representative of that river. Time and funding restrictions (many surveys were privately funded) limit the ability of these collectors to conduct more comprehensive surveys.

## 1.7 Aims of This Study

### *1.7.1 Documentation of species distribution*

This study attempts to fill in some of the more obvious gaps in the readily available knowledge of fish species in the Peninsula. At present, knowledge is limited mostly to the more accessible or well studied areas. This has led to the impression that some species are rare and/or have very restricted distributions (see Wager, 1993). The current study should help better define the extent of continuous distributions within the area, and document the presence of species in areas from which they were not previously known to researchers and, ultimately, to planners.

### *1.7.2 Habitat preferences*

Some species of fish have very specific habitat requirements if they are to breed and grow successfully. This study will record the habitats most favoured by what species. Certain fish are dependent on availability of specific types of cover (eg snags, aquatic plants) or water quality (eg tea-tree water). Availability of habitat may help to explain why some species are rare in some areas or common in others, and may help to explain the discontinuous distribution of some species.

### *1.7.3 Database*

The data collected during this research is being entered in a database. This information will be held by Queensland Lands Department, and the National Resource Information Centre (NRIC) and Environmental Resources Information Network (ERIN) in

Canberra. It will be available to assist in future planning for development, and as a 'baseline' of information for future reference. The information on water chemistry may be useful to fish or crayfish farmers who need to know what water quality conditions are ideal for maximum growth of a particular species.

Fisheries will also maintain the information collected as a database to help managers make more informed decisions about fisheries policy.

*1.7.4 Areas of particular significance*

There appear to be a number of areas which have species found nowhere else in the Peninsula, or which have assemblages of fish species which are unusual. This investigation intends to document any areas of special significance in terms of habitat or species diversity which were surveyed.

## 2.0 HABITAT OF FISH IN CAPE YORK PENINSULA


### Summary

1 Flooding is of paramount importance for rejuvenation of habitat, migration, and breeding of fish. The actual period of inundation of flood plains in Cape York Peninsula is short, compared to that of many other river systems.

2 Lagoons and river channels offer vastly different habitats for fish, the main difference being that exposure of shallow water to sunlight in lagoons allows proliferation of aquatic plants.

3 With some exceptions, east coast rivers are short, clear flowing perennial streams and west coast rivers large, intermittent ones. Lagoons are common and vital habitats in the west coast systems.

4 The Alligator Rivers region has been studied intensively over the past twenty years, and although useful comparisons can be made, the rivers there differ significantly from rivers in Cape York Peninsula.

5 Most previous studies concentrated on areas with easy access or proximity to 'the top'.

6 There is a huge gap in our knowledge due to access problems in the wet and lack of funding for repetitive, ecological research.


### 2.1 Geological History

The following discussion is based on papers by Torgersen *et al.* (1983, 1985). During the Pleistocene Period, lower sea levels than present exposed the present day Gulf of Carpentaria, which received runoff from the Fly Strickland basin in New Guinea and all the rivers in the Gulf of Carpentaria drainage basin. This sea was, as indicated by remains in the sediments, marine to brackish over the period of its existence. For 36 to 26 000 year before present (BP) the lake was fresh to brackish. It is possible that the upper layers and margins were fresh enough to permit fish to move between river mouths. The distribution of the primary freshwater fish saratoga (*Scleropages jardinii*) in the Fly and Gulf of Carpentaria streams appears to support this. The early diversion of the Fly River by the Oriemo uplift 36 000 years before present (Blake and Olier, 1969) may be responsible for the differences in fauna between this river and the Gulf of Carpentaria rivers. The closest rivers to the Fly River (on the north west of Cape York Peninsula) would be the ones with the closest faunal affinities, as noted by Allen and Hoese (1980) for the Jardine River.

## 2.2 Ecology of Flood Plain Rivers

### *2.2.1 Flooding*

The rivers flowing to the western side of Cape York Peninsula are all flood plain rivers ie., during the wet seat they break their banks to cover large areas of flat country. These are savannah type rivers, the most extreme form of flood rivers, which cease to flow seasonally. They have been termed sandbank rivers (Jackson, 1963). Conductivities and silt levels are reasonably high during flood events (Welcomme, 1985). Due to their comparatively small size (on an international scale only the Murray Darling system ranks in the top 100 world rivers) and distance from major population centres, these rivers have been poorly studied.

Flood plains are important areas for growth of fish and other aquatic biota. In the Northern Territory, most fish breed during the wet season, and usually move out of their dry season habitat to do so (Larson and Martin, 1990). In the tropics, flow is far more important than temperature for breeding, and most fish breeding cycles are governed by flow regimes (Welcomme, 1985). The floods covering flood plains in most of the Peninsula rivers appear to be short lived. Flow in the river channel may persist for a long period, but the period of extensive flooding would rarely exceed two or three weeks. This may occur several times in the course of a good wet season, but is dependent upon cyclones, rain depressions and strong monsoonal trough development.

Flooding is also highly important for migration of fish. In most flood plain rivers fish move out of dry season habitats, or migrate to suitable upstream habitats, to spawn (Bishop *et al.* 1986, Welcomme, 1985). Catadromous species such as barramundi move downstream to estuaries to spawn (Davies, 1986). Many species are dependent on flowing water or submerged vegetation, and the increased food supplies afforded by floods, for breeding. Also, some species of fish appear to depend on chemical stimuli from recently inundated dry ground for spawning (Lake, 1967). Floods also scour out sediment in dry season pools, and rejuvenate habitat by shifting fallen timber and changing stream bed topography.

### *2.2.2 River channels and lagoons*

Western Peninsula

The river channel habitat in western Peninsula usually has a sand substrate (or rock in parts of the Edward, Holroyd and Coleman Rivers) and is completely devoid of aquatic macrophytes. On very rare occasions in permanent pools individual water lilies (*Nymphaea* sp.) may be found. The obvious reason for this is the scouring effect of large volumes of sand and gravel shifted during floods, and the unstable substratum during the period of flow in the channel. River channels usually are lined with paperbark trees (*Melaleuca* spp.), although in upper reaches of the same rivers bottlebrushes (*Callistemon*) may be more common. The roots of the littoral (bank) trees, and undercuts beneath them, provide shelter for a wide range of smaller, or cryptic (hiding) fish species. Directly behind the fringing paperbark trees is usually mixed gallery forest, often composed of large trees. The fringing paperbarks, and to a lesser extent the gallery forest, shade the margins of the pools, in some places completely covering them. This shading effect of the shallow margins would also inhibit aquatic macrophyte growth. Fallen trees are very common along all water courses and provide shelter for large predatory fishes and the branches provide shelter for small omnivorous species such as the glassfishes (Ambassids), hardyheads (Atherinids) and rainbows (Melanotaeniids). Rocks in the river channel also provide shelter. Intermittent stream pools tend to turn slightly green with the arrival of the first storms in October-November.

The deep water habitats provided by many pools are important dry season refuges (Bishop and Forbes, 1991) for those species which are not reliant on aquatic vegetation. In the Alligator Rivers region the sandy creek beds have their highest species diversity in the late wet to mid dry season (Bishop and Forbes, 1991). The river channel habitats provide significant migration routes for all species that undertake breeding migrations (Welcomme, 1985).

A distinction should be made here between lagoons or waterholes, and oxbow lakes. Lagoons are usually depressions in the ground high above the river channel bed level, up on the flood plain. They usually have sparse littoral tree cover, and gently sloping sides. Oxbow lakes differ to lagoons in that they are usually deeper, have dense fringing vegetation, and steeper banks. The depth of the bed is generally only a little higher than that of the river channel.

Lagoon habitats differ significantly from the river channels. Substrates are mud or silt, and there is an abundance of aquatic vegetation growing to the surface around the margins out to about 2-3 m depth. The middle may or may not (depending on clarity) have attached aquatic plants (usually *Najas tenuifolia* or *Chara*) growing in the deeper water but not reaching the surface. In the Archer River, eelgrass (*Vallisneria*) may be the predominant aquatic plant. The edges of lagoons with more stable water levels usually have several species of reed (*Eleocharis* spp., *Lepironia auriculata*) present. Paperbark trees usually surround lagoons, but often are some distance from the water level for most of the dry season. In the wet season root masses of paperbarks provide significant habitat for fish. Snags and fallen timber are far less common in lagoons than rivers. Lagoon waters are usually more turbid than river waters. Billabongs in the Northern Territory are habitats for decomposition and breakdown of organic matter from terrestrial sources (Bishop and Forbes, 1991). Lagoons in the Peninsula are similar, often having a thick layer of leaf litter around margins. In the storm season they turn green, due to influx of nutrients in runoff water. Disturbance from feral or domestic animals also increases turbidity.

Oxbow lakes share characteristics of both lagoons and river channel pools. Aquatic vegetation may be present, but is often patchy. Fringing vegetation is usually dense, so snags and fallen timber are present marginally. Substrate at the inflow end (during flood) may be sand, but generally the substrate is mud, or a mixture. Depth is usually greater than in lagoons, and no aquatic vegetation is present in the middle. Dense leaf litter beds may be present, preventing aquatic plant growth and adding tannins to the water. Roots and undercuts, snags and rocks, where present, are the main cover type.

In Cape York Peninsula, few locals make any distinction between oxbow lakes and lagoons. A few refer to oxbow lakes as lagoons and lagoons as waterholes, but the reasoning behind this varies. The term lagoons generally covers all out of river bed water bodies. The term 'hole' usually refers to river bed pools, particularly in the dry season when they are separated.

The Jardine River is an exception to the generalities above. Aquatic vegetation fringes the margins, and there is a thin band of water lilies, reeds and aquatic macrophytes extending out up to 5 m into the river channel in places. Mostly the vegetation is in a thin (1 m) band on the margins, and leaf litter accumulates under it. We have not observed as many lagoons near the Jardine as near other rivers. Shallow swamps appear to predominate. The Jardine swamps near the mouth are slightly saline. The upstream swamps tend to be shallow and support mainly emergent vegetation. Leggett (1985) found several species of fish in this environment.

Eastern Peninsula

The Normanby flood plain and Annan Rivers will not be discussed here, as they have been well studied. Three types of waterbodies, as discussed earlier, predominate in this area.

Rainforest streams and rivers are characterised by their clear water, usually high current, and virtual complete shade of the water by overhanging vegetation. Banks are bound by roots of trees, and are usually undercut. Lagoons are virtually non-existent, probably because the flood plain is restricted. Where present, lagoons are on the coastal plains in woodland. Vegetation is similar to that in the western lagoons, although *Utricularia* (bladderwort) tends to be more abundant. The giant waterlily, *Nymphaea violacea*, is also present in east coast river lagoons. The lower reaches of the largest river, the Pascoe, are wide, shallow, sandy expanses, sparsely vegetated with hornwort (*Chara*) in the mid dry season. *Aponogeton* is present growing amongst the roots along the edges. *Aponogeton* in the McIvor River grows on rock substrates in those places where sunlight penetrates the canopy for part of the day. Instream timber is not abundant, probably getting washed away in floods and breaking down rapidly. However, fallen trees are a significant habitat component. Rocky areas and riffles are common, also.

There are substantial dune fields and sand country areas from Cape Bedford through to Cape Flattery, and from Temple Bay to Cape York. Two comprehensive studies on Cape York Peninsula dune field lakes were conducted in the 1980s. Timms (1986) investigated the limnology of lakes at Somerset, Ussher Point, Cape Flattery and Cape Bedford in 1983. Lees and Saenger (1989) investigated the limnology of these lakes in 1984. All the lakes studied by Timms (1986) were water table exposures. The Shellburne Bay lakes are sometimes perched lakes, the water being retained by a layer of organic cemented sand (<5 m deep), with acidic water. A limited but characteristic fish fauna is present in each lake, suggesting isolation for considerable periods of time (Lees and Sanger, 1989). The aquatic invertebrates and plants are all common tropical species (Timms, 1986). Water quality characteristics, particularly ionic ratios, were also presented in both papers. The dune field lakes are generally very similar in that emergent vegetation predominates (usually reeds, *Juncus* and *Eleocharis*), and the substrate is sand. Macrophytes are usually tolerant of acidic conditions, and generally are sparse (bladderwort, *Utricularia*; hairgrass). The water quality may vary significantly, even in dune lakes virtually side by side one may be clear and neutral and the other deeply tannin stained and acidic. Others may be clear and highly acidic and devoid of fish and crustaceans. Many dune lakes have no outflow or inflow, filling and draining through seepage, although in some areas outlets are present.

The Olive River is perennial from its sandstone-fed tributary Glennie Creek downstream. Harmer Creek is perennial over most of its length. Numerous small coastal streams drain the dune fields, and hundreds of parched lakes are present in the dune fields. The Olive River is named after the deep brown colour of its water, caused by tannins. This humic colour is present in many, but not all, of the dune field lakes and creeks. The Olive River has very high habitat complexity, with gallery forest covering much of the water, deep pools, enormous quantities of fallen timbers, and aquatic vegetation (*Blyxa, Eriocaulon*). It has sluggish flow for most of the year.

Glennie Creek and Harmer Creek are similar in that they flow through sandy country, have few deep holes, and are perennial. Sparse eelgrass (*Blyxa*) and hornwort (*Chara*) are present in places. Instream cover is limited to scattered logs and small branches, and few rock walls. Lagoons are present in the flood plain of the Olive and Harmer Rivers, and are basically similar to those on the west coast. Many of the lagoons dry up or shrink considerably during the dry season, probably due to the porous soils. Lagoons may be crystal clear or deeply tannin stained, but were never observed to have the muddy or green coloured turbidity present in western lagoons.

The Stewart River differs from other east coast rivers in that it is intermittent and drains fairly flat country. It bears more similarities to a western river.

### *2.2.3 Fish diversity*

Fish diversity in a river system is usually measured as a function of basin area. Although Australia has a relatively small number of fish species (Allen, 1991), our northern rivers compare favourably with the more speciose, large rivers of tropical Asia, Africa, and South America (Bishop and Forbes, 1991). When species number is plotted against drainage basin size, Northern Territory rivers have higher species density than rivers of comparable size from South America and Asia. However, there are still many undescribed taxa (species) in those continents and figures presented in Welcomme (1985) may be misleading. In the Amazon, it is possible to find 60-70 undescribed species of fish in a single lagoon in a day (Bleher, pers. comm. 1993). There is a definite correlation between basin size and fish diversity, the larger a basin gets, the more species of fish are present. Temperate streams have far fewer species than tropical ones (Bishop and Forbes, 1991).

## 2.3 Monsoonal Rivers in Northern Australia

The Alligator River region in the Northern Territory is the only region in monsoonal Australia where fish ecology has been investigated in any detail. The following refers to the results of Bishop *et al.* (1986), and Bishop and Forbes (1991).

The streams in the Alligator River region are different to those of Cape York Peninsula in that the headwaters start on a rocky plateau, pass through a deep escarpment gorge and then over vast flood plains and wetlands before reaching estuarine reaches. The headwaters fish populations usually have low diversity due to the restrictions in upstream movement. Riparian (bankside) vegetation in many creeks is dominated by screw pine (*Pandanus*), which is uncommon in Cape York Peninsula. The rivers in the Alligator River region are flood-drought rivers, flowing strongly and covering the flood plains in the wet, and are similar to the peninsula rivers in that they reduce to chains of billabongs in the dry. The region is dominated by stringybark (*Eucalyptus tetradonta* and *E miniata*) woodland, which extends across Northern Australia from the Kimberleys to Cape York Peninsula (Dunlop and Webb, 1991).

Discontinuous distribution of fish species appears to be a feature of North Australian fish faunas. Many species (e.g., saratoga, *Scleropages jardinii;* archerfish, *Toxotes lorentzi*; McCulloch's rainbow, *Melanotaenia maccullochi*) present in one system may not be present in adjoining systems. Allen and Hoese (1980) believed that temperature differences were responsible for this. Bishop and Forbes (1991) believed that distance from the coast, geological history and physiographic features would also be important in areas of similar latitudes.

The fauna of the Jardine River has strong relationships with that of southern lowland New Guinea, with 63% of Jardine species present in New Guinea (Allen and Hoese, 1980). The similarities in fish faunas relate back to the period of lower sea levels, when the rivers of southern New Guinea and the Gulf of Carpentaria all drained into a freshwater inland sea in what is now the Gulf of Carpentaria (Torgersen *et al.*, 1985). The Jardine does bear similarities to the New Guinea rivers in terms of its being perennial and surrounded by swamps. However, the New Guinea rivers, particularly the Fly/Strickland system, are far longer, more turbid, and drain thick rainforest country.

## 2.4 Previous Studies in Areas Covered by CYPLUS

Fish surveys conducted by R Leggett, B Pusey and other ANGFA members have usually been at points or road crossings or other points of easy access. S. H. Midgley conducted surveys of many rivers in areas off the beaten track. Most of these surveys have sampled one or two sites on the river, and few, except Midgley, have looked at lagoons. All studies were limited for reasons alluded to earlier.

Fish diversities and species composition in monsoonal rivers varies dramatically over time, with species diversity in any one habitat decreasing as the dry period progresses (Bishop and Forbes, 1991). Thus, it is essential to study as great a diversity of habitats as possible in order to get a reasonable idea of what species are present. It would be unrealistic to expect that all species of fish in a river system would be caught by any survey group, as species composition varies diurnally (day/night) and seasonally.

The methods used by other collectors vary, with some (Allen and Hoese, 1980; Lees and Saenger, 1989) using rotenone. Only Pusey had used electrofishing. All other collectors relied on dip nets, seine nets, gill nets, lure fishing and observations to record presence of fish species.

### 2.5 Data "Gaps"

The vast majority of studies on fish in Northern Australia to date have been taxonomic (Bishop and Forbes, 1991). Due to the lack of development and poor roads much of the peninsula is inaccessible by vehicle during the wet season. Ecological studies in tropical Australia have only been pursued in the Alligator River region because of the politically sensitive issue of uranium mining and consequent provision of funding for research and infrastructure to improve access (Bishop *et al.*, 1986). Fundamental research on ecology requires long term study of selected sites. At present, this is not possible on Cape York Peninsula.

Predictions of possible effects on fish faunas and aquatic habitats cannot be made if the fundamental factors that affect breeding, distribution, inter and intra specific interaction, etc., are not known. Likewise, it is impossible to judge the apparent health of sections of aquatic ecosystems from a few visits. Much of this judgment is highly subjective. The appearance of a water body is dependent on the time at which it is observed - straight after the wet season lagoons look extremely healthy. As the dry progresses, feral and domestic animals concentrate around lagoons, water levels drop, and the appearance can be totally different. The importance of lagoons as refuges and as specialised habitats for some species has also been largely overlooked previously.

# 3.0 DATA COLLECTION - MATERIALS AND METHODS

**Summary**

1. Data was collected on species present in a river system, fish distributions, faunal assemblages and species of commercial and recreational importance.
2. Habitat data was collected as inputs from the surrounding country may be of significance.
3. Information on the breeding state of fish was collected incidentally to other fish data.
4. Water quality was monitored in all environments sampled.
5. Habitat disturbance was observed at the time of sampling, and disturbed environments observed to have low species diversity.
6. Notes on other fauna observed (particularly crocodiles, freshwater crayfish and prawns) were taken.
7. Methods and materials used in fish sampling, water quality, and habitat assessment are detailed.
8. Sites were selected on the basis of accessibility and proximity to disturbed areas.
9. The main limitation of the project was time, as only one visit per site was possible generally, which only gives a snapshot of conditions at that time, and may not reflect the situation at other times of the year.
10. Specimens of almost all species collected were lodged with the Queensland Museum.
11. Samples for electrophoretic and DNA typing were forwarded to researchers at the Southern Fisheries Centre and the Queensland Museum, respectively.

## 3.1 Fish Data Collected

### *3.1.1 Species lists*

Species lists for each site sampled are in Appendix 2. A condensed list of species from each river system is also included. Fish were identified using Allen's (1989) book "*Freshwater Fishes of Australia*". Species not covered in that book were keyed out in Munro (1967), Collette (1974), Grant (1982), Allen and Cross (1982), Allen and Burgess (1990), or Allen (1991). Additionally, striped sleepy cod (*Oxyeleotris selheimi*) and gobies (*Glossogobius* sp. 1. and *Glossogobius* sp. 2.) were identified by D Hoese in 1993. In all cases, Allen (1989) was considered the latest and therefore most valid work. The exception is that we have called silver tandans *Neosilurus argenteus*, in consideration of it being the name used in the Zoological Catalogue of Australia and in Larson and Martin, 1991. Allen (1989) refers to this species as *Porochilus argenteus*.

All specimens were sent to the Queensland Museum for identification confirmation or correction and lodged in their collection.

### *3.1.2 Distributions*

Species distributions for selected species are mapped in figures in Appendix 3. A point distribution pattern was used as any one species may not be present throughout the entire drainage basin. This is particularly true of catadromous (marine or estuary breeding) species and marine vagrants. These have been mapped separately as freshwater penetration. However, the accuracy of these is limited as our sampling may have missed some species in upper reaches of some rivers. As many other fish surveys on the Peninsula did not include positions for their sites, mapping more complete distributions was not considered appropriate due to possible accuracy problems.

### *3.1.3 Faunal assemblages*

One of the aims of (1.7.4) this study was to identify unique or unusual faunal assemblages. For the purpose of this study, a unique faunal assemblage is a group of animals in an area isolated from the bulk of the population (e.g. delicate blue-eye, *Pseudomugil tenellus* and poreless gudgeon, *Oxyeleotris nullipora* at Silver Plains; or a particular area with unusually high species richness e.g., Olive River). Additionally, apparent limits of distributions and overlaps are of interest.

### *3.1.4 Species of commercial and recreational importance*

Special note was taken about presence of species of commercial or recreational importance. Abundance or otherwise of these species in some locations may indicate which conditions are most favourable or conducive to survival. Some species, like saratoga, may be particularly vulnerable to overfishing, and knowledge of their distribution and favourable conditions may assist in managing populations should the need arise.

Knowledge of distribution of catadromous and migrating species is also important in the event that any water management regimes are introduced. Dams and weirs obstruct upstream movement of fish. If distribution of fish is known prior to installation of such structures, possible negative impacts could be ameliorated at the design stage. Of particular interest in this respect are barramundi, which may be affected by ponded pasture development, and tarpon, freshwater prawns and sooty grunter, whose upstream movement and thus access to feeding or breeding grounds could be obstructed.

It is also of interest to know whether there are discrete stocks of fish which have different characteristics. The coal grunter (*Hephaestus carbo*) on the east coast appear to grow much larger than the west coast ones. Whether this is due to genetic differences or due to environmental factors is uncertain. The same applies to saratoga. Such results could be of application in breeding.

### 3.2 Habitat

Habitat assessment is outlined in 3.73. Surrounding country is of particular importance as external inputs are important in some environments (e.g. rainforest streams) or may be almost nil in others (e.g. lagoons). Instream cover is important as some fish appear to be dependent upon presence of aquatic vegetation or sand substrate or particular types of cover for survival and breeding success.

### 3.3 Breeding Biology

When samples were cut open for preservation it was noted whether the fish was in breeding condition or not. Often, fish being handled (particularly mouth brooders) were observed to be spawning or ready to spawn. Gravid or running ripe fish were also noted.

### 3.4 Water Quality

Water quality parameters were measured as described in section 3.72. Comparisons between lagoons and river beds, upstream and downstream, or associations with surrounding vegetation, may be useful. Consideration of water quality changes during the progression of the dry season would be necessary regarding the importance of lagoon habitats for fish. Water quality parameters collected from all sites sampled are presented in Appendix 4.

### 3.5 Habitat Disturbance

Observations were made on the level of habitat disturbance at the time of sampling. Disturbance by feral and domestic animals, presence of exotic weeds, fishing/camping activities, agriculture or mining were all activities which can disturb aquatic environments and may cause problems. Generally heavily disturbed sites (mine sites, road crossings) were avoided as the main aim of the project was to document the fish present as baseline data to provide a benchmark for future studies and to document the species present. Disturbed environments in the Palmer River and Wenlock River were observed and found to have depauperate fish diversities compared to other locations.

### 3.6 Notes on Other Fauna

Fauna such as crocodiles and file snakes were often captured or observed on trips and their presence noted. If other non-aquatic fauna was particularly abundant or prominent it was also noted. Presence of feral pigs and horses is important due to their effects on watercourses and swampy land. Where the fyke net was set the presence of turtles was noted. Presence of high numbers of piscivorous birds was noted at some locations.

### 3.7 Methods and materials

*3.7.1 Fish sampling*

3.7.10 Non-destructive sampling

As wide as practical a selection of sampling methods was used in order to achieve the objectives of this study. As sampling was to be non-destructive, rotenone was not an option, although it is one of the most widely used and efficient methods of sampling fish. It was not an option in this study as some of the waterholes sampled were used for domestic and stock water supplies, or were favourite fishing holes. In some areas, visibility was limited and a wide variety of fish do not float when they die.

At each site sampled, information on water chemistry and habitat was collected in addition to fish data. The position (latitude and longitude) was determined using a Magellan Global Positioning System. All records of fish, water chemistry and habitat have GPS co-ordinates linked to them, for inclusion into the CYPLUS database and GIS. A few fish of each species were kept as samples for the Queensland Museum. These were slit open ventrally and preserved in 10% neutral buffered formalin.

Each site was assigned an eight digit site code. The first four numbers are the river code (from the national coding system), the second two the site code, and the last two refer to the visit. As most sites were visited once, this is usually 01. Therefore, the site code 9221 12 02 means the Coen River, the twelfth site sampled and the second visit to that site.

Temperature of surface water was measured at each sampling time using a thermometer.

3.7.11 Electrofishing

Electrofishing is a non-destructive sampling method in which a pulsed electrical current of 700-1000 volts is used (usually, depending on conditions) to stun fish. Some fish are attracted to the field and are highly sensitive, others are frightened away. It is most useful for pulling fish out of hiding places such as snags, weedbeds or mud. It is of limited use in open water. The radius of the field from the anode pole varies with the temperature and conductivity of the water, but can be effective up to 1 m. Some extra sensitive fish can sense it over 5 m away, but are not attracted from that distance.

Fish were temporarily stunned, scooped up, and kept in a bin of water. After a section of water body has been fished, the fish were measured in mm (standard, fork and total length), weighed in grams, and most were returned to the water alive. Water temperature was measured before starting, and the depth each fish came from, and the habitat, were recorded. Only ten fish of each species were measured and weighed. Additional fish were counted. Length of time spent fishing was recorded. Approximately 100 m of representative stream or lagoon length was sampled. After that was completed, extra area was sampled and only additional species recorded.

3.7.12 Netting

Four different sizes of monofilament gill nets were employed. Each net was 25 m long, and the 35 mm, 63 mm, 88 mm nets had a drop of about 2 m. The 150 mm net had a drop of about 3 m. Each net was set approximately one hour before dark and hauled in about one hour after dark, although times of hauling varied with the length of time taken to clear nets. Nets were set perpendicular to the bank in order to collect both open water and inshore species.

Fish caught were cut out of the nets to avoid damage and minimise deaths. When more than ten of any species were caught, the excess were counted and released immediately. Fish were measured and weighed as with electrofishing.

Individual nets were used instead of panel nets (a composite net made up of sections of different sized mesh) to avoid selection of species on basis of habitat or size. Many fork tailed catfish are open water fish which are not usually caught close to the edges or weed banks. Longtom were caught along the edges of lily banks and only in 35 mm nets. Nets set parallel to the bank may therefore miss some species. Panel nets set perpendicular to the bank may miss other species if the mesh sizes do not correspond to the size of fish in that area. A 35 mm mesh will not catch a 10 kg barramundi. Many large barramundi were caught only 0.5 m from shore. A disadvantage with fishing in the method described is the large numbers of bony bream and fork tailed catfish caught, which take a lot of care in handling, and thus time.

3.7.13 Seine nets

Two seine nets were used, a 15 mm mesh size 25 m long bait net and a 1 mm mesh, 3 m long, 2 m deep net. The 15 mm net was used in open waters, and was particularly useful in catching those smaller open water species missed by netting, such as gar and juvenile bony bream. Generally one person stood on the bank and another swam the net out and brought it in (See Plate 1). The 1 mm net was mainly used in weed banks and leaf litter habitats to catch smaller cryptic species. A section of bank about 4 m long would be dragged 3-4 m off the bank into the shore.

These nets were used mainly to supplement electrofishing, and only species different to those found electrofishing measured and weighed. Nets were only used where entry into the water was considered to be relatively safe. Use was limited to areas which were clear of snags, crocodiles and other obstructions.
Seine nets were not always successful as surface dwelling fish (e.g. gar) can swim over the top if it is pulled down at all while hauling. Some species like tarpon and saratoga jump over the net while it is being hauled in. Use of seines was very restricted due to the need for a clean bottom. Seines roll up totally in weed beds and do not catch. They are selective for some species which are rarely caught by other means.

3.7.14 Lure fishing

Lure fishing is extremely useful to catch some species which do not net well or which only respond well to electrofishing in cool (< 25°C) water. It is also useful in pulling out species susceptible to lures which may not have been caught with other methods due to scarcity. The length of time spent lure fishing was recorded and data on fish recorded as above.

3.7.15 Fyke net

A fyke net was used on several occasions, specifically to catch eels. Its use was limited as normally turtles are caught and may drown where water is too deep to allow access to air. Reports of eels in several western rivers (where they aren't supposed to be) prompted use of a fyke net. The fyke net was set from about one hour before dark and collected the following morning.

### *3.7.2 Water quality*

Water chemistry/physical parameters measured were temperature, pH, dissolved oxygen, conductivity, alkalinity, total hardness, calcium hardness, total phosphate, tannin, and turbidity (by secchi).

Plate 1. Pulling the 5 mm seine net at Lake Wicheura, near Cape York.

Plate 2. Measuring water clarity using a secchi disc. Black Creek, near Hope Vale.

All measurements were taken from surface water at about 20 cm deep. Where depth permitted, temperatures, pH dissolved oxygen and conductivity were also measured at about 2-2.5 m to see if there was stratification.

Where possible, all parameters were measured between 10.00 and 14.00. Time measured was recorded. Temperatures (°C), pH, dissolved oxygen (mg/L) and conductivity (µs) were measured using a calibrated TPS meter. Alkalinity, total hardness, calcium hardness, total phosphate and tannin/lignin were all measured using colorimetric HACH field kits. Magnesium hardness was calculated by subtracting calcium hardness from total hardness. All these parameters were measured in mg/L. Water clarity was measured by secchi disc. A secchi disc is a disc painted black and white. It is lowered into the water until it cannot be seen, and raised until it becomes visible. The depth at which it becomes visible is recorded in metres. See Plate 2.

*3.7.3 Habitat*

Habitat assessment was done at approximately the same time as water quality. An approximate percentage area of various types of cover, substrate, flow type , type of aquatic vegetation, rocks or other features, maximum depth, and flow readings where measurable for the stretch of river sampled, was recorded. Disturbance was noted (e.g. feral animals, cattle, erosion, camping, etc.), although, as will be discussed later, it was only an indicator of disturbance at the time of sampling, not to be taken as a general indicator of stream health.

Riparian (bankside) vegetation, surrounding vegetation, and land use were also noted. Siltation or other effects, level of the river etc. were recorded. A rough stretch of the length of stream sampled was done to indicate location and size of cover and layout.

**3.8 Site Selection**

River systems studied were selected on the basis of previous studies (or lack of them) and size. It was assumed that larger rivers would have more species in them than smaller ones, and that smaller rivers would have a subset of the fauna present in nearby large systems Sampling at points along the entire length of a river should collect most species present in that system. Smaller creeks and rivers were initially chosen on the basis of their surrounding environment. Particularly, the uniqueness of sand dune lake faunas (Lees and Saenger, 1988) indicated that small water bodies isolated from each other may have faunal assemblages of interest. Sampling sites were selected on the basis of accessibility primarily, and other considerations such as closeness to disturbance (e.g. road crossings, mining) were taken into account. Disturbed areas were avoided as it was believed they may not reflect the true diversity of species normally found in a river. Studies comparing disturbed and undisturbed sites would have been interesting, but require repeated sampling and more in-depth documentation than was possible with the resources available.

Where possible, sites about equal distances apart along the river were selected. Also where lagoons were present, a lagoon close to the river site was also sampled. In some cases lagoons with different characteristics were chosen, e.g. with abundant vegetation or without, or highly turbid lagoons. Sometimes, only lagoons were sampled as river beds were dry at the time they were visited.

Other sites were chosen because they represented different habitats, or levels in the river (e.g. upstream, downstream, etc.). Waterfalls or rocky areas were also targeted as likely locations for aggregations of fish or as barriers to upstream movement by migratory species. Some creeks or lakes which appeared to be unusual, or from which unusual fish had been reported by locals, were also sampled, despite their proximity to other sites.

### 3.9 Shortcomings

Fish species composition in the tropics in a given habitat is largely dependent on the season (Bishop and Forbes, 1991). Catchability also depends on the time of day (Midgley, personal communication 1994). To sample fish at one location at a time of year will give an indication of what is present at that time. However, it would require repeated sampling in all seasons to be able to say what is not present. The vast area to be covered and the variety of habitats meant that only one site could be examined per day, and due to logistics of keeping preserved specimens and limited space, trips were limited to two weeks. Each site was examined as fully as possible with the resources available. Several sites which were re-visited produced extra species, or missed others which were common previously. It would take years of work in the field to fully document the fish fauna. Undoubtedly there are numerous species we did not collect. In the Wenlock River for example, black-banded rainbows (*Melanotaenia nigrans*), snub-nosed gar (*Arramphus sclerolepis*) and elongate glassfish (*Ambassis elongatus*) have been collected previously. These species were not observed or caught in this study. Banded rainbows (*Melanotaenia trifasciata*) in some locations superficially resembled black banded rainbows (*M. nigrans*), but fin ray counts showed otherwise.

Fish do not always behave predictably. In 1991 and 1992, no swamp eels were caught in any locations. In 1993 swamp eels were caught in almost all rivers sampled. What is perplexing is that several rivers (Wenlock, Archer, Harmer and Olive) were sampled in 1990 and 1991 and no swamp eels were caught, but in 1992 they were, often in comparatively large numbers. In Toby's Lagoon on the Holroyd River, very few fish of any species were caught. In other lagoons on the Holroyd large numbers of fork tailed catfish, bony bream, barramundi and archer fish were caught. Netting in Toby's Lagoon produced only five fish, and no fork tailed catfish or saratoga, which are predominant large fish in most lagoons. No fish kills had been reported, and nothing short of dynamiting the entire two kilometre length of the lagoon could have reduced fish populations so much. We could offer no explanation for the lack of fish on that night. A return trip could be an altogether different story.

Recording of the habitat which fish are caught from does not necessarily reflect the habitat they use most or rely on. When electrofishing, fish were observed to move from open water to cover, where they were caught. In eutrophic lagoons (lagoons full of aquatic weeds), many fish sleep right on the surface waters, whereas in the day they are active deeper down. Fish in open water or deep water are far less likely to be caught electrofishing than fish in snags, as the technique is very biased.

Each site differs markedly with season. Many river sites on intermittent rivers dried out after being sampled. Lagoons, particularly, suffer the ravages of feral pigs, horses and to a lesser extent, cattle, during the dry season. Due to the drought in 1991-1992, vast numbers of pigs aggregated around the few waterholes remaining and caused damage which may have been limited had there been more surface water around. Lagoons look substantially different in the early dry season with abundant vegetation, both aquatic and littoral. Pig damage later on makes most waterholes muddy and they look severely degraded. To make a judgement on the basis of one visit is therefore not indicative of the general condition of the area. It is only indicative of conditions at one point in time, which may be aberrant or different to the normal condition.

Fish identification in the field was, at times, problematical. Particularly, juvenile fish are difficult to identify as tooth patterns or other distinguishing features are not fully developed. Juvenile catfish were all identified as lesser salmon catfish (*Arius graeffei*) on the basis of eye shape, although it was probable that some at least were Berney's catfish (*Arius berneyi*). The distinguishing characteristics of these species overlap to a considerable extent and expert opinions are required. In many cases, duplicate specimens (large and small) or those which appeared slightly different were collected and forwarded to the Queensland Museum where our identifications will be confirmed or corrected. Gobies were also problematical, as a number of them superficially appear similar. Often, only juveniles were captured. The state of goby taxonomy in Australia is in a flux at present. Hoese and Allen are presently revising the genus.

The genus *Scortum* (leathery grunters) is presently also in a state of flux, and there were some problems encountered with members of the genus.

### 3.10 Specimens lodged in Queensland Museum

A few specimens of each species from each site sampled were collected and preserved for lodging in the Queensland museum. Upon return to Walkamin, fish were washed in water for a day or two, and transferred to 70% alcohol for storage. Identifications of fish were checked and most were keyed out according to Allen's (1989) *Freshwater Fishes of Australia.* More intensive work was done on those species which had not been observed in the area before or which are difficult to identify. Fish specimens were mailed to the Museum, where our identifications were confirmed and, where necessary, corrected.

A small collection (one or two of each species from the Peninsula) is maintained at Walkamin Research Station as a reference collection.

### 3.11 Samples for other Researchers

#### *3.11.1 DNA research*

Duplicate specimens of rainbows (Melanotaeniids) and hardyheads (Atherinids) were frozen, or preserved in absolute alcohol for DNA typing by a University student studying fish genetics. Fish to be frozen were anaesthetised or put directly into the freezer whole. Fish fixed in alcohol were anaesthetised, cut open, and dropped into the alcohol. Some samples were frozen in liquid nitrogen when that was available.

#### *3.11.2 Electrophoresis*

Samples of coal grunter *(Hephaestus carbo)*, saratoga *(Scleropages jardinii)* and black catfish *(Neosilurus ater)* were collected from east coast and west coast rivers. An eye, a piece of liver and a piece of muscle were taken from fish freshly killed with an overdose of phenoxy-ethanol anaesthetic, put in vials and frozen in liquid nitrogen. These were sent to the Southern Fisheries Centre where electrophoretic studies should determine whether there are significant differences between the east and west coast populations, and if there are close relationships between fish from certain river systems or not.

## 4.0 INFORMATION ON GIS DATA

**Summary**

1. Point data on the sites sampled will be entered into a GIS system which will allow immediate access to data on that site.

2. The GIS will initially be in the Department of Lands, Brisbane, and the National Resources Information Centre, Canberra. Additionally, the Environmental Resources Information Network, Canberra, has part of the data on fish distributions. The Queensland Museum is entering all fish specimens deposited into a MAPINFO GIS which records the distributions of fish all over the State.

### 4.1 The CYPLUS GIS

An integral part of the CYPLUS NRAP is the establishment of a Geographic Information System (GIS). As will be explained elsewhere in other project reports, the GIS is a computer based method of mapping out characteristics of an area. The GIS of fisheries data will be point data. On a map of Cape York Peninsula, sites sampled will be marked. When any site is selected data attached to that site can be accessed.

### 4.2 Potential uses of the CYPLUS GIS

*4.2.1 Predicting species distribution*

Using the various data sets in the CYPLUS GIS, predictions about possible distribution patterns or ranges of various fish species could be made. Those predictions would supplement greatly the point data on fish already collected. Particularly, faunal associations with vegetation, soil type, or elevation could be made. From the point data, fish species could be linked to attributes more fully mapped by other projects. For example, we have only found McCulloch's rainbow fish (*Melanotaenia maccullochi*) in soft, acidic, tannin stained water. This water type is virtually always associated with heath type vegetation and sandy soils. By selecting sites with McCulloch's rainbow fish from the fish database, and overlaying vegetation and soil maps, it will be possible to see those attributes which determine the fish's distribution. Other locations which would be a possible habitat for McCulloch's rainbow fish could be found by selecting the combination of characters (heath and sandy soil) which are preconditions for suitable habitat. By doing this, a more complete probable distribution pattern could be worked out, something that would take years of field work to complete.

The GIS could also be used to more accurately map distribution of species by, for example, contour lines. Fish like pennyfish (*Denariusa bandata*) tend to live in lowland flood plain lagoons. By determining the maximum elevation at which pennyfish are found, and mapping the area below that and on the flood plain of the river, their complete distribution could be seen more easily.

*4.2.2 Conservation/resource information*

The CYPLUS GIS will allow managers to see what effects certain future developments may have on species or habitats of particular significance. Mapping the downstream effects of mining or agricultural development is possible in a visual format. By having data available in an easy to use, readily accessible visual format, it should be relatively easy to find most of the available information on a given area by selecting that area or point and calling up the attributes on layers attached to it. For example, if a company decided to build a nuclear power plant at Coen, CYPLUS GIS could be used to access the available geological and biological information about the area within a defined radius of Coen. Information pertinent to building, water availability, environmental impacts, affected zones, etc., could all be accessed or modeled on the GIS.

Alternatively, if somebody wanted to farm fish, but was not sure where to buy land, then soils data could be used to locate suitable areas for ponds. Fish data could be used to ascertain whether the species to be farmed is native or already established in the basin. Current fisheries policy prohibits introduction of fish into drainage basins in which they are not native. Translocations of other species, both in Australia and overseas, has often proved disastrous to established local fisheries, or seriously damaging to the natural fish or invertebrate faunas.

*4.2.3 Other uses*

The applications of a GIS are only limited by the imagination of the user and the quality and form of data upon which it is based. There are a vast number of applications to which the CYPLUS NRAP data could be put to use, which should help in responsible management of the resources of Cape York Peninsula.

**4.3 Database**

The CYPLUS GIS database is a relational database set up to enable easy access of data from the GIS. Freshwater fish data collected on data sheets (See Appendix 5) was initially entered into three spreadsheet formats due to time constraints. It was necessary to format this data for input into the GIS environment. The original data has now been split up into 10 separate sheets (described below), following a database design methodology, worked out with G. McColm from the Department of Lands, Brisbane.

**4.4 Data Quality Information**

*4.41 Lineage*

Raw data was collected as outlined in Chapter Three, Methods and Materials. This data was collected from July 1992 to June 1994.

*4.42 Completeness*

Not all data collected was submitted to the GIS as some (site drawings, riparian vegetation data) was not in a form practical for inclusion or was difficult to handle with the resources available and the short time frame. Most data relating to fish, habitat and water chemistry has been submitted for inclusion into the GIS.

*4.43 Issues for consideration*

Sample methods were kept as uniform as possible to limit possible differences in data quality due to differences in intensity and efficacy of sample techniques. However, due to conditions in the field, not all methods could be used at any one location. Long nosed swamp dogs, turbid water, high conductivity, extreme temperatures, obstacles and heavy aquatic plant growth inhibited use of various sampling techniques to some degree. As discussed in Chapter Three, presence or absence of fish may be seasonal or determined by other factors, which greatly affect the reliability of short term studies such as this one.

Selection of sample sites was biased due to the constraints of accessibility and time. The Kendall River was unable to be sampled due to time constraints, and some areas of the Archer River were unable to be sampled due to denial of access to the area. Often upstream sites were extremely difficult to access due to terrain.

The period over which the data was collected may not be totally representative of a 'normal' year on the Peninsula. The first year (1992) was particularly dry, resulting in a number of usually perennial waterholes and rivers drying out. The time of year when sampling was conducted in a river system may have had effects also, as species tolerant of high temperatures and low oxygen levels may have been more abundant at sites sampled late in the year, than more delicate species requiring high dissolved oxygen levels or flowing water.

### 4.5 Data Dictionary

The data dictionary describing the data in the CYPLUS GIS follows. This is the data dictionary which will be attached to the GIS for user reference.

*Description of data:*

Freshwater fishes are those fish which spend most or all of their lives in freshwater. Freshwater fishes provide an important recreational resource, and are also valuable in the aquarium fish trade. Information on the habitat and distribution of freshwater fish will allow better, more informed management of this resource. The data are structured as points, indicating specific sites sampled. These are indicative of conditions at one point in time and may change over time. They are therefore useful only as an indicator of conditions at the time of sampling.

CONTENT OF DATA:

NUMBER of LAYERS: 1

LAYER NAME SPATIAL FEATURES DATA STRUCTURE

Ten separate files of fish and habitat data are provided. These are:

1. Fish Data. data collected on the fishes collected from each site sampled. These include information on the size of the fish and the environment in which it was caught. Ten fish of any one species caught by a particular method were measured and weighed. .
2. Site Data. This gives the site code and the latitude and longitude of each site.
3. Site Visit. This indicates the number of times each site was visited.
4. Surface Water Chemistry. measurement of surface water quality parameters taken near the water's surface. These include various water chemistry parameters and temperature.
5. Depth water chemistry. Four water quality parameters pertinent to fish were measured at depth in lagoons or holes where water flow was limited. Temperature and oxygen levels at depth, if different to these at the surface, may indicate stratification of the water into separate layers.
6. Cover. Instream cover gives a description of the percentage of different types of cover found in the section of stream surveyed.
7. Substrate. Substrate data indicates the approximate percentage of underwater substrate which was present at a particular site, within the area sampled.
8. Vegetation. The types of vegetation present, usually identified to genus, and the approximate percentage cover in the area studied.
9. Methods. The methods used in collecting fish and the length of time for which each was employed. If no fish were collected by a particular method it was still recorded as having been used.
10. Habitat Data. Data on habitat in the area studied including water flow, flow type, disturbance rating and maximum depth in each flow type.

| CODE | DESCRIPTION |
|---|---|
| Alkalinity | A measure of the buffering capacity of the water, tested as $CaCO_3$, measured in mg/L. |
| Aq_Veg_Typ | The genus or type of aquatic vegetation present.<br>1 Eelgrass (*Blyxa* spp.).<br>2 Eelgrass (*Vallisneria* spp).<br>3 Water lilies - members of the genera *Nymphaea* and *Nymphoides*.<br>4 Reeds and rushes (*Eleocharis, Lepironia, Juncus*).<br>5 Bladderwort (*Utricularia* sp.).<br>6 Water thyme (*Hydrilla* sp.).<br>7 Members of the family Characeae (*Chara* and *Nitella*).<br>8 Floating plants. In this study only *Azolla* and *Lemna* (duckweed).<br>9 Filamentous algae or algal sludge on bottom. Does not refer to Characeae.<br>10 Waternymph (*Najas tenuifolia*).<br>11 Water milfoil (*Myriophyllum* spp.).<br>12 Littoral vegetation flooded at high water (e.g. couch grass, *Melaleuca* forest etc.).<br>13 Other species not in above categories e.g. *Aponogeton, Potamogeton*. |
| Ca | Calcium hardness. A measure of calcium carbonate in the water, measured in mg/L. |
| Cond | Conductivity- ability of the water to conduct an electrical current. Measured in μ siemens/cm. It is a measure of the amount of ions in the water. |
| Cover_Code | The type of cover in which the fish was caught.<br>1 Open water.<br>2 Rocks.<br>3 Branches (small snag).<br>4 Logs(snag).<br>5 Log jam (large snag).<br>6 Branch overhang.<br>7 Roots.<br>8 Undercut.<br>9 Submerged vegetation (aquatic vegetation usually completely submerged).<br>10 Floating vegetation (free floating aquatic vegetation, not attached).<br>11 Emergent vegetation (vegetation attached to the bottom but with floating or emergent leaves). |

| | |
|---|---|
| | 12 Algae (with the exception of members of the Characeae which were classed as macrophytes). |
| | 13 Leaf litter. |
| | 14 Constructions (man made structures or sawn timber). |
| | 15 Urban rubbish. |
| | 16 Rock and vegetation. |
| | 17 Snag and vegetation. |
| | 18 Standing timber. |
| | 19 Roots and undercut. |
| | 20 Emergent and floating vegetation. |
| Date | The date on which the observation was made. Most sites were sampled over one day, or two consecutive days. |
| Depth(m) | Approximate depth of fish in water when captured, or approximate depth in which measurement was taken. Measured in metres. |
| Depth_Rec. | Indicates whether water chemistry parameters were also measured at depth<br>Y - indicates parameters were measured at depth. These are held in a separate file.<br>N - indicates parameters were measured at one depth only. |
| Disturbance | A rating on a scale of one to six of disturbance from factors such as feral animals, cattle, camping, mining, erosion, siltation. This is a subjective scale and is only an estimate of disturbance at the time of the site visit.<br>1 extreme.<br>2 very high.<br>3 high.<br>4 moderate.<br>5 low.<br>6 very low disturbance. |
| Duration | Duration of fishing time in minutes. |
| E_or_S | Emergent or submerged.<br>1 Emergent. Includes all plants which normally grow above or float on top of the water. Does not include *Myriophyllum*. Does include lilies.<br>2 Submerged. All plants which normally grow completely under water. Includes *Myriophyllum*. |
| Extras | Refers to extra fish caught in the fishing time over the ten that were measured and weighed. |
| Fish_Obs. | A unique identifier identifying each individual fish observation. |
| FL(mm) | Fork length. length of the fish from the anterior extremity to the base of the fork (in those fish with a forked tail). |

| | |
|---|---|
| Genus | The genus of fish captured. Taxonomy follows that adopted in Allen, 1989, with exceptions as listed in Appendix Two of the Final Report. |
| Flow type | The type of flow environment in which the fish was collected.<br>1 Swamp-shallow, generally temporary water body completely overgrown with emergent grasses, sedges and reeds.<br>2 Lagoon-permanent or temporary water body not connected to main river bed. Usually up on flood plain.<br>3 Pool-water body within the stream bed, low flow rate.<br>4 Backwater-water with no discernible flow, usually downstream of an obstruction like a sandbank.<br>5 Gentle flow-flow easily measurable but gentle.<br>6 Glide-water flows fast and deep (usually more than 50 cm deep).<br>7 Riffle-water flows fast and shallow (less than 50cm deep).<br>8 Rapid-white water. Usually flows through large rocks or boulders.<br>9 Cascade-vertical drop of water more than 50 cm.<br>10 Flood-area of high flowing water near bank during flood event, or flooded area.<br>11 Soak/drain-swampy area or artificial drain.<br>12 Dam-artificially constructed water body.<br>13 Tidal-water level fluctuates with tides but saltwater intrusion infrequent. |
| Flow_Rate_(RP/40sec) | Flow rate measured as revolutions per 40 seconds on a stream master flow meter. Can be calculated to velocity by the following formula, where n=number of revolutions.<br>$n < 1.12 \quad V = 0.1293\,n + 0.0146$ m/s.<br>$1.12 < n < 9.58 \quad V = 0.1246\,n + 0.0198$ m/s.<br>$n > 9.58 \quad V = 0.1342\,n - 0.0722$ m/s.<br>Measured in the middle of the flow , at the appropriate depth. |
| Flow_Type(%) | The percentage of the sampled section of stream with that flow type. |
| Habitat type | Type of habitat, whether in the stream bed or (generally) on the floodplain.<br>1 stream bed habitats or flowing waters.<br>2 lagoons and other habitats not in the stream bed. |
| Latitude | The latitude position taken with a Magellan GPS. In degrees, minutes, and decimal points of minutes. All latitude positions are South. Accuracy is to within 100m of actual location. |
| Longitude | As for latitude. All longitude positions are East. |
| Max_Depth(m) | The maximum depth in metres of the particular flow type. |

| | |
|---|---|
| Method | Codes describe the method by which the fish were captured. Method is entered even when fish were not caught using that method, to indicate what methods were used at each site.<br>1 Electrofishing.<br>2 1½"gill net.<br>3 2½" gill net.<br>4 3½" gill net.<br>5 6" gill net.<br>6 Fine seine (1 mm mesh size).<br>7 Large seine (10 mm mesh size).<br>8 Sighted.<br>9 Baited line.<br>10 Lure fishing.<br>11. Fyke net. A passive net designed to catch fish in a funnel shaped end.<br>12 Panel net. (Gill mesh-50, 75,100 mm in 10m lengths sewn together as a single net 30m in length. |
| Mg | Magnesium hardness. Calculated as calcium hardness subtracted from total hardness. |
| Museum number | The acquisition number used by the museum for samples collected by us and deposited at the Queensland museum. At present these are incomplete but nearly all specimens with sample numbers were deposited with the museum. It may take some time for these numbers to be forwarded to us. |
| Oxygen | The concentration of dissolved oxygen in the water measured in mg/L. |
| %_Present | The percentage of the sampled section of stream with the attribute concerned. e.g. the percentage of the sampled section of stream with a mud substrate. |
| pH | A measure of hydrogen ion concentration, above 7 being alkaline and below 7 being more acid. |
| PO4 | Total phosphate as $PO_4$ . |
| Sample number | The sample number we used to identify specimens collected for the museum. |
| Secchi | A measure of the clarity of the water. a black and white disc is lowered into the water until it cannot be seen, and then raised until it becomes visible. The depth at which it becomes visible is recorded in metres. A metre is the length of the path traveled by light in a vacuum during a time interval of 1/299 292 488 of a second. |

| | |
|---|---|
| Site code | This follows the national river system coding. This is the national River basin numbering System, established by the Australian Water Resources Council, and adopted as the unofficial standard by the Queensland Department of Primary Industries Water Resources Commission. The first three numbers are the national code for a particular drainage system. The following number is the identifier for subdivisions within that drainage system. The four numbers are usually the same for the whole data set. The following two numbers are our site code number, and the two after that indicate which visit to that site it was (in most cases we only visit a site once, hence it's usually 01). |
| Site ID | The first six numbers of the site code, i.e. the National river code system number and the site number. |
| SL(mm) | Standard length. The length of the fish from the anterior extremity to the base of the caudal peduncle (where the scale pattern becomes irregular). |
| Species | The specific epithet, which with Genus makes the complete scientific name. In some cases a subspecies name is also included here where subspecies were clearly distinct. |
| Substrate_typ | The substrate over which the fish was caught<br>1 Bedrock<br>2 Boulders<br>3 Pebbles<br>4 Gravel<br>5 Sand<br>6 Clay<br>7 Composite (usually a mix of clay and gravel)<br>8 Mud<br>9 Sand and mud<br>10 Rocks and mud. |
| Tannin | A measure of tannins and lignin (as mg/L) in the water. |
| T. Hard | Total hardness. A measure of carbonate (calcium and magnesium) in the water. Measured as mg/L. |
| Time | The time at which the attributes were measured. In twenty four hour time |
| Time start | Time that fishing commenced, 24 hour time. |
| TL(mm) | total length. Total length of the fish from the anterior extremity to the posterior extremity (in millimetres). |
| Visit_Obs. | A calculated index number for the combination of site code and flow type. |
| Water temperature | Water temperature at the surface when the fish were captured. In degrees Celsius. |

Wt(g) Weight measured in grammes.

OTHER INFORMATION

Sources for identification and naming of fish.

All species except the following exceptions were identified using keys in :

Allen, G. R. 1989 Freshwater Fishes of Australia. TFH Publications: Neptune City

| Species | Source of keys for identification |
|---|---|
| *Caranx sexfasciatus* | Grant, 1982 |
| | |
| *Butis butis, Gerres filamentosus, Oxyeleotris gyrinoides, Thryssa scratchleyi, Eleotris melanosoma, Eleotris fusca, Elops machnata, Redigobius chrysosoma* | Allen, 1991 |
| *Zenarchopterus novaeguineae, Zenarchopterus buffonis* | Allen, 1991; Collette, 1974; Munro, 1967 |
| Family Chandidae (*Ambassis, Denariusa, Tetracentum, Parambassis*) | Allen and Burgess, 1990 |
| Family Melanotaeniidae (*Iriatherina, Melanotaenia* etc.) | Allen and Cross, 1982; Allen, 1989 |
| *Oxyeleotris selheimi* *Glossogobius* spp 1 & 2 ) | Identified by D. Hoese in 1993 |

## 4.6 Location and Access

The CYPLUS GIS will be held both at the Queensland Department of Lands in Brisbane and in NRIC (Natural Resource Information Centre) in Canberra. By its nature this will include virtually all the numeric data collected during this survey. These coverages will be in ARCINFO format.

Contacts for access to the database should be made to :-

| | | |
|---|---|---|
| Ian McNaught<br>PO Box E11<br>Queen Victoria Terrace<br>Parkes ACT 2600 | OR | Graham McColm<br>Department of Lands<br>Locked Bag 40<br>Cooparoo Delivery Centre<br>Qld 4151 |

### 4.7 Other Data Repositories

Additionally, a fisheries GIS in MAPINFO will be put together. As the Queensland Museum is using MAPINFO for its fish mapping program (mapping locations of all specimens in the collection) the fisheries GIS should be able to be appended to and/or interact with the Museum one.

All biological data is also being deposited with ERIN (Environmental Resources Information Network) in Canberra and stored in a Microsoft ACCESS database. It will be transferred to ORAQLE at a later date. The contact there is :-

Matt Bolton
ERIN
GPO Box 787
Canberra ACT 2601

## 5.0 CATCHMENT 1010 - HARMER CREEK AND SAND DUNE LAKES

**Summary**

1. Most of the basin is sand country, dominated by vast dune lake systems.
2. Few previous studies concentrated on lakes.
3. Three sites on Harmer Creek and five lakes sampled.
4. Twenty two fish species collected from Harmer Creek. Four additional species collected from lakes.
5. Obbe's catfish (*Porochilus obbesi*), black catfish/jewfish (*Neosilurus ater*) and saratoga (*Scleropages jardinii*) not previously reported from dunefield lakes in North Queensland, were collected.
6. Black catfish from Harmer Creek appear to be genetically different to those from elsewhere on the Peninsula on the basis of electrophoretic protein analysis.
7. Banded rainbows (*Melanotaenia trifasciata*) and mouth almighties (*Glossamia aprion*) were breeding at the time of study. Saratoga caught in August were ovigerous.
8. Water quality good, soft and slightly acidic. Often humic (tannin stained).
9. Apparent habitat disturbance was limited.
10. Estuarine crocodiles (*Crocodylus porosus*), file snakes, giant prawns and redclaw crayfish common.

### 5.1 Basin Characteristics

This catchment basin is composed largely of sandy country, although in the south western corner of the drainage there is ironstone country. Refer to soils mapping project (Land evaluation CYPLUS NR02), bedrock data (Regolith CYPLUS NR12) for details on geology. The area has a good water retention potential. Harmer Creek is a perennial stream in the south of the basin. It is a small creek, 47 km long, draining an area of 770 square kilometres. There are numerous other short creeks in the basin, often draining a very small area but fed from the large aquifers in the dunes. There are literally hundreds of sand dune lakes in the area. A large portion of this area is currently National Park or special purposes reserve, and is part of the traditional lands of the Injinoo people. A small area is grazed by cattle at low densities in the south.

Much of this country is sand dune heath (Refer to Vegetation Mapping NR01 for details). Water draining from this country often has a high content of humic substances, tannin and lignin, from peat and other vegetable matter. This stains the water a brown colour and often makes it acidic. However, some lakes and watercourses are not affected by this and clear water is present.

## 5.2 Previous Studies

No previous published reports of any fish surveys in Harmer Creek were located. Beumer *et al.* (1981) reported long finned eels (*Anguilla reinhardtii*) from Captain Billy Creek, north of Harmer Creek. Timms (1986) studied limnology of lakes near Somerset (Lakes Wicheura and Bronto) and Ussher Point, including fish sampling. Lees and Saenger (1989) studied four sand dune lakes in Shelburne Bay in detail, and used rotenone (fish poison) to capture fish. Species lists from the latter two studies are presented in Appendix One.

## 5.3 Sites Sampled

Harmer Creek is a generally shallow creek with a gravel/sand bed which flows through sand and sandstone country in its lower reaches. Deep (2-2.5 m) holes are present at bends with rock ledges or near logs or trees in the stream bed. The colour of the water (tea tree stained) makes the water look deeper. Water quality characteristics are presented in Appendix 4. Fallen timber provides the major instream cover at most sites. Rocky ledges and undercuts are also important. Virtually no macrophyte (aquatic plants) vegetation is present in the creek bed except for some stonewort (*Chara*) and filamentous green algae. Refer to Figure 2 for location of sites sampled.

Lake Bronto is a deeply stained tea-coloured lake near Bamaga in the north of the catchment. Bladderwort (*Utricularia*) and reeds (*Eleocharis* sp. and *Lepironia auriculata*) were abundant. The deepest point we measured was 0.95 m. The instream cover was limited to aquatic vegetation. The water was acidic and had a high tannin content. The substrate was sand.

Table One. Sites sampled - Harmer Creek and Sand Dune Lakes. Drainage Basin 1010.

| Map Ref. | Site Code | Name | Date | Latitude | Longitude |
|---|---|---|---|---|---|
| A | 1010 01 01 | Sand dune lake near Harmer Ck | 30 Sep 1992 | 11°57.5'S | 142°56.2'E |
| B | 1010 02 01 | Old Harmer Creek Crossing | 29 Sep 1992 | 11°58.87'S | 142°50.63'E |
| C | 1010 03 01 | Harmer Ck, Beach Rd Crossing | 06 Aug 1993 | 11°58.49'S | 142°49.78'E |
| B | 1010 02 02 | Old Harmer Ck Crossing | 07 Aug 1993 | 11°58.87'S | 142°50.63'E |
| D | 1010 04 01 | Harmer Ck on Sand Dune Rd | 08 Aug 1993 | 11°58.75'S | 142°53.45'E |
| | 1010 05 01 | Lake Wicheura | 10 Aug 1993 | 10°46.21'S | 142°33.58'E |
| | 1010 06 01 | Lake Bronto | 11 Aug 1993 | 10°46.11'S | 142°34.02'E |
| | 1010 07 01 | Sach Waterhole | 12 Aug 1993 | 11°02.73'S | 142°44.73'E |
| | 1010 08 01 | Ussher Point Lake | 13 Aug 1993 | 11°10.17'S | 142°47.04'E |

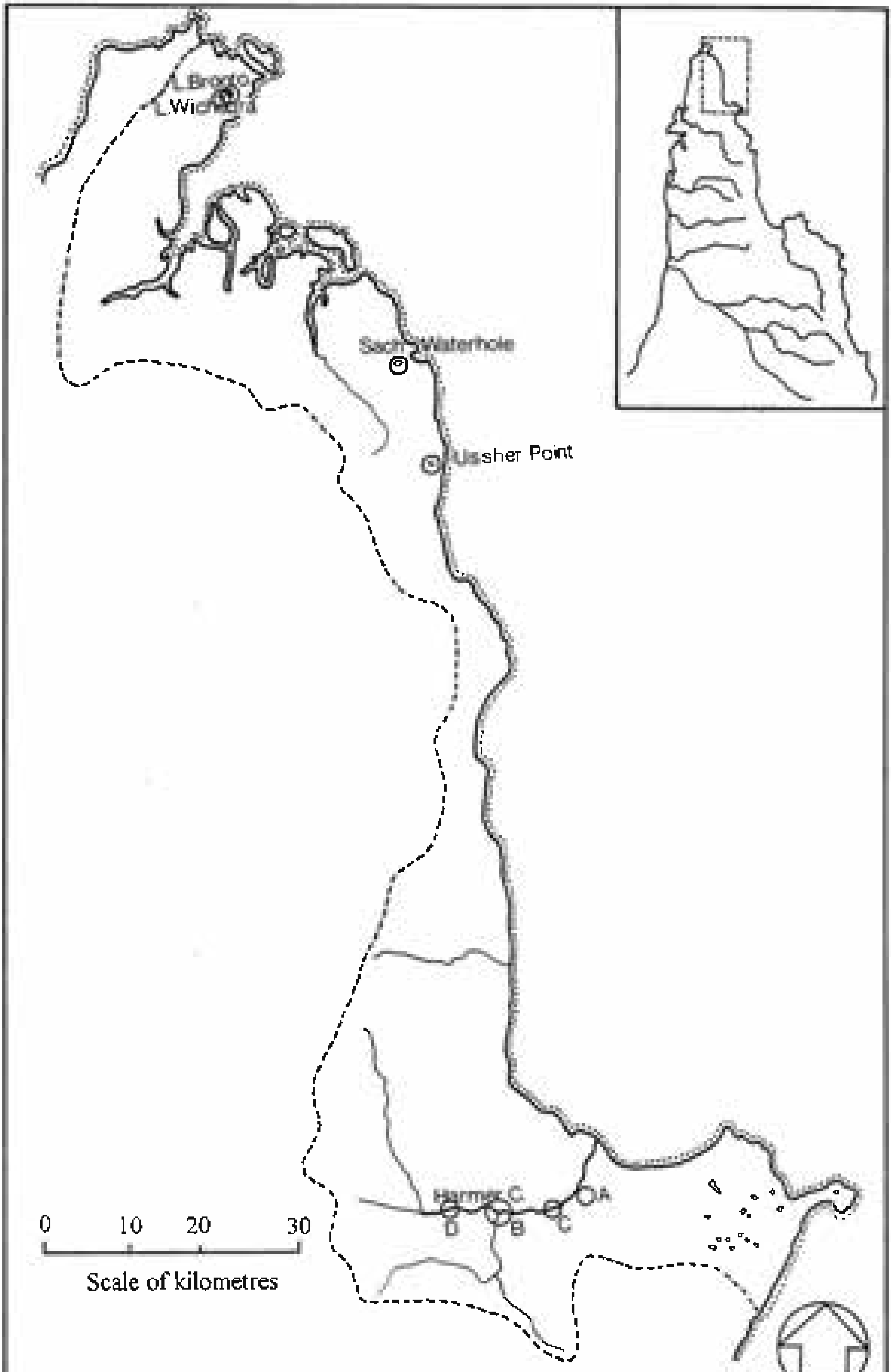


**Figure 2 Harmer Creek and Sand Dune Lakes- Drainage Division 1010**
Markers indicate sample sites (refer to Table 1 for date and site names)

Lake Wicheura, only a couple of hundred metres from Lake Bronto, had similar vegetation. However, the water there was clear, with neutral pH and little tannin. The maximum depth we measured was 2.6 m. Aquatic vegetation was mostly reeds (*Eleocharis* and *Lepironia auriculata*) and a mucilaginous green algae which formed a layer up to 10 cm deep on the bottom. The substrate was white sand. There were no snags, as in Lake Bronto.

Sach waterhole is a large lake which had been used as a water point for bauxite prospecting and mining nearby, according to Meun Lifu, the head ranger at Injinoo Community. Sach waterhole is similar to Lake Wicheura in that the water is very clear and pure, although the conductivity was high. The maximum depth measured was 1.9 m. At Sach waterhole there were floating mats of reeds (*Lepironia auriculata*), which were on the southern and western ends of the lake. They extended about 1 m deep in the water. Pitcher plants (*Nepenthes mirabilis*) and various ferns including *Nephrolepis* and mangrove fern (*Acrostichum speciosum*) grew in the mats. These mats may be substantially different to those in the Northern Territory, which are composed of *Hymenachne* sp. This was the only location where such mats were observed in this study.

The lake at Ussher Point was interesting as it was devoid of all fish life, was of a deep blue colour and had little vegetation (See Plate 3). The pH was measured to be 3.28, which is probably too acidic for many fish. However, Lees and Saenger (1989) found six species of fish in a Shelburne Bay lake with a pH of 3.44. Other parameters measured indicated no buffering capacity (alkalinity as Ca $CO_3$ was 0). The substrate in this lake was largely fine mud. Timms (1986) studied this lake in July 1983, and collected Gertrude's blue-eyes (*Pseudomugil gertrudae*). The pH was then was 4.8. As Timms' observations were made closer to the wet season, this is not surprising.

The lake in the sand dunes at Shelburne Bay was similar to Lake Wicheura in vegetation, but was discoloured brown by tannins, and was acidic. Depth could not be measured as a boat could not be taken in and there was a probability of crocodiles being present. Similar lakes in this locality are all shallow, with a mean depth of 0.8 m, but up to 2 m in the wet season (Lees and Saenger, 1989). The substrate was sand. All aquatic vegetation was marginal, suggesting that it was deep in the middle. This lake had contracted greatly, due to the exceptionally dry weather of previous years. It was visited again in August 1993, and covered about double the area it did in September 1992.

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Plate 3. The highly acidic lake at Ussher point. This lake was devoid of all fish life when visited in August, 1993

Plate 4. Coal grunter (*Hephaestus carbo*) from Harmer Creek. The orange colour of the flecks is not well reproduced by photography.

### 5.4 Fish Species Present

Species lists for Harmer Creek and dune lakes are presented in Appendix 2. Harmer Creek has a relatively high number of species (23) for such a small creek within a small catchment. The species collected by Lees and Saenger (1989) are included in Appendix One for comparison. Not surprisingly, nearly all the species collected from the sand dune lake near Harmer Creek are present in the creek. There is a swamp running parallel to the dune which separates the lake from Harmer Creek which could, in times of exceptional flooding, connect the lake with Harmer Creek. It was interesting that sailfin glassfish/perchlet (*Ambassis agrammus*) and threadfin rainbows (*Iriatherina werneri*) were common in the lake and not the creek.

The fauna of Harmer Creek is very similar to that in the Jardine. All species collected from Harmer Creek have been collected in the Jardine River, except for jungle perch (*Kuhlia rupestris*) and belut/mud eel (*Monopterus albus*). This is not surprising, as both watercourses drain similar country. Jungle perch and mud eels have an east coast distribution (Allen, 1989). We did not catch any bony bream (*Nematalosa erebi*).

Some sand dune lakes on the north east coast of the peninsula were studied by Timms (1986), who studied the limnology of Lakes Bronto and Wicheura, and the lake at Ussher Point. Additionally, B. Hansen visited Lake Wicheura in 1988, and observed only poreless gudgeons (*Oxyeleotris nullipora*). Timms collected northern purple spotted gudgeons (*Mogurnda mogurnda*) in Lake Wicheura, and purple spotted gudgeons and swamp eels (*Ophisternon gutturale*) in Lake Bronto. All three species were caught in both lakes in this study. Our swamp eel specimens were identified at the Queensland Museum as *Ophisternon bengalense*.

Sach waterhole had a comparatively large number of species compared with the other dune lakes sampled, having eight species. (Lakes Bronto and Wicheura had only three each)

The lake at Ussher Point was also sampled by Timms (1986) and Gertrude's blue-eye (*Pseudomugil gertrudae*) was caught. These may have come from the small creek which connects Sach waterhole to the sea. This creek could not be sampled due to the presence of two large crocodiles.

Coal grunter / spotted perch / golden bream (*Hephaestus carbo*)(Plate 4) in Harmer Creek grew to an unusually large size compared to the other systems. The largest caught had a standard length (SL) of 217 mm, and weighed about 300 g. (Standard length is the length measured from the tip of the nose to the base of the tail). Several more were in that size category. This is considerably larger than coal grunter from other river systems sampled except the Olive. In our experience they grow to about 100 mm SL in other systems in the Peninsula. Specimens up to 160 mm SL have been collected from the Gregory River (Vari, 1978).

The colouration of coal grunter from Harmer Creek and the Olive River was different to that of populations on the west coast and in the Lockhart and Claudie Rivers. The gold or yellow flecks on the operculum and sides in other fish were a salmon pink to light red colour in Harmer Creek and Olive River specimens. This colour was more pronounced on the operculum. Fish can change their colour according to conditions, and it is possible that the humic waters of the Olive River have prompted this colour, although specimens from Rainbow Lagoon (which has clear water) in the Olive River were a definite orange-red colour on the operculum and sides.

## 5.5 Distributions

### *5.5.1 Extent*

There was a huge gap between sampling stations, between Ussher Point and Harmer Creek. The only record we could find of freshwater fish in that area was of the Pacific short-finned eel (*Anguilla obscura*), from Captain Billy Creek (Beumer *et al.*, 1981). Additional species which breed in salt or saline water (short finned eel, *Anguilla reinhardtii;* jungle perch, *Kuhlia rupestris;* snakehead gudgeon, *Ophieleotris aporos;* empire gudgeon, *Hypseleotris compressa*) could be expected to be found in fresh waters where access is possible from the sea. Although Lakes Wicheura and Bronto had a limited fish fauna at the time of sampling, Sach Waterhole had quite a diverse fauna. Obbes' catfish (*Porochilus obbesi*) and black catfish/jewfish (*Neosilurus ater*), from Sach Waterhole, and saratoga from Shelburne dune lake, are species not previously documented from dune field lakes in far north Queensland.

Spangled perch (*Leiopotherapon unicolor*) and barred grunter (*Amniataba percoides*) were not collected by us, or reported present in the creek by locals. Their apparent absence from Harmer Creek and the Olive River is discussed in 6.4.1.

The distribution of other species is patchy. As noted by Lees and Saenger (1989), each lake appears to have its own peculiar fauna. This may be in part due to the comparative isolation and distance between lakes. Lakes in close proximity (e.g. Wicheura and Bronto) have the same fauna. Water quality also may determine presence or absence of fish species. The lake at Ussher Point was apparently unsuitable for any large aquatic life other than damsel fly nymphs.

### *5.5.2 Habitat dependence*

Threadfin rainbows (*Iriatherina werneri*) were only present in lakes with soft acidic water in this drainage basin. They were absent from the creek. The sand dune lake threadfin rainbows were caught in emergent vegetation. Threadfin rainbows appear to be dependent on aquatic vegetation as in other locations they are associated with it (e.g. Allen and Hoese, 1980; Leggett and Merrick, 1987).

M^c^Culloch's rainbows (*Melanotaenia maccullochi*) were found in both lake and creek habitats, and both environments were soft water also. Presumably this species prefers humic waters, as it was found in areas with pH below 7.0 and stained water.

It was unusual that sailfin glassfish / perchlets (*Ambassis agrammus*) were caught only in lakes and not the creek. In other locations they are common in both, although prefer areas of low flow. Possibly the restricted areas of suitable habitat in Harmer Creek, or the large number of predatory fishes, explain their apparent absence.

One-gilled eels (belut, *Monopterus albus* and swamp eels, *Ophisternon bengalense*) were only collected from muddy banks or mud covered leaf litter in shallow water close to the banks. They are adapted to burrowing in the mud, and it would appear that mud is an essential prerequisite for them to be in an area. One exception to this was Lake Wicheura, in which they were present under algae.

Catadromous species of fish (those which spawn in salt water but move upstream to grow and feed in freshwater), barramundi (*Lates calcarifer* ) and tarpon/oxeye herring (*Megalops cyprinoides*), were found in the most upstream sites sampled in Harmer Creek. None were found in sand dune lakes. However, eels (*Anguilla* spp.) may have been present in the sand dune lake at Shelburne and were present in Sach Waterhole. Eels are capable of considerable feats in migration and colonising freshwater environments, and would probably be capable of colonising most coastal streams and lakes. The threadfin silver biddy (*Gerres filamentosus*), was only found in one of the sampling sites further downstream. It is considered to be more of a marine vagrant than a catadromous species (Allen, 1991).

## 5.6 Species of Commercial and Recreational Importance

All main recreational species of importance were present in good numbers in suitable habitats in Harmer Creek. However, as stated in the introduction, one-off visits indicate conditions only at the time or season of sampling. Saratoga, barramundi, large coal grunter , jungle perch and jewfish (*Neosilurus ater*) were caught wherever there was adequate depth for them. Tarpon/oxeye herring (*Megalops cyprinoides*) were also present.

Harmer Creek is too small in its freshwater reaches to be commercially fished with nets. An attempt to fish in the upper tidal reaches resulted in nets being severely damaged and all fish caught being eaten by crocodiles between 2.5-6 m in length. It is doubtful that much commercial fishing occurs in the creek proper, if at all. However, campers use several sites on the station. One of these is on the upper tidal reaches of the creek, and the other at the crossing on the road to White Point. Most campers head for the beach. People living in the area do fish occasionally for food.

Jewfish / black catfish / eeltailed catfish (*Neosilurus ater*) from Harmer Creek were sampled and electrophoresis (protein studies) done on them by Dr. C. Keenan at the Southern Fisheries Centre, Deception Bay. They had different proteins to eeltailed catfish from other east and west coast rivers. Further research on the protein and enzyme profiles is needed to confirm this but initial results suggest that Harmer Creel eeltailed catfish differ significantly from other populations.

Ornamental fish present in the region studied included threadfin rainbows (*Iriatherina werneri*), banded rainbow fish (*Melanotaenia trifasciata*) and M^c^Culloch's rainbow fish (*Melanotaenia maccullochi*). The threadfin rainbows were only collected by us at the sand dune lake. They were of an unusually large size (some almost 4 cm long) for this fish but not of the same intensity of colour as those from further south. However, as fish do change colour depending upon diet, conditions (breeding, season, etc.) surroundings and stress, it is possible they have deeper colours at other times. Banded rainbows from Harmer Creek are not as spectacular as other tribes of the species from the Weipa area or the Goyder River in the Northern Territory. M^c^Culloch's rainbows from Harmer Creek were the green finned variety, which look more like the Jardine form of the species. There are two forms - a red finned Cairns variety and a green finned New Guinea variety (Leggett and Merrick, 1987).

### 5.7 Breeding Observations

In the early August 1993 sampling period on Harmer Creek, all female saratoga (*S. jardinii*) were noted to have ovaries in an advanced state of development. Many ova were pea sized, which is close to the size they are in the breeding season.
Several male mouth almighties (*Glossamia aprion*) were observed incubating eggs in their mouths in August, also.
Female banded rainbow fish were observed to have swollen abdomens and developed ova when cut open for preservation. Some males were also running ripe.

### 5.8 Water Quality

In Harmer Creek, water quality at all sites sampled was fairly consistent, which is not surprising considering the short length of stream in which the sample sites were. See Appendix 4. All water parameters measured were about equal, except there was detectable phosphorous at Beach Road crossing (1010 0401), possibly due to the presence of cattle congregated around mineral licks in the area. Tannin levels were 1-1.6 mg/l, and secchi visibility 1.1-1.38 m or deeper.

The dune lakes were all similar in that they had lower pH than the creek, all but Sach waterhole had readings below 6. Conductivities were also markedly higher than the creek, although Lakes Wicheura and Bronto had very low conductivity. All these lakes except the sand dune lake near Harmer Creek represent the level of the local water table (Timms, 1986). Differences in conductivities may be attributable to these areas' ground water characteristics (see ground water resources project NR16 for ground water details). The sand dune lake was probably a perched lake, sealed by a layer of humicrete. Generally, lakes were fairly clear, except for Lake Bronto and the sand dune lake, both of which had substantial (> 1.8 mg/l) amounts of tannin. Differences between Lakes Wicheura and Bronto in calcium levels, tannin, pH and oxygen could be partly attributed to the greater level of humic material in Lake Bronto contributing to biological oxygen demand, reduced clarity of water, and acidity. Stratification was not observed in any of the lakes.

### 5.9 Habitat Disturbance

On the basis of all visits, all sand dune lake environments had suffered little or no disturbance. Aborigines camp and teach children bushcraft near Lake Wicheura from time to time. The Injinoo council does not permit camping at Lake Wicheura without permission and it is managing camping elsewhere. Sach Waterhole has an abandoned settlement nearby and a road going to the old jetty, but this is little used. The sand dune lake on Shelburne is only accessible by foot or helicopter.

Some minor erosion was observed associated with crossings or roads on Harmer Creek. Pig damage appeared to be limited to accessible creek bank areas. In the sand dune lake at Shelburne, pig damage was observed in September of 1992, possibly because pigs were congregated near freshwater. Swampy areas of reeds (*Eleocharis*) had been dug up. Overall, however, habitat disturbance as observed at the times of visiting was low.

Cane toads (*Bufo marinus*) arrived in this area in about 1989-1990 (see Cohen and Williams, 1993). A dramatic impact on local fauna was noted by residents. Terrestrial fauna was devastated with their arrival, and catches of all species of freshwater fish plummeted. Particularly, eeltailed catfish /jewfish (*Neosilurus ater*),coal grunter and saratoga were affected. However, jewfish (?*Tandanus* sp.) are reported to feed on toad eggs without ill effect (Covacevich and Archer, 1975). Fish which breed in estuaries (and therefore have annual recruitment) or ocean (e.g., eels) were not affected as severely. The situation settled down with the stabilisation of toad numbers after the initial population explosion, but some locals believe that general fish numbers are down on what they used to be before cane toads came.

### 5.10 Notes on Other Fauna

Estuarine crocodiles (*Crocodylus porosus*) were common and regularly observed in the lower reaches of the creek. Freshwater prawns (*Macrobrachium rosenbergii*) and redclaw crayfish (*Cherax quadricarinatus* ) were present but not abundant at the time of sampling. File snakes (*Acrochordus arafurae*)were present.

## 6.0 CATCHMENT 1020 - OLIVE RIVER

**Summary**

1 The Olive River basin consist of two areas. The southern tributaries (Glennie, Emu, and Snake Creeks) drain sandstone country and are perennial. The Olive drains the drier country to the north and west of the sandstone plateau in Bromley, and is intermittent.

2. Only one previous study (H. Midgley, 1988) was located. All species collected in that survey were collected by us.

3. Thirteen sites in the basin were sampled. Four lagoon sites, five Olive River sites and three tributary sites were sampled. Additionally, a small creek near Bolt Head was surveyed.

4. The Olive River was noted for the abundance of gudgeon and sleepy cod (Eleotrid) species. It has very close affinities with the fish fauna of the Fly River in new Guinea. Thirty six species were collected, of which two were marine vagrants.

5. The Olive is the southernmost point on the east coast of the distribution of saratoga (*Scleropages jardinii*), threadfin rainbows (*Iriatherina werneri*) and Macleay's glassfish (*Ambassis macleayi*). It is the northernmost system where eastern sleepy cod (*Oxyeleotris gyrinoides*) were collected. Threadfin rainbows were common in river locations, which is unusual as normally they are associated with aquatic vegetation.

6. There is a high concentration of fish of recreational importance in the Olive. There is potential as a site for collection of broodstock of aquarium fish species.

7. Small species of fish were observed breeding from August through to December. Saratoga bred after the first storms.

8. Water quality was generally good. One site was deoxygenated after a flush of ash from a bushfire was washed in after a storm. Water quality in lagoons differed and apparently was dependent on surrounding vegetation.

9. Feral pigs were the major disturbing influence, increasing erosion and lowering bank stability. Some erosion associated with roads was observed.

10. Estuarine crocodiles were common. Giant prawns (*Macrobrachium rosenbergii* and *M. lar*) and redclaw crayfish (*Cherax quadricarinatus*) were present but not abundant.

### 6.1 Basin Characteristics

The Olive River basin can be divided into roughly two subcatchments, that draining the high sandstone ridges and sandy heath country of Bromley Station, and that draining Bramwell Station. Refer to NR02 soils mapping for geology details. The total catchment area is about 1760 square kilometres. Glennie Creek, Snake Creek and

Emu Creek are all perennial, and the Olive itself is only perennial downstream from its junction with Glennie Creek. All of the area with perennial streams is currently under consideration for purchase as a national park. Much of the drainage is ungrazed at present as no managed cattle are on Bromley lease. The upper Olive River proper on Bramwell is grazed by cattle.

The area drained by Glennie Creek is heath country in the upper reaches, and stringybark woodlands at the sites sampled lower down. The Olive itself flows through woodland. All tributaries and the main river have dense gallery forest in the channel and river bed, extending up to about 5 m from the top of the banks (refer to vegetation mapping NR03 for details). Water in all tributaries is humic (tea coloured), which is probably how the river got its name, due to the dark colour of the water.

### 6.2 Previous Studies

Hamar Midgley surveyed the Olive River crossing at Bromley in 1988. This site corresponded to our site number 1020 03. A copy of his species list is presented in Appendix One. All fish species caught by Midgley were also collected at that site by us.

### 6.3 Sites Sampled

A total of 13 sites were sampled on the Olive River (Table 2). Where possible, local names were used for the locations but some were not named and a name based on the characteristics was coined. See Figure 3.

The Olive River itself, and Snake Creek, are deep channeled streams. The channel is a deep trench up to 6 m below the level of the flats and flood plains immediately adjacent to it. Long pools are connected by shallow riffles flowing over sand banks. The gallery forest is extremely thick and dense. Pools may be up to 3.5 m deep, but normally are 1.5-2.0 m deep. Instream cover is highly complex with enormous quantities of fallen timber in the stream (See Plate 6). The channel in nearly all places but deeply eroded bends is covered by the gallery forest. Leaf litter is present in quantity only in non-flowing sections of the river. In September 1992 the river above the Glennie junction stopped flowing, although Snake Creek and Glennie Creek flowed all year. Eelgrass (*Blyxa*) grows in areas of gentle flow where there is sufficient light penetration. Water lilies (*Nymphaea* sp.) were present in small numbers in pools in the river bed which were exposed to direct sunlight. The substrate in riffles is sand or pebbles, and in pools it may be mud.

Glennie Creek also flows in a restricted channel, but this has much lower banks than the Olive, with gently sloped margins. Still, the creek bed is generally 3-4 m below the level of the surrounding floodplain. The two locations sampled on Glennie Creek had moderate flow rates, and were usually 30-50 cm deep (maximum depth in pools 2 m, but few pools were present). *Blyxa* (eelgrass)was abundant on banks sheltered from the main flow. As in the main river bed, there was very high habitat complexity with large amounts of fallen timber. Water was slightly humic, but not very acidic. Secchi visibility was > 2 m (secchi is a measure of the clarity of the water).

A small creek draining a small patch of coastal rainforest near Bolt Head was sampled (See Plate 5). The bed of this creek was composed of fine sand. Habitat was highly complex, with abundant marginal vegetation (screw palm, *Pandanus* sp.) and grasses in the water, and numerous logs and roots along the banks. The stream itself was only about 1.5 m wide in the widest pools. Water was humic, with a secchi of 0.65 m, and a pH of 4.19. Tannin concentration was 4.0 mg/l.

Four lagoons were sampled, one on Glennie Creek and three on the Olive River. Only two, Rainbow Lagoon and Glennie Creek lagoon, were permanent. Threadfin Lagoon and Drying Lagoon dry out in September to November.

Each lagoon was quite different in water quality and cover. Rainbow lagoon had extensive beds of hornwort (*Chara* sp.) and water nymph (*Najas tenuifolia*), and some water lilies (*Nymphaea* sp.) in small patches. The water was clear (secchi 1.55 m) and neutral with no detectable tannin. When sampled, the level was lower than usual, as evidenced by the exposed tree line. This lagoon appeared to be an oxbow lake or at least was once part of an anabranch. It was deeper than all other lagoons and by far the largest (about 300 m long). There was little overhanging vegetation at the time of sampling.

Glennie Creek lagoon had abundant aquatic vegetation, with lilies, *Blyxa* and reeds (*Eleocharis*) providing cover, and the substrate was covered by thick leaf litter. This small (about 30 m long) lagoon was shaded by woodland with a few gallery forest species. The water was humic and acidic (pH 5.8), with low oxygen levels (1.52 mg/l). This lagoon was one of a chain in a drainage channel from a dry paperbark (*Melaleuca*) swamp forest. Glennie Creek lagoon was about 2 m deep.

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Plate 5. Bolt Head Creek, an isolated drainage in the Olive River Basin. Note the tannin stained water

Plate 6. Snake Creek. Fallen timber and leaf litter provide abundant instream cover.

Threadfin lagoon was shallow and clear water, and full of submerged couch grass, bladderwort (*Utricularia* sp.) and water lilies (*Nymphaea* sp.), covering the entire area. At the time of sampling paperbark trees lined the banks and were in the shallow ends of the lagoon. The feature of this lagoon was the area of couch grass, emergent grasses, and knotweed (*Polygonium* sp.), although floating bladderwort (*Utricularia gibba*) overlaid much of the submerged grass.

Drying Lagoon was almost devoid of submerged vegetation with a solitary water lily (*Nymphaea* sp.) present. The water was highly turbid (secchi 0.2 m), and acidic (pH 4.7) with high tannin levels (3.0 mg/l). The substrate was mud and leaf litter. This shallow (0.45 m) lagoon had completely dried out one month after sampling.

Table Two. Sites sampled - Olive River. Drainage Basin 1020.

| Map Ref. | Site Code | Name | Date | Latitude | Longitude |
|---|---|---|---|---|---|
| A | 1020 01 01 | Rainbow Lagoon | 18 Sep 1992 | 12°12.47'S | 142°58.22'E |
| B | 1020 02 01 | Olive River near Rainbow Lagoon | 18 Sep 1992 | 12°12.63'S | 142°58.226'E |
| C | 1020 03 02 | Bromley Crossing | 17 Dec 1992 | 12°14.01'S | 142°52.65'E |
| D | 1020 04 02 | Fishing Hole | 31 Oct 1992 | 12°14.68'S | 142°51.26'E |
| E | 1020 05 01 | Snake Creek | 01 Nov 1992 | 12°17.63'S | 142°51.48'E |
| F | 1020 06 01 | Top Crossing - Bramwell | 16 Dec 1992 | 12°14.5'S | 142°50.01'E |
| G | 1020 07 01 | Black Hole | 17 Dec 1992 | 12°13.23'S | 142°56.9'E |
| H | 1020 08 01 | Bolt Head Creek | 05 Aug 1993 | 12°14.87'S | 143°04.85'E |
| I | 1020 09 01 | Threadfin Lagoon | 19 Aug 1993 | 12°13.45'S | 142°54.53'E |
| J | 1020 10 01 | Drying Lagoon | 20 Aug 1993 | 12°13.9'S | 142°52.87'E |
| K | 1020 11 01 | Upper Crossing Glennie Creek | 19 Sep 1993 | 12°21.01'S | 142°59.99'E |
| L | 1020 12 01 | Glennie Lagoon | 19 Sep 1993 | 12°21.01'S | 142°59.89'S |
| M | 1020 13 01 | Lower Glennie Crossing | 20 Sep 1993 | 12°17.91'S | 142°58.03'E |

The Olive River was the driest it had been in living memory at the end of 1992, according to Mrs T Heinemann of Bramwell Station. The upper Olive River and the northern branch had dried out completely and there were no waterholes or lagoons left to sample in those areas.

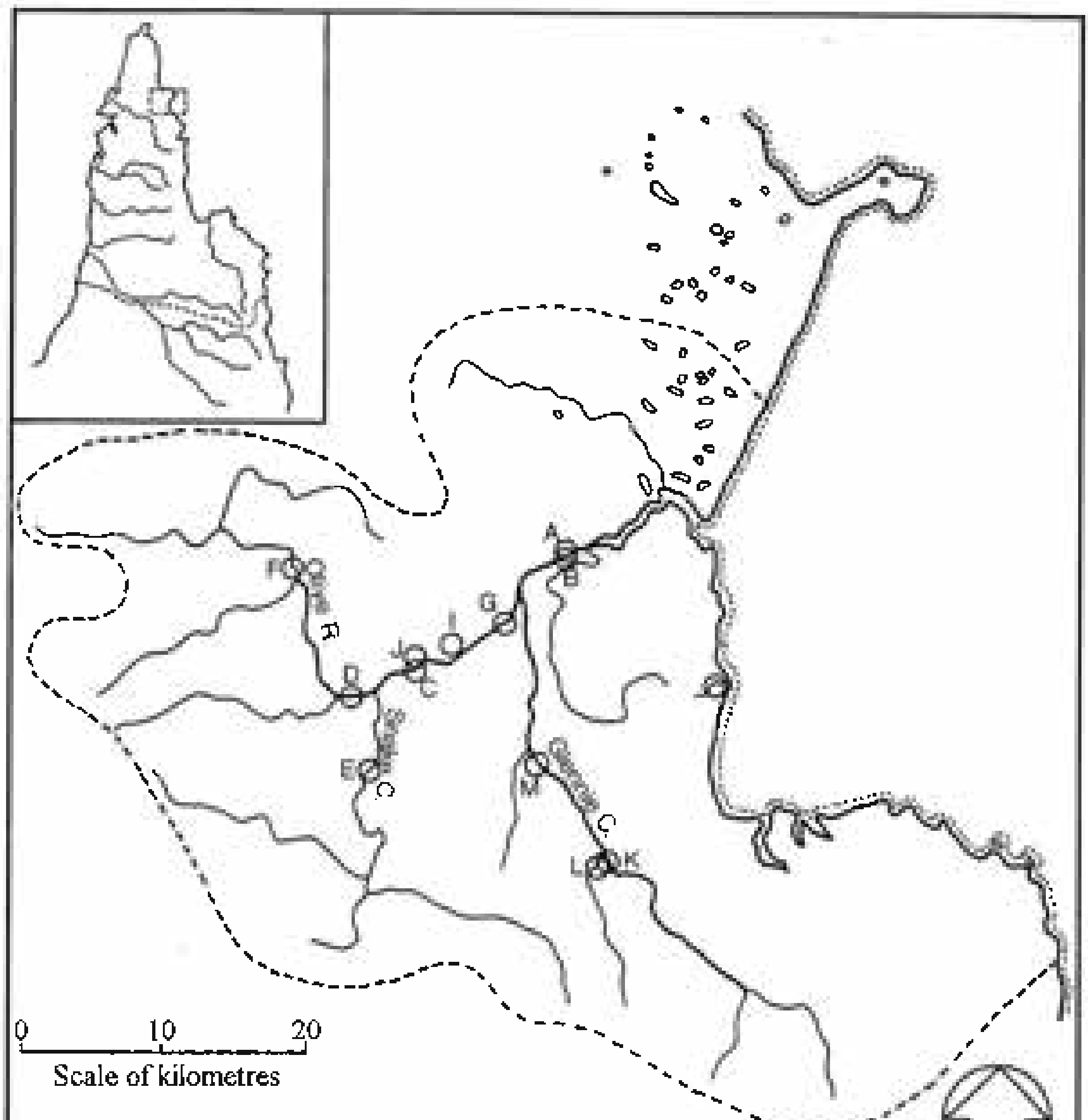


**Figure 3. Olive River - Drainage Division 1020**
Markers indicate sample sites (refer to Table 2 for date and site names)

### 6.4 Fish Species Present

Species lists for the Olive River and lagoons are presented in Appendix Two. The Olive River has an extremely high species diversity for a small intermittent stream. Thirty six species of fish, of which two were marine vagrants, were collected (See Appendix Two). It represents the southernmost distribution of saratoga (*Scleropages jardinii*) and Macleay's Glassfish / perchlet (*Ambassis macleayi*) on the east coast, and the northernmost distribution of eastern sleepy cod / gauvina (*Oxyeleotris gyrinoides*). The Olive River contained a high proportion of the species documented from the Jardine River. A combined total of Jardine River species from Allen and Hoese (1980) and Leggett (1987) comes to 37 species. We collected 34 species in the Olive River, not including mangrove jack / red bream (*Lutjanus argentimaculatus*) or threadfinned silver biddy (*Gerres filamentosus*). This represents 86% of species common to both rivers. Additionally, 81% of the Olive River fish fauna is found in New Guinea, which is even closer in resemblance than that observed by Allen and Hoese (1980) and Leggett (1987) of 75% for the Jardine River.

Every sampling trip to the Olive River produced at least two species not previously encountered, and undoubtedly more trips would increase the list. The complexity of the habitat and the extra sampling effort applied (compared to Harmer Creek) was probably the reason for the higher number of species encountered in the Olive River.

Coal grunter (known locally as spotted or golden bream) grow very large in the Olive River, as they do in Harmer Creek. (see Chapter Five). We have reports from local people of the occasional specimen up to 3 lb (about 1.4 kg) being caught. Although these are exceptional, it does display the potential for use of these stocks for broodstock should breeding of these fish for aquariums ever be undertaken.

Of interest is the apparent lack of bony bream (*Nematalosa erebi)* in both Harmer Creek and the Olive River. This fish is the principal fodder fish for barramundi in impoundments (MacKinnon, unpublished report). Bony bream prefer to live in dry eucalypt or desert areas, and live in slow flowing waters feeding on benthic algae and detritus (Allen, 1989). The Olive River is mostly shaded, and thus the main food sources for this fish either restricted or absent. Bony bream have not been recorded from this area previously. Possibly the large number of predators and small volumes of water reduced numbers of this normally ubiquitous fish to a point where our sampling techniques miss them.

Eastern sleepy cod (*Oxyeleotris gyrinoides*) were widespread on the east coast, and are common in all east coast rivers as far south as the Johnstone River (unpublished observations). Presumably, previous studies have misidentified it, confusing it with sleepy cod (*Oxyeleotris lineolatus*). The relative abundance of sleepy cods (eleotrids) is an indicator of the habitat complexity of the Olive, which has large quantities of fallen timber providing cover for them.

Macleay's glassfish was common in the Olive River. The Olive represents the only recorded location of this species on the east coast.

Barred grunters (*Amniataba percoides*) were apparently absent from the Olive River. These fish are presumed to inhabit all east coast rivers, (Allen, 1989). Their apparent absence is of interest as it displays a discontinuity of distribution. Barred grunters are not present in New Guinea, and their presumed absence from the Olive River and other east coast streams south to Lakefield may indicate that these streams have closer affiliations to New Guinea faunas than to Carpentaria or more southerly east coast faunas.

Four species of gobies (*Glossogobius*) were collected from the Olive River. Two keyed out to be *Glossogobius* species A and *Glossogobius* species C of Allen (1989). When D Hoese examined them in 1993, he said that they were both undescribed species. Gobies were well represented in the Olive River, as concave gobies (*Glossogobius concavifrons*) and golden goby (*Glossogobius aureus*) were also collected there.

## 6.5 Distribution

### *6.5.1 Extent*

Several species displayed very restricted distributions, which may have been complicated by the extremely dry conditions which had prevailed for the previous two years. Jungle perch (*Kuhlia rupestris*) were only found in Snake Creek and Glennie Creek in low numbers, probably because both these creeks are perennial and have a faster flow rate than the Olive proper. The preferred habitat of jungle perch is fast, clear rainforest streams (Allen, 1989), and in the Olive River catchment, the Glennie is the closest approximation of these conditions.

Spangled perch (*Leiopotherapon unicolor*) were collected at one location (Drying Lagoon). This is surprising as normally they are abundant throughout their wide distribution, and are tolerant of very dry conditions, possibly being able to aestivate (fish equivalent of hibernate) in moist places (Allen 1989). These fish can breed rapidly when conditions permit. Spangled perch were not caught on the Harmer Creek, and were uncommon on all east coast streams sampled except the Stewart River. Possibly rainforest streams or heavily shaded gallery forest streams are not the best habitats for the species in this area.

The south pacific eel (*Anguilla obscura*) has not previously been collected from this area, either. However, its distribution is accepted as being over the entire east coast, and it was uncommon in the Olive River, compared to the long finned eel (*Anguilla reinhardtii*). As this species is extremely difficult to differentiate from the northern eel (*Anguilla bicolor*), specimens sent to Queensland Museum will be examined by Dr. J. Beumer in due course to confirm identification.

### *6.5.2 Habitat Dependence*

It is difficult to say with certainly which species were restricted to lagoons or flowing waters as the largest permanent lagoon (Rainbow Lagoon) had been `cleaned out' by a crocodile which moved on once the fish were gone, according to locals. However, saratoga and black catfish (*Neosilurus ater*) were caught in Rainbow lagoon.

Of interest was the apparent absence of chequered rainbows (*Melanotaenia splendida inornata*) from the river. They were present, and often abundant in lagoons. In Glennie Creek, however, both species were present in both the lagoon and the creek, at the upper site. Both chequered rainbows and banded rainbows (*M. trifasciata*) have wide habitat preferences (Allen and Cross, 1982).

Eastern sleepy cod / gauvina (*O. gyrinoides*) were only caught in the Olive River proper and not in any of the tributaries or lagoons. Sleepy cod prefer logs or snags as cover, and these were present in lagoons and the tributaries. Water quality in the small number of lagoon sites sampled did not differ greatly from the main river. Presumably some other factors are involved in recruitment which limit spread of this species outside the river.

As mentioned earlier (5.5.2), threadfin rainbows (*Iriatherina werneri*) are usually found associated with vegetation in lagoons. In the Olive River they were found in both the river and lagoons. Surprisingly, they were even caught in pools with little cover and large numbers of predatory fish such as barramundi, eastern sleepy cod and mangrove jack. A large number were even found in a very small pool (< 2m long) inhabited by a large (412 mm SL) saratoga, with no cover (SL = Standard length, the length from the tip of the nose to the base of the tail)(See Plate 31, p. 259). Many of these individuals were juveniles, so presumably vegetation is not essential for reproduction. In this case, roots may have provided a spawning substrate.

Gertrude's blue-eye (*Pseudomugil gertrudae*) was also found in open water in the Olive River, although it too prefers aquatic vegetation and submerged logs for cover (Allen and Cross, 1982). They were more abundant in beds of aquatic weed (*Blyxa*) in the river than elsewhere.

Due to the extreme dry conditions prevailing on some sampling occasions, it was difficult to find habitats such as riffles and glides which are a normal part of river beds. Sites in Glennie Creek did provide these habitats, which are preferred by gobies

(*Glossogobius* spp.). Gobies appeared to be more numerous in Glennie Creek than the Olive River.

The one-gilled eels (Synbranchids), swamp eel (*Ophisternon bengalense*) and belut / mud eel (*Monopterus albus*) were only caught in muddy banks in Glennie Creek and in Glennie Creek lagoon. As most of the locations sampled had sand substrate, it appears the mud is essential for these eels. It is of interest that none were collected or seen in 1992, when the mud-bottomed Rainbow Lagoon was sampled. No one-gilled eels were collected at all in 1992, but they were present in all rivers sampled in 1993 (with few exceptions). Possibly 1992-93 was a good year for recruitment after the long dry period.

### 6.6 Species of Commercial and Recreational Importance

The Olive River was unusual in that on the first cast of a lure a fish would strike, in any location where this method was tried. Saratoga, coal grunter, barramundi, archer fish / rifle fish (*Toxotes chatareus*), jungle perch and oxeye herring/tarpon (*Megalops cyprinoides*) were caught in considerable numbers by this method. All of these species are important to recreational fisherman and small tributaries and pools had five species in them. Jungle perch appeared to be restricted to flowing water. Local land holders and some keen sports fishermen are the only people who regularly go to the Olive and thus it is easy to catch fish there.

The mouth of the Olive is probably fished from time to time by barramundi fishermen, but is not big enough and too far from infrastructure to support full-time professional fishermen.

There is potential for collection of ornamental fish for broodstock. Olive River coal grunter would make attractive aquarium fish. The Olive River population of the reddish-spotted coal grunter is the southernmost one and hence closer by road than others. The ease with which large coal grunter are caught means that broodstock collection would be quite easy. Coal grunter can be bred artificially, successful methods were developed at Walkamin Research Station in the 1980's. The large size of Olive River coal grunters and their attractive colouring make them an alternative for the South American oscar (*Astronotus ocellatus*),currently popular as an aquarium fish.

Olive River threadfin rainbows are also very attractive aquarium fish. Threadfin rainbows breed readily in outdoor ponds as far south as Gympie in Queensland. Their small size and trailing fins make them popular aquarium subjects (Allen and Cross, 1982). The Olive River fish appear to grow larger than their counterparts from the Jardine, which are also more plainly coloured. Olive River threadfins have black second dorsal and anal fins, and some times a yellow first dorsal. The body may be a suffused red colour when the fish are kept over a dark substrate. Threadfin rainbows from other locations do not appear to develop colouration this attractive, at least in aquaria. Olive River threadfins grow up to 40 mm SL in aquaria, although in the wild none over 30 mm SL were caught.

Banded rainbow fish (*M. trifasciata*) are also found in abundance in the river channel, in an attractive red-finned variety. Banded rainbow fish display a great variety of colour patterns over their geographic distribution, which are eagerly sought after by collectors.

### 6.7 Breeding Observations

On all sampling trips (August, October, November, December) all species of rainbow fish, blue-eyes, threadfin rainbows and hardyheads (*Craterocephalus stercusmuscarum*) were ripe and numbers of fry indicated they were breeding. Mouth almighties (*G. aprion*) were observed breeding from September through to December. Saratoga were not observed breeding until December. Immature specimens only of this species were kept as samples, so ovary development was not observed. In 1992 storms did not start in the Olive River area until the beginning of December, possibly delaying breeding. Apparently saratoga require the initial storms to initiate spawning, although they may be ready to spawn much earlier, as indicated by specimens from Harmer Creek, which had fully developed eggs in August. Being mouth brooders would be a distinct advantage then, as many pools become deoxygenated in parts, or even completely deoxygenated with the first flush of leaf litter and nutrients into them in storm runoff. In 1992 this effect was particularly severe as virtually the entire Olive catchment was burnt out by bushfires which burnt out most graziers and ravaged reserves. Leaf fall following bush fires, and ash, increased the amount of organic matter entering streams with the first runoff from storms at this time.

### 6.8 Water Quality

Water quality in Olive River itself appeared to be quite good for fish, with generally high oxygen levels and slightly acidic water (see Appendix Four). In the November and December sampling periods tannin levels were higher and secchi readings lower than earlier in the year, which is not surprising as water flow had ceased by then. Tannin and secchi readings were much better (lower and higher respectively) in Glennie Creek which flows year round.

The low oxygen reading at Black Hole, and the low secchi value, was due to storms the previous two days which had washed a lot of ash into the hole and increased the biological oxygen demand. Another hole sampled further downstream that same day had higher readings as the river was flowing there (that site was below the junction with Snake Creek). Fish kills due to deoxygenation of lagoons at the beginning of the wet season are well documented in the Northern Territory (Bishop, 1980). Black Hole appeared to be close to the point where deoxygenation could have occurred, but mortalities were not observed.

Water quality in the lagoons differed from that of the river and appeared to be dependent on the surrounding vegetation and lagoon topography. Rainbow Lagoon, a large lagoon, was at a low level when observed and probably received little leaf litter (a tannin source). Smaller lagoons surrounded by trees had higher tannin levels. Rainbow lagoon was less affected by pigs and birds than the others probably due to its more steeply sloping sides and lack of food in the limited margin area.

### 6.9 Habitat Disturbance

On the basis of the 1992 visits, the Olive River had suffered considerable disturbance from feral pigs and minor erosion due to roads. As 1992 was particularly dry, pigs had congregated near water sources in significant numbers. All lagoons on the Olive but Rainbow lagoon had dried out. Most lagoons were dug up to the extent that it looked as if a disc plough had been through. The river bed was similar. Of particular concern was the way in which pigs rooted up the damp soil at the bases of the banks of the river. This dislodged and destroyed any binding vegetation, dug up tree roots, and made those soils particularly susceptible to erosion upon the commencement of flow. Although we could not say for certain, it appears that pig activity is deepening the river channel by destroying riparian (bankside) and in channel vegetation. It was interesting to note that in parts of the river inhabited by large crocodiles this damage was not as severe, and the bordering gallery forest had a good complement of juvenile trees, as opposed to the upper reaches where damage was severe and gallery forest density reduced. Glennie Creek was only observed after the wet season, in 1993. Pigs had dispersed and apparent pig damage was not observed to the same extent.

Some washouts were observed on the river banks near the road. The presence of gallery forest and its binding effects on the soil appear to help minimise this damage.

### 6.10 Notes on Other Fauna

Wildlife in the Olive was abundant. File snakes (*Acrochordus* sp.)were common and a problem in all locations where nets were set. Estuarine crocodiles (*Crocodylus porosus*) were common and inhabited very small freshwater holes far up the river. A juvenile (about 40 cm long) was seen in November in a partly dried out hole. Pig damage around holes inhabited by crocodiles was limited, and was an indication of presence of crocodiles, but no guarantee. Locals reported crocodiles to be a health hazard along the length of the Olive and its tributaries.
Bird life was abundant on the two lagoons on the Olive sampled in 1993. Large numbers of fish were observed to have fluke (digenean trematode) cysts embedded in the skin, these metacercariae probably originated from eggs passed by herons and/or egrets. Night herons were abundant along the river, sheltering in the gallery forest by day. Palm cockatoos were also very common.

Freshwater prawns (*Macrobrachium rosenbergii* and a species similar to *M. lar*) were common but not abundant. Redclaw crayfish (*Cherax quadricarinatus*) were collected in quantity from Drying Lagoon, but had never been collected prior to that. Holes similar to the burrows of redclaw in the Jardine River were present in coffee rock banks of a couple of locations. Specimens of redclaw were collected and brought to Walkamin live for morphological and genetic investigations.

# 7.0 CATCHMENT 1021 - PASCOE RIVER AND TRIBUTARIES

**Summary**

1. The Pascoe is the largest perennial east coast stream included in this study. It drains mostly sand country in the lower and middle reaches. Generally the Pascoe has steep banks, a small floodplain, and lagoons are few.
2. There have been numerous previous studies at the crossings of the Pascoe and its tributaries. Leggett (1990), Pusey (pers. comm.), Midgley (1985) and Armstrong (1987) all collected at river crossings, Brown Creek, Garraway Creek or Canoe Creek.
3. Nine sites were sampled, four on the Pascoe, four on tributaries and one lagoon. On Hann Creek, which had not previously been surveyed, three sites were sampled.
4. Fish abundance was low, although there were many species. Black bream (*Hephaestus fuliginosus*) and coal grunter (*H. carbo*)were not collected by us. Twenty eight species were collected, of which six were essentially marine.
5. The Pascoe and its tributaries were the northernmost point where Roman nosed gobies (*Awaous crassilabrus*) and speckled gobies (*Redigobius bikolanus*) were collected. Roman nosed gobies and poreless gudgeons (*Oxyeleotris nullipora*) appeared to have specific habitat requirements.
6. Commercial fishing is done on an itinerant basis. Although numerous species of recreational importance were present, low numbers appear to limit potential.
7. Few species were observed breeding or ripe due to the time of the sampling period.
8. Water quality was very good at all locations, soft and pure with low conductivity.
9. Little habitat disturbance was noted except for turbidity downstream of road crossings.
10. Estuarine crocodiles (*Crocodylus porosus*)and freshwater crocodiles (*C. johnstoni*)were present in the river. Giant prawns (*Macrobrachium rosenbergii*) and redclaw crayfish (*Cherax quadricarinatus*) were present.

## 7.1 Basin Characteristics

The Pascoe is the largest perennial stream studied by us on the east coast of Cape York Peninsula, being 109 km in length and draining an area of 2035 square kilometres.. Although included in the same basin as the Olive, there are very few similarities between the two rivers. The Pascoe is fed by large aquifers in the sandstone country around the middle reaches from the upper road crossing down to Wattle Hills station. Upstream from there, the fractured rock and high rainfall (partly orographic) of the Iron Range area ensures year round flow of the Pascoe and its major tributaries. The upper reaches of the Pascoe were largely inaccessible by road, but are in dense woodland, acacia scrub and patches of rainforest. Much of the middle section flows through large heath areas of very poor, sandy soils. At Wattle Hills the river broadens out to a wide stream with long, shallow sandy stretches and deep holes near sandstone or rock bars, rocky points, and bends. Gallery forest on the slopes up from the banks gives the appearance of a heavily timbered stream, but this forest is marginal and gives way to woodland or heath. On the lower reaches, which are tidal, there is some mangrove palm (*Nypa fruticans*) and mangrove fern (*Acrostichum speciosum*) on the shores.

Lagoons are uncommon on the Pascoe. It runs through a belt of hilly country and consequently there is little flood plain area in which lagoons could form. Only one lagoon was found, this was a backflow billabong which filled with backup water during rises in the river level. There are several lagoons on anabranches near the junction with the Little Pascoe River in the upper reaches.

The banks of the Pascoe itself were, in the sections observed, very steep and high, up to 30 m above the river bed. The gallery forest grew on these banks. Brown Creek is a tributary which flows through relatively flat sandy country vegetated with woodland. Hann Creek, a perennial tributary flowed from the high sandstone ridges of Bromley and northern Wattle Hills. Hann Creek rose in open woodland in the hills on Bromley, but in Wattle Hills it had increased in size and had a thin gallery forest in parts. Part of it flowed through the poor heath country in the northern section of Wattle Hills.

### 7.2 Previous Studies

Leggett (1990) collected freshwater fish from the Pascoe River, Canoe Creek, Brown Creek and Garraway Creek in 1988. Ten species were collected at the top crossing of the Pascoe, four at Canoe Creek, five at Brown Creek and two at Garraway Creek. Some specimens collected were deposited at Queensland Museum.

Brad Pusey sampled two sites on the Pascoe River in August 1990, above both major road crossings. His group collected fourteen species of freshwater fish and bully mullet (*Mugil cephalus*). Midgley (1985) sampled Brown Creek, a major tributary of the Pascoe, in 1985. Armstrong (1987) collected a colour variety of banded rainbow fish (*Melanotaenia trifasciata*) on the Pascoe in 1985.

Of these sites, only two were sampled by us. Brown Creek and the lower crossing of the Pascoe were sampled in June and July 1993.

## 7.3 Sites Sampled

Sites sampled on the Pascoe River and its major tributaries are listed in Table Three. Four sites on the river and one backflow billabong close to the river were sampled. All sites were downstream of the upper road crossing, which was sampled by both Leggett and Pusey. Three sites on Hann creek, a major tributary of the Pascoe, were sampled, one at the headwaters, and about one third down its length, and one near its junction with the Pascoe. Brown Creek was sampled upstream from the Portland Roads road crossing, which was also sampled by Leggett in 1988.

Table Three. Sites Sampled - Pascoe River and Tributaries. Drainage Basin 1021

| Map Ref | Site Code | Name | Date | Latitude. | Longitude. |
|---|---|---|---|---|---|
| A | 1021 01 02 | Hann Creek - Bromley | 26 Jun 1993 | 12°28.46'S | 142°58.24'E |
| B | 1021 02 01 | Brown Creek | 27 Jun 1993 | 12°45.39'S | 143°6.28'S |
| C | 1021 03 01 | Pascoe River W.R.C. Gauging Station 1021 02 | 29 Jun 1993 | 12°39.59'S | 143°2.95'E |
| D | 1021 04 01 | Pascoe River Wattle Hills homestead | 30 Jun 1993 | 12°33.74'S | 143°8.88'E |
| E | 1021 05 01 | Hann Creek - Firebreak Road | 01 Jul 1993 | 12°30.99'S | 143°0.97'E |
| F | 1021 06 01 | Hann Creek - Gerald's Place | 16 Jul 1993 | 12°33.92'S | 143°4.63'E |
| G | 1021 07 01 | Pascoe River - Fyfe's Lagoon | 17 Jul 1993 | 12°49.32'S | 143°55.36'E |
| H | 1021 08 01 | Pascoe River - Waterfall Road | 18 Jul 1993 | 12°47.97'S | 142°55.48'E |
| I | 1021 09 01 | Pascoe River - Frenchman's Road | 26 Aug 1993 | 12°42.02'S | 143°1.42'E |
| J | 1021 10 01 | Pascoe River - above upper crossing | 4 Jun 1994 | 12°53.86'S | 143°1.81'E |

Each river site was different but the bottom three sites (Wattle Hills homestead, Water Resources Commission gauging station 1021 02 and the Frenchman's Road crossing) all had similarities (See Plate 7). The river in these locations had broad (60-90 m) shallow (10-30 cm) sections between deep (1-2 m) pools. Small channels up to 1 m deep ran along either side. Water was very clear (2.5 m secchi)(secchi is a measure of water clarity) and moderate flow. The banks were roots of paperbark trees (*Melaleuca*) and gallery forest trees, and usually had a sparse growth of *Aponogeton* along them except in the deeply shaded parts. Some stonewort (*Chara*) and little algae was growing in the shallow sandy sections of the middle of the river. In rocky sections no vegetation was present. Snags and logs were present in small quantities, mainly along the margins. There were some undercuts on the edges but generally most root masses extended to the bottom.

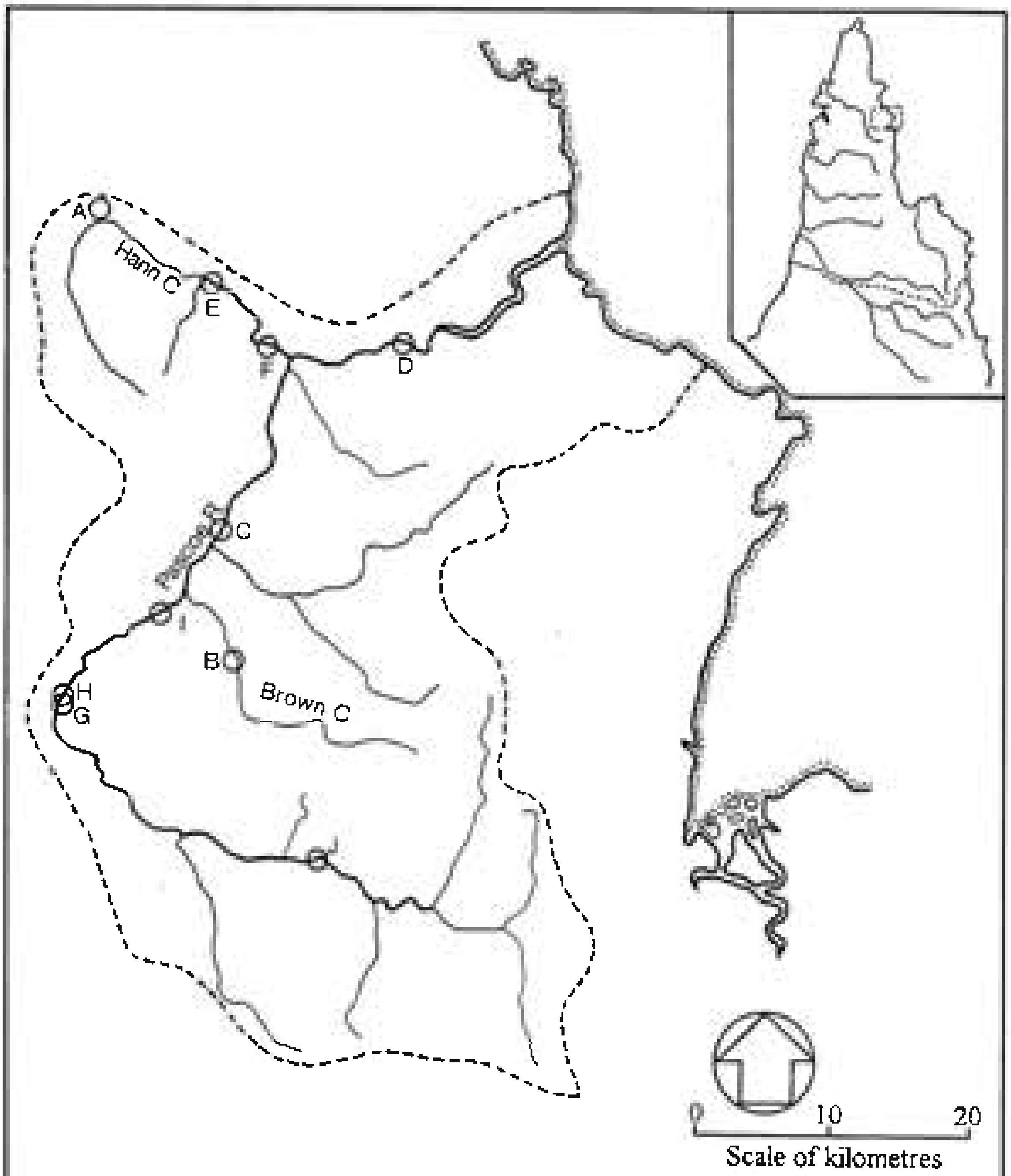


**Figure 4. Pascoe River - Drainage Division 1021**
Markers indicate sample sites (refer to Table 3 for date and site names)

The site on the waterfall road, near Fyfe's lease, was a more typical small stream site, with riffles and glides and few snags. Substrate was either sand or pebbles depending on flow type. Small amounts of eelgrass (*Blyxa*) and stonewort were present in areas of gentle flow or backwaters. This site was typical of a small fast flowing stream in the upper reaches of any river.

The lagoon at Fyfe's homestead is a small lagoon about 30 m wide and 100 m long, heavily vegetated with giant water lily (*Nymphaea violacea)*, water lilies (*Nymphaea* sp.), water snowflake (*Nymphoides* sp.), eelgrass (*Vallisneria* sp.), stonewort (*Nitella* sp.), and masses of bladderwort (*Utricularia gibba*). The lagoon was shallow (1.7 m) and the water was humic but not very acidic (pH 6.24). It fills by backflow from a channel which runs downstream to the river. In exceptional floods there is some flow through from runoff.

Hann Creek flows year round from the high sandstone ridges in the southern side of Bromley. Even in the highest country during the dry year 1992, Hann Creek flowed, and had either a sandy or pebbly bed, with riffles and small pools up to 1.2 m wide and 0.5 m deep. Vegetation was very sparse, with a few scattered plants of eelgrass (*Blyxa*) present. A few snags and roots comprised the cover present.

At the lower two sites, Hann Creek was larger, swiftly flowing with a sandy substrate and had very little aquatic vegetation. Both sites were completely shaded by dense gallery forest, and the banks were characterised by dense root masses. Site 1021 06 01 had a long pool up to 2.5 m deep, and snags were present, and some leaf litter and overhanging vegetation provided cover. Site 1021 07 01 had more rapid flow, and was shallower (maximum depth of 1.5 m but average of 0.3 m). The creek flowed shallow to swift and there was a lot of fallen timber and small branches etc. on the bed, much of it partly covered with sand.

The site sampled on Brown Creek on the main Portland Roads road was a long pool up to 1.2 m deep, with riffles and a glide at the upper end. There was very little cover, with a few small beds of stonewort (*Chara*) and few snags. Roots in undercut banks provided most cover. The substrate was sand or pebbles. Water flow was gentle in the pool, but quite swift at the top. The banks were lined with gallery forest with few paperbark tree and bottlebrushes (*Callistemon*) in the creek bed or banks.

The river upstream of the upper road crossing was electrofished for a length of three kilometres in June 1994, in an attempt to capture coal grunter reported from there. No additional species were collected from this area, which could not be sampled as completely as other sites due to time constraints. The uppermost area was a large granite area, with large open areas of shallow pools, cascades and rapids. No aquatic vegetation was observed. In July 1994, K. Bishop, G. Gill and B. Herbert walked to the headwaters of the Pascoe, and Hot Water Creek (headwaters and near the mouth), but failed to find coal grunter. However, they have been reported from lagoons in the vicinity of the junction of the Pascoe and Little Pascoe River by a long time resident.

### 7.4 Fish Species Present

A total of 28 species of fish were recorded from the Pascoe River. Of these, red bream or mangrove jack (*Lutjanus argentimaculatus*), crimson tipped gudgeon (*Butis butis*), turrum /giant trevally (*Caranx sexfasciatus*), ebony gudgeon (*Eleotris melanosoma*), threadfin silver biddy (*Gerres filamentosus*) and spotted scat (*Scatophagus argus*) were caught in the lower reaches and could be considered as essentially marine species temporarily in fresh water. This reduces the total to 22 species of freshwater fish sampled by us in the Pascoe and its tributaries.

For a river of its size, the Pascoe had remarkably few fish in it. The lack of cover and clean water probably reduce productivity to a low level. Rainforest streams generally have low productivity in relation to fish production. Also, the time of the year at which sampling was done was the period of minimum fish activity according to local residents.

The crimson tipped gudgeon (*B. butis*) was only caught in the lower site near the homestead. It is the only location in which they were caught in this study.

All other species of fish caught were well within the known ranges for these species. Roman nosed gobies (*Awaous crassilabrus*) were found many kilometres upstream from the sea in Brown Creek, and at the headwaters of Hot Water Creek. This would represent a considerable upstream migration if this fish has a marine larval stage in its life history, as is thought to be the case (Allen, 1989). From Brown Creek to the limit of tidal influence is about 45 km, and about 10 km further down to brackish water. Distances like this, while not unusual for New Guinea fish, are not as commonly encountered in many species of Australian fish, barramundi (*Lates calcarifer*) and oxeye herring/tarpon (*Megalops cyprinoides*) being obvious exceptions.

Eastern sleepy cod / gauvina (*Oxyeleotris gyrinoides*) was collected at most sites on the Pascoe and its tributaries, and was the only large sleepy cod (Eleotrid) found by us. We believe that previous records of sleepy cod (*Oxyeleotris lineolatus*) by Pusey and Leggett were in fact misidentifications, although it is not impossible that our survey missed sleepy cod and theirs missed eastern sleepy cod.

Aru gudgeons (*Oxyeleotris aruensis*) were also collected on the Pascoe River. The characters (fin ray and scale counts) match the diagnosis for Aru gudgeons. Similar fish from the wet tropics area collected by Dr B. Pusey were sent to Dr G. Allen who identified them as a new species. We cannot be certain that what we have called Aru gudgeons are in fact that, but the Queensland Museum has confirmed our identifications and they do match the diagnosis.

What was collected is not as interesting as what was *not* collected. Leggett, Midgley and Pusey all collected black bream / sooty grunter (*Hephaestus fuliginosus*) from the Pascoe, and local people said they were present. We collected at sites where, in western rivers, there are always black bream (i.e. riffles and snags). The granite rock area upstream of the upper road crossing closely resembles areas of the Tully River system in which large numbers of black bream aggregate, yet none were collected or seen there. All methods which are assured ways of catching or seeing black bream (lure fishing, live baits, snorkeling, set lines, electrofishing) were tried and no black bream were seen. Gary Cotter, a recreational angler, canoed down the Pascoe and never caught any black bream, and he may catch up to several hundred in a day in the western flowing rivers (see Steptoe, 1994a, b). We have doubts about their presence in the Pascoe as we caught no black bream anywhere on the east coast of Cape York Peninsula, except the Annan River, where they were introduced. No specimens of black bream from the Pascoe River have been lodged with the Queensland museum (see Wager, 1993). However, no one survey can be assured of catching all the species present in a river system, and we are no exception. It is an issue which should be followed up because Pascoe River black bream may be different to those found elsewhere. Considering that the fauna of the Pascoe is distinctly east coast (lacking all of the distinctive west coast species) this is a definite possibility.

There are also unconfirmed reports of coal grunter in restricted areas in the Pascoe (Little, pers. comm.). As these are a distinctive fish, they would be hard to confuse with anything else. The distribution of coal grunter within a river system may be patchy, and it is not inconceivable that they are present in the Pascoe. It is unusual that nobody else has reported them, although the area they were reported from is several kilometres walk from the upper crossing. None were seen by us when the area was intensively electrofished in June 1994.

## 7.5 Distributions

### *7.5.1 Extent*

All species collected in the Pascoe were sampled from the Olive River to the north and/or the Lockhart River to the south, or were reported from those rivers, with the exception of the marine vagrants listed earlier, and speckled goby (*Redigobius* *bikolanus*). Speckled gobies and Roman nosed gobies (*A. crassilabrus*) were only caught in the Pascoe River and systems further south. We did not collect or see any in the Olive River. Although it is possible that they were missed in the Olive River, the Pascoe and other rivers in which those species were found have clear, non-humic water and are perennial. Possibly the large numbers of gobies (four species) in the Olive River provide too much competition for establishment of more goby species.

The Pascoe River was the northernmost point from which ebony gudgeons (*Eleotris melanosoma*) were collected. This may reflect more the absence of a site on the Olive River close to the sea, rather than a real absence.

Chequered rainbow fish (*M. spl. inornata* ) were collected from all streams and tributaries of the Pascoe. They were collected previously by Ray Leggett. Dr Gerald Allen confirmed our identification of this species. Chequered rainbows are generally considered to be Gulf of Carpentaria to Northern Territory species, but their extent down the east coast of Australia is considerable (see Appendix Three). Dr Pusey of Griffith University reported Australian rainbows (*M. spl. splendida*), the east coast form, from the Pascoe River. These were not sampled there by us or by Ray Leggett, and it would be unusual if both species co-existed in the same river system. Chequered rainbow fish closely resemble *Melanotaenia splendida rubrostriata*, the red striped rainbow fish of New Guinea, and are only differentiated by minor colour differences (Allen, 1991). The spread and development of the species on the east coast of the ancient land mass would suggest it has better abilities to survive and colonise environments than many of the other species from the ancient Carpentaria Lake.

### *7.5.2 Habitat dependence*

Obviously, all the marine vagrants mentioned earlier are dependent on a habitat close to the estuary. Several other species appeared to be tied to special habitats.

Poreless gudgeons (*O. nullipora*) were found in two locations on the Pascoe River, in Fyfe's lagoon, and small pools beside the river channel upstream from the main crossing. Fyfe's lagoon is humic stained with thick vegetation throughout. Only the striped form was collected from the Pascoe River. As no poreless gudgeons were found elsewhere in the Pascoe, and their distribution in the Olive system was restricted to humic habitats, in east coast population this may be a prerequisite for their survival. There is some confusion over the taxonomic status of poreless gudgeons (Allen, 1989; Larson, personal communication). Possibly the east coast and west coast populations are different, and require taxonomic investigation.

Jungle perch (*K. rupestris)* were found in all sites except the highest site on Hann Creek and Fyfe's lagoon. All other sites had flowing clear water which appears to be a prerequisite for this species. Quite large individuals were caught in locations where no people had fished before.

Roman nosed gobies (*A. crassilabrus*) burrow into sand, and were only found in habitats with loose sand substrates. These habitats are generally found in areas with reasonable water flow, so these two factors must be present for Roman nosed gobies to be collected.

A form of chequered rainbow fish (*M. s. inornata*) different to those in the river was collected from Fyfe's lagoon and small water holes beside the river upstream of the upper crossing. This form has red stripes along the sides (See Plate 8). The fish from the river were all much lighter in colouration. Specimens kept in aquaria have retained this colouration, but have not grown to a large size. Possibly this is a dwarf form which does not fare as well in the river currents as the normal form. Additionally, a unique form of banded rainbow fish (*Melanotaenia trifasciata*) was observed in the uppermost headwaters of the Pascoe. This form had a distinctive black stripe running horizontally from the middle of the body back to the base of the caudal peduncle, below the broad band in the mid line. These were only observed in a restricted location near 13° 51' S and 143° 12' E.

### 7.6 Species of Commercial and Recreational Importance

Barramundi were commercially harvested by gillnet fishermen in the lower reaches of the Pascoe River. Unconfirmed reports put the value of the catch by one fisherman at $40 000.00 worth over the 8 weeks following the opening of the season in February. Other species are also caught, such as trumpeter and threadfin salmon, but no figures were available on these. Prawn trawlers operate off the coast in Weymouth Bay and use Portland Roads as the point to meet a mother ship. This is used by net fisherman as well. Discharge of rivers during the monsoon is an important factor in success of breeding and recruitment of some prawn species.

Other species of recreational importance in the Pascoe include jungle perch and red bream. Local people tend to fish the estuarine waters only, although those living closer to Hann Creek junction use that area. Red bream, jungle perch, barramundi and eel tailed catfish/jewfish are the most sought after species. Jungle perch were abundant, but the other species appear to be restricted to deeper water near snags or rocks. Small jungle perch were plentiful in all areas where there was good water flow.

Plate 7. The Pascoe River below the Water Resources gauging station 102102, at Wattle Hills

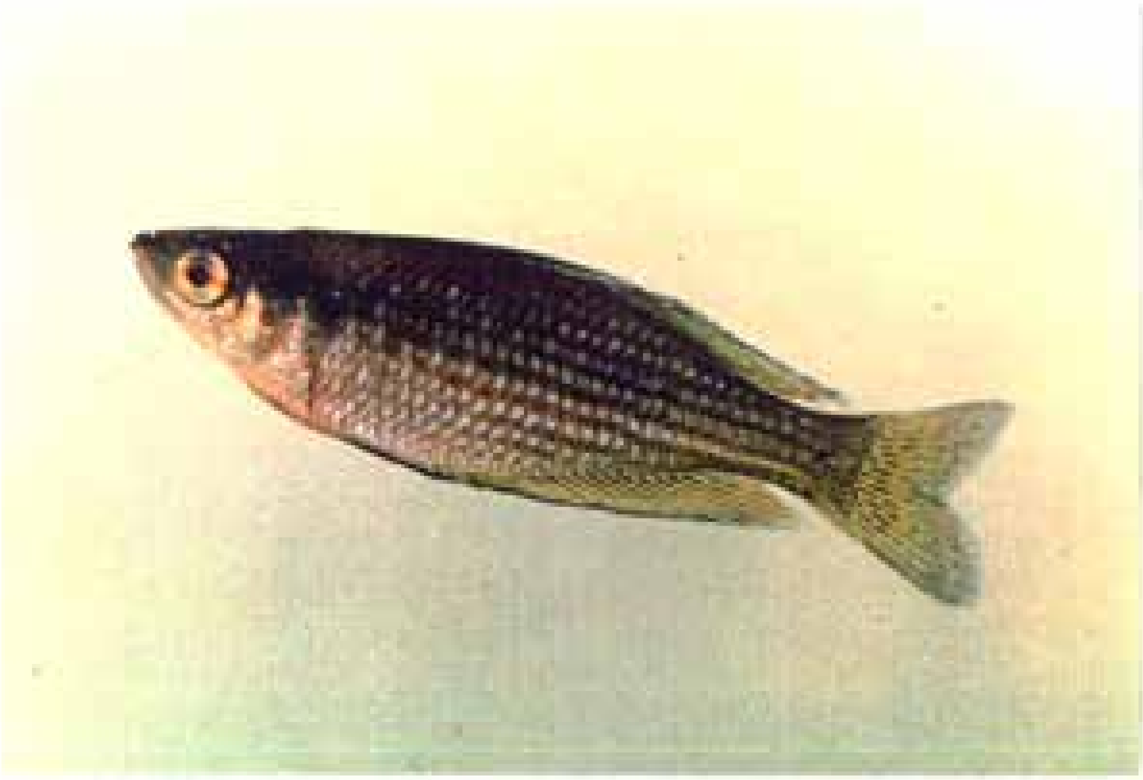

Plate 8. A chequered rainbow from Fyfe's lagoon. These specimens were invariably small (<50 mm TL) and had less body depth than chequered rainbows from the river.

For a river of its size, the Pascoe appeared to have low fish abundance. This seems to be a common trait in rainforest rivers, where most productivity is allochthonous (from external sources) (e.g. Welcomme, 1985). In tropical streams in Australia, the fauna adapted to using this food source appears to be limited. Most of the large species present are carnivorous, and the smaller fodder fish are omnivorous/carnivorous. The apparent absence of bony bream, an important fodder fish and detritus recycler, may have an effect on numbers of fish. However, the Olive River is full of large carnivores, and appears not to have bony bream either. The time of the year we visited was not best for fish, as it is the period of lowest activity. Probably a visit at a warmer time of the year would be better to more fully sample the fishes in the Pascoe River.

The potential for recreational fishing in the Pascoe River is, on the basis of the partial results presented in Appendix Two, limited. Few of the larger more favoured recreational species were caught. Although jungle perch were abundant, larger ones are highly vulnerable to overfishing and any recreational fishing ventures would be better off limited to the estuarine areas. Some residents on Wattle Hills are interested in setting up small scale, low impact ecotourism ventures for nature lovers and naturalists to visit. Whether these become reality, and whether recreational fishing would be a part of it, remains to be seen.

## 7.7 Breeding Observations

Rainbows (banded and chequered), gobies (*R. bikolanus*), and hardyheads (*Craterocephalus stercusmuscarum*) were all ripe at the time of sampling. Whether they actually breed at the coldest time of the year is uncertain. Temperatures were generally below 25°C, which is comparatively cool for Peninsula aquatic environments. At the time of sampling it was raining or overcast, which would reduce temperatures to a certain extent. Possibly a period of sunny weather would raise temperatures and stimulate spawning.

## 7.8 Water Quality

Water clarity by secchi was exceptionally high in the Pascoe River, being over 2 m at all sites except Fyfe's lagoon, where it was only 1.19 due to the humic water there. See Appendix Four for water quality parameters. The water in Brown Creek and the Pascoe River itself had comparatively low conductivity, which may be due to the country they drain, high rainfall country on fractured rock. The water at Hann Creek was exceptionally pure with very low conductivity (33-40 µs/cm), at the downstream sites, where flow was greatest. This is a reflection of the sand country which feeds the Hann. Conductivity was considerably higher in the upper reaches of the Hann. This may have been due to the lower flow and the small catchment area which appeared to be a soil pocket in the sandstone hills on Bromley, which may have contributed salts to the water. Hardness and alkalinity were very low in all reaches of the Hann, when compared to the Pascoe, again due to the differences in the country their headwaters come from.

The progressive drop in conductivity observed as one progresses down the Pascoe River (95.8 $\rightarrow$ 76.3 $\rightarrow$ 78.7 $\rightarrow$ 64.2 µs/cm) could be explained by the number of feeder streams running from the sandstone hills of Bromley downstream from site 1021 09 01, at the Frenchman's Road crossing.

Phosphate levels were a little higher than those usually encountered on Peninsula rivers, but this may be attributed to the rainforest source of the river and some human settlement along its course. Hann Creek, with no settlement close to it, and no rainforest on most of its course, had no detectable phosphorus.

### 7.9 Habitat Disturbance

Very little habitat disturbance was noted, although there was some turbidity downstream of road crossings after vehicles had passed through. At both major road crossings this was more attributed to dirt and dust washing off vehicles than the actual bed of the river, which is sand at the top crossing and rock at the lower one. There is virtually no grazing or other large scale agricultural activity in the catchment. Some road construction camps and subsistence agriculture at points along the river may contribute nutrients, but probably in quantities too small to pose a problem to communities further downstream.

Pig damage observed was minimal, possibly this was due to the time of sampling, when the area was still very wet and pigs were dispersed. Pig digging observed in the extreme upper catchment in July 1994 was extreme, and probably has impacts during the early wet season.

### 7.10 Notes on Other Fauna

Estuarine crocodiles and freshwater crocodiles were present in the river, although we did not positively identify either. Wattle Hills residents had seen large estuarine crocodiles as far upstream as the gauging station 1021 02. Residents at Fyfe's reported freshwater crocodiles in the lagoon from time to time. We did not catch any file snakes (*Acrochordus* sp.) but several were seen.

Freshwater prawns (*Macrobrachium rosenbergii*) and redclaw (*Cherax quadricarinatus*) were present but uncommon. Bird life was spectacular, and Iron range area is noted and famous for its bird fauna as it represents the southernmost range of some bird species.

## 8.0 CATCHMENT 1030 - LOCKHART AND CLAUDIE RIVERS

**Summary**

1. The Lockhart and Claudie Systems have different characteristics. The Lockhart runs through a floodplain area and is shallow and sandy. The Claudie Rivers drain steep rainforest mountains and have a high habitat complexity.
2. Leggett (1990) and Hansen (1989) collected on the Claudie River, at the road crossings.
3. One site on the Lockhart and two on the Claudies were sampled. Two sites in the extreme south of the basin, in sandy country, were surveyed.
4. Shortfinned catfish (*Neosilurus brevidorsalis*) and coal grunter (*Hephaestus carbo*) were collected from both rivers. Twenty five species, of which three were essentially marine, were collected from the northern sites. Fourteen species were collected in the sand country sites. Only one of these was present in the lake and not the creek.
5. Shortfinned catfish were uncommon and appeared to require roots and slow flow areas as habitat. Both rivers had similar fish faunas. Scrubby Creek was the only west coast site from which delicate blue-eyes (*Pseudomugil tenellus*) and sexually dimorphic poreless gudgeons (*Oxyeleotris nullipora*) were collected.
6. There was little recreational fishing on the Lockhart, Claudies, or the Chester, but the estuaries of all are heavily used.
7. Small fish (rainbow and speckled goby) females were ovigerous.
8. Water quality was good and similar at northern sites. Turbidity was extreme immediately below road crossings. Prior to the wet season some water quality parameters in Three Quarter Mile lake could not be measured due to the high turbidity. Tannin levels in the lake and Scrubby Creek were high.
9. Habitat disturbance was low except near road crossings. Pig damage was widespread in the rainforest but was not concentrated on streams.
10. File snakes (*Acrochordus* sp.) were present in the Lockhart River. Redclaw crayfish (*Cherax quadricarinatus*) and giant freshwater prawns (*Macrobrachium rosenbergii*) were common.

### 8.1 Basin Characteristics

The Lockhart and Claudie Rivers are two quite distinct river systems with different characteristics. The East and West Claudie Rivers drain rainforest areas of Iron Range National Park and reserves. Much of the lowland area of the Lockhart basin has been cleared in the past, and is now heavily grassed, but the river margins have retained their forest cover. This area receives very high rainfall, due to the orographic (mountain influence) effects of the Tozer Range, Dorriwill Ridge and Nelson Range. Much of the catchment is not accessible by road. The rainforest and fractured rock base serve as a permanent aquifer for the short dry periods. The drainage basin extends through quite steep, densely forested country.

The Lockhart River drains the Macrossan and McIlwraith ranges to the south, and runs a fairly straight course to the north. It is only 57 km in length. Much of the low lying country of the flood plain was cleared for cattle grazing which is not continued. All of the country is Aboriginal Reserve, administered by the Lockhart River community. One outstation is present on the river, and others nearby. The margins of the Lockhart River are forested with a gallery forest on the steep banks. The stream bed itself is shallow and sandy.

Both rivers are perennial, and have no lagoons associated with them, although there are small temporary swamps and basins on the Lockhart. The Claudie Rivers drain rainforest country which has been logged and seen some mining activity in the past, and which is now protected as National Park or Timber Reserve. The Lockhart River drains undisturbed ranges, but its flood plain was cleared extensively in the past and now large areas of it are grassland.

Scrubby Creek and Three Quarter Mile Lake are situated in tall woodland on sand country, in the extreme south of the basin (See Figure 5). Three Quarter Mile Lake has a small catchment in the dune field, and Scrubby Creek drains the surrounding sand country. Eventually Scrubby Creek joins the Chester River near its mouth. Three Quarter Mile Lake is a permanent, large (about 1 km diameter) shallow (up to 2 m) sand dune lake. The dunes have long been stabilised by vegetation. The outflow is at the south-western edge, into Scrubby Creek, which is intermittent. Scrubby Creek is additionally fed by short streams draining the very steep slopes between Bald Hill and Double Hill, and due to the limited catchment stops flowing annually, although a few waterholes remain in it during the dry.

## 8.2 Previous Studies

For an area which has been intensively studied due to its affiliations with the New Guinea fauna (Thomson, 1935; Lavarack and Puniard, 1988), the Lockhart/Claudie system has been relatively overlooked by ichthyologists. The only reports of sampling trips in the region were those of Leggett (1990) and Hansen (1989).

Leggett sampled the West Claudie River and Scrubby Creek in 1988, and Hansen collected on the West Claudie River, Line Hill Creek, and waterholes near the community (Leggett's Scrubby Creek was one in the far north of the basin). As far as we know, the Lockhart itself has not been surveyed for fish by collectors. See Appendix One for Leggett's and Hansen's results.

Local people living at Nundah outstation reported that barramundi, eels and red bream were caught in a waterhole nearby, but that they usually fished in the estuary.

## 8.3 Sites Sampled

One site on the Lockhart River, two sites on the Claudie River, and two sites on Scrubby Creek were sampled (See Table 4).

### *8.3.1 Lockhart River*

The Lockhart River site was about 1 km upstream of the crossing, in an area with steep banks and a wide (10 m) sand/gravel creek bed (Plate 9). The banks were lined with gallery forest and there were bottlebrush trees (*Callistemon*) in the river bed. Most of the river bed was partly shaded by gallery forest or bottlebrushes. Filamentous green algae was the only aquatic vegetation observed, although locals told us that water lilies (*Nymphaea* sp.) were present in holes further upstream. The stream was generally 2-3 m wide at the time of sampling, and where it ran against the bank there were shallow undercuts and roots. Riffles and glides were present in the upper section of the site. Large logs crossed the river in several spots, and beds of leaf litter were present in areas of little current. Most of the stream flow was gentle.

### *8.3.2 Claudie River*

The West Claudie River was sampled upstream of the main road crossing. The site was completely shaded by dense rainforest, and consisted of a long pool at the head of which was a cascade. The substrate was sand and rocks, with rock close to the cascade. No aquatic vegetation was observed. The site contained a few snags and leaf litter was present near the banks. Ray Leggett sampled this site in 1988.

The Claudie River at the old Mission Road crossing was heavily shaded by rainforest vegetation, except for a pool above the causeway. The river substrate here was mainly sand. A few *Aponogeton* plants were present. Roots and undercut banks provided shelter in the narrow, shallow sections. There were deep (1.7 m) pools at either end of the site.

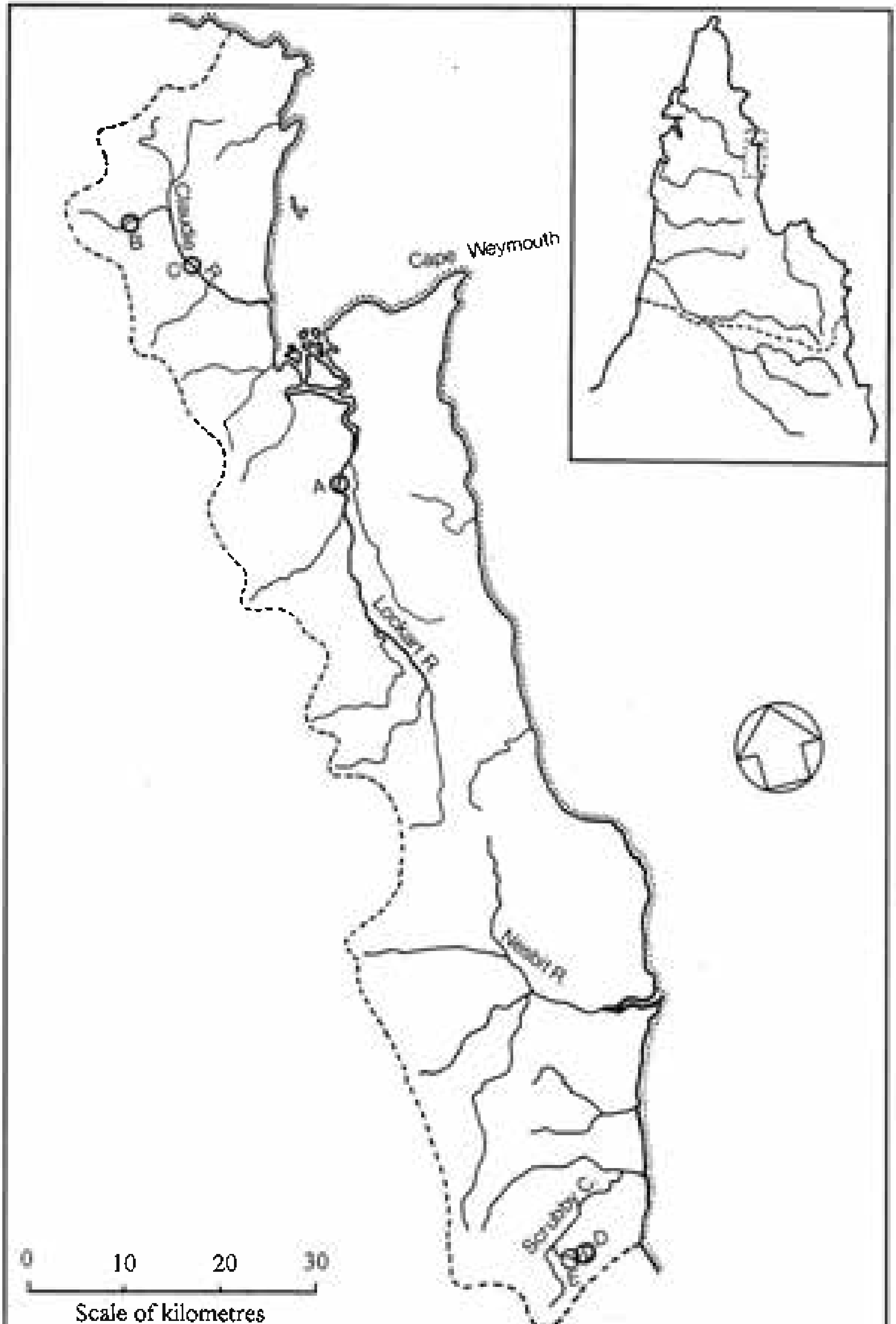


**Figure 5. Lockhart and Claudie Rivers - Drainage Division 1030.**
Markers indicate sample sites (refer to Table 4 for date and site names)

*8.3.3 Scrubby Creek and Three Quarter Mile Lake*

Three Quarter Mile lake is situated in sandhills east of the McIlwraith range about 40 km due east of Coen Aerodrome. The Lake is about 1 km in diameter. Substrate is fine sand, overlain by a layer of peat. Much of the Lake floor is covered by stumps, roots and dead shrubs. In December 1992, no aquatic vegetation was present and the nearest vegetation (mangrove fern clumps, *Acrostichum speciosum*) was about 15 m from the water's edge. In June 1993 water up to 2 m deep had flooded the marginal paperbark (*Melaleuca*) forest. Bladderwort (*Utricularia gibba*), waterlilies (*Nymphaea* sp. and *Nymphaea violacea*) were sparsely distributed around the margins. Reeds (*Eleocharis* sp. and *Lepironia auriculata*) were present on the outer margin of the paperbark forest. In the paperbark forest the peat substrate was deeply covered in leaf litter and snags. Clumps of mangrove fern covered about 50% of the marginal paperbark forest floor. Snags and logs were abundant. Three Quarter Mile Lake was accessed after a 1 km walk through thick heath scrub and so sampling was difficult. The northern side of the lake was sampled in 1992, and the western side in 1993. On the first occasion a 15 mm seine and the fine seine were used to drag the lake proper. On the second occasion when the marginal vegetation was flooded the fine seine only was used. The water was too dark to electrofish effectively.

Scrubby Creek was sampled both above and below the road crossing. The entire creek was shaded by large paperbark trees, but shallow parts had a dense cover of eelgrass (*Vallisneria* sp. and *Blyxa* sp.). The substrate was mostly sand, with a few muddy patches. Submerged aquatic plants and leaf litter were the main cover in the stream. Flow was gentle, and many pools were present between riffles. No flow reading could be taken in the flowing areas as they were too shallow. There was a small forest of red beech (*Dillenia alata)* forming an understorey beneath the paperbark canopy in the upper part of the site. Pools were up to 2 m deep, but the average depth was 0.2-0.4m.

Table Four - Sites Sampled - Lockhart and Claudie Rivers. Drainage Basin 1030.

| Map Ref. | Site Code | Site Name | Date | Latitude | Longitude |
|---|---|---|---|---|---|
| A | 1030 01 01 | Lockhart River. Nundah | 24 Jun 1993 | 13°02.81'S | 143°23.65'E |
| B | 1030 02 01 | West Claudie River Crossing | 25 Jun 1993 | 12°44.65'S | 143°14.18'E |
| C | 1030 03 01 | Nundah Rd. Crossing. Claudie River | 15 Jul 1993 | 12°47.65'S | 143°17.54'E |
| D | 10300401 | Three Quarter Mile Lake | 2 Dec 1992 | 13°44.92'S | 143°29.34'E |
| D | 10300402 | Three Quarter Mile Lake | 10 Jun 1993 | 13°44.92'S | 143°29.34'E |
| E | 10300501 | Scrubby Creek | 10 Jun 1993 | 13°44.66'S | 143°28.51'E |

## 8.4 Fish Species Present

### *8.4.1 Lockhart River*

Eighteen species of fish were collected at the Lockhart River site, (see Appendix Two) of which only one, threadfin silver biddy, (*Gerres filamentosus*) is classed as a marine vagrant. Most of the species collected here were also found in the west Claudie River, and were also collected there by Ray Leggett.

Of special interest was the presence of shortfinned catfish, (*Neosilurus brevidorsalis*), previously only collected from the Jardine and Jackson Rivers (Allen, 1989) and Olive River (present study). This fish appears to be uncommon throughout its distribution. We only collected two specimens in roots, in a pool (See Plates 9 & 10). This fish is also distributed throughout southern New Guinea, and shows some variation (Allen, 1991) which warrants further investigation. Another species apparently outside of its "normal" distribution is the coal grunter, *Hephaestus carbo*. This record represents the southernmost extent of its distribution on the east coast.

Celebes gobies (*Glossogobius celebius*) were also recorded in the Lockhart River, which is an extension north of the known distribution. This species is widespread throughout the Indo-Pacific region and apparently has a marine life cycle (Allen, 1991). Poreless gudgeons (*Oxyeleotris nullipora*) were collected mainly from roots in the river bank, and Aru gudgeons (*Oxyeleotris aruensis*) were abundant in roots and undercuts. Hansen (1989) recorded observations by a resident of old Lockhart River Mission which was sited on the coast about 12 km east of our site. Salt water blue eyes (probably *Pseudomugil signifer*), red scats (*Scatophagus argus*) and archerfish (*Toxotes chatareus* and/or *T. jaculatrix*) were observed in this location. Interestingly, as Hansen noted, no blue eyes were recorded from either the lower Claudie or Lockhart River sites.

### *8.4.2 Claudie River*

Shortfinned catfish (*N. brevidorsalis*) and coal grunter (*H. carbo)* were also collected on the Claudie River. Again shortfinned catfish were uncommon, only one specimen being collected. Eastern sleepy cod (*O. gyrinoides*), not previously reported from this area, was also collected in the Claudie. Spot fin gobies (*Redigobius chrysosoma*), an estuary breeding species of goby, were collected at the causeway on the Claudie River.

A total of 22 species, 3 of which are essentially marine or estuarine, (ebony gudgeon, *Eleotris melanosoma*; thread finned silver biddy, *G. filamentous;* spot fin goby, *R. chrysosoma*) were collected.

Plate 9. The Lockhart River near Nundah Outstation, the habitat of short finned catfish (*Neosilurus brevidorsalis*).

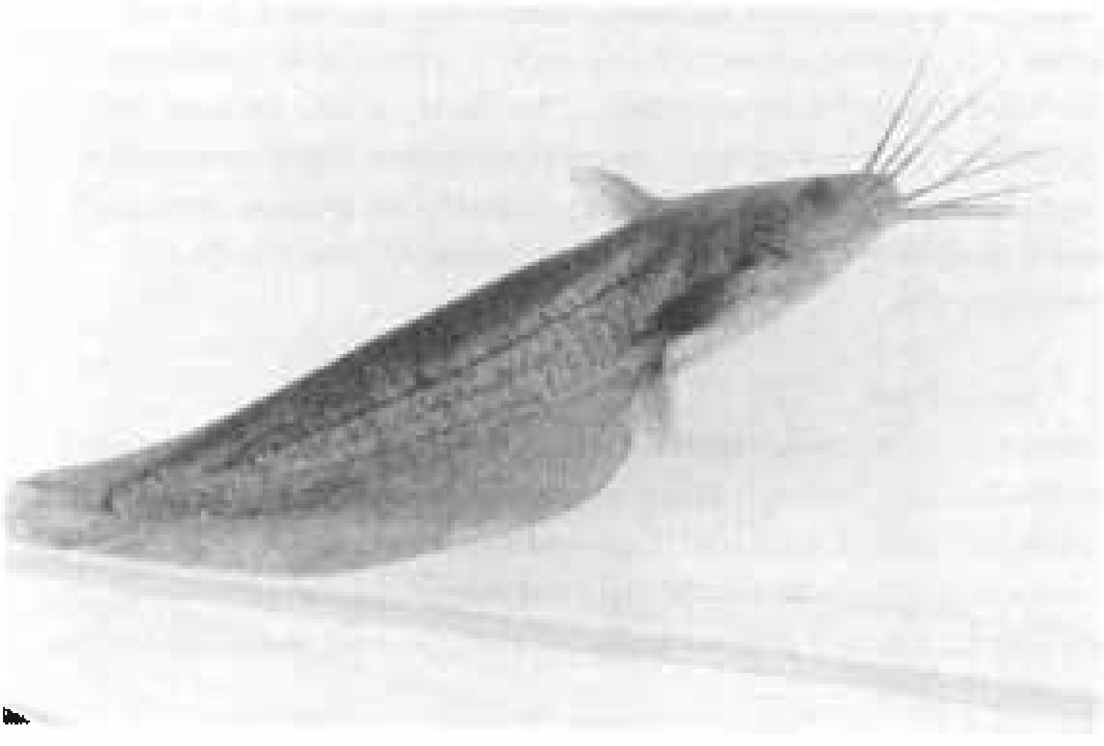

Plate 10. A short finned catfish from the Lockhart River.

*8.4.3 Scrubby Creek/Three Quarter Mile Lake*

Three Quarter Mile Lake did not produce many species, but was unable to be fully sampled when it was full due to the difficulty of access, unfavorable topography and possible presence of crocodiles. Only six fish species were collected from Three Quarter Mile Lake (sailfin glassfish, *Ambassis agrammus;* Mueller's glassfish, *Ambassis mulleri*; Australian rainbow, *Melanotaenia splendida splendida*; poreless gudgeon, *Oxyeleotris nullipora*; Rendahl's catfish, *Porochilus rendahli* and black catfish/jewfish, *Neosilurus ater*). Only Rendahl's catfish was caught in the lake and not the creek.

Scrubby Creek was of special interest due to the presence of McCulloch's rainbow (*Melanotaenia maccullochi*), Gertrude's blue-eye (*Pseudomugil gertrudae*), delicate blue-eye (*Pseudomugil tenellus*), poreless gudgeon (*Oxyeleotris nullipora*) and Australian rainbow (*Melanotaenia splendida splendida*). McCulloch's rainbow and Gertrude's blue-eye are both species with disjunct distributions isolated in small pockets. The record of them from Scrubby Creek is another extension of their distributions and appears to be another very restricted distribution. McCulloch's rainbow was only found in sand dune heath country in Cape York Peninsula, in soft humic waters. Gertrude's blue-eye has not been reported from this area previously. On the east coast it is only found in humic (tea coloured) waters.

Poreless gudgeons were found in Scrubby Creek in two forms, a plain brown form (male) and a mottled or striped form, with pale vertical bars on the body (female). Those two forms correspond to the sexually dimorphic (two forms) poreless gudgeons from the Jardine River described in Leggett and Merrick (1987). This is interesting as poreless gudgeons found to the north, in the Lockhart River, were all striped. In many locations poreless gudgeon numbers caught were sufficient to be reasonably assured of getting at least one male.

Delicate blue-eyes had only been reported from the Jardine and Edward Rivers in Queensland (Allen, 1989; Hansen, 1987). It is interesting that delicate blue-eyes, McCulloch's rainbows and the apparent Jardine River race of poreless gudgeons were found together in one location, isolated from other populations. That these "Jardine" fish are so far south in a restricted distribution warrants further investigations into their distribution in the area and their affinities with other populations.

The distribution of fish takes a strange twist as this was the northernmost location of *Melanotaenia splendida splendida*, the only "east coast' species found at this site.

Presumably Scrubby Creek represents a mixture of relict populations and colonising species.

## 8.5 Distributions

### *8.5.1 Extent*

The presence of shortfinned catfish, chequered rainbows and coal grunters in the Lockhart and Claudie Rivers is an anomaly, as it represents a discontinuous distribution pattern. Coal grunter are very visible and obvious, even if not easily caught, and their absence from the Pascoe River represents a break in their southwards east coast distribution. Shortfinned catfish are uncommon everywhere they have been caught in Australia, and so if present were possibly missed in the Pascoe. This apparent discontinuity could be explained by the uplift of the McIlwraith, Table and Tozer ranges, which separated the Claudie and Lockhart from the Pascoe. The relatively poor fauna of the Pascoe, compared to the Lockhart and Claudie, suggests that it may be a `new river', inhabited largely by colonising or catadromous species. The Pliocene uplifts and movements (Doutch, 1974) may have been sufficient to result in the formation of the Pascoe River and isolate the Claudie and Lockhart. Results from the regolith project (NR 12) indicate that the Pascoe river was formed after the headwaters of the Wenlock were turned eastwards by uplifting mountain ranges. The fish fauna of the Pascoe indicates otherwise. If the Pascoe did originate as part of the Wenlock, the absence of fish such as saratoga, striped sleepy cod (*Oxyeleotris selheimi*), and coal grunters is hard to explain. Further south, the Stewart River has elements of west coast river fauna which are attributable to its origin from the headwaters of the Holroyd. It is surprising that if the Pascoe had similar origins that it does not have some of the more hardy western river fish.

Chequered rainbows (*Melanotaenia splendida inornata*) were recorded from the Lockhart and Claudie Rivers by both Leggett (1990) and Hansen (1989). This species is supposed to have a Carpentaria distribution. This distribution to the south on the east coast is a significant extension of its range.

### *8.5.2 Habitat dependence*

Although only three specimens of short finned catfish were collected, all were found in areas of slow flow amongst roots. Allen (1989, 1991) reports that they are in a wide variety of habitats in New Guinea and the Jardine including both clear flowing streams and turbid backwaters and lagoons.

Despite the habitat differences between the Lockhart and Claudie Rivers, their fish faunas are remarkably similar. If marine vagrants are excluded, the two rivers share fourteen species. Only speckled gobies, mouth almighties (*Glossamia aprion*) and eastern sleepy cod were found in the Claudie and not the Lockhart. This may reflect the lower sampling effort in the Lockhart than in the Claudie, rather than differences due to habitat. Certainly, mouth almighties and eastern sleepy cod are virtually ubiquitous along the east coast in rivers with gallery forest.

Chequered rainbows were only caught in the lower Claudie River and Lockhart River, and not in the West Claudie. Chequered rainbows in other areas on the Peninsula seemed to be outnumbered by banded rainbows (*Melanotaenia trifasciata*) in locations of strong flow (comparatively speaking). Chequered rainbows dominated in areas of slow flow and lagoons. Generally upstream locations are stronger flowing than downstream. On occasions, drying pools may contain some banded rainbows, but these are vastly outnumbered by chequered rainbows and possibly they do not breed as successfully in these habitats.

As mentioned previously, M^c^Culloch's rainbows , Gertrude's blue-eyes and poreless gudgeons appear to favour humic waters, and this may be due to their inability to compete with other species in more favourable environments, or due to adaptation to survive in these locations. Poreless gudgeons were collected in Lake Wicheura, which does not have humic water, but there are few competitors there. Possibly, on the east coast, these species were more widespread, but as changes in water regimes and environments occurred over time, they became restricted to humic environments.

Delicate blue-eyes were only collected in areas of dense aquatic vegetation (as were Gertrude's blue-eyes), possibly indicating a requirement for this habitat. Elsewhere, delicate blue-eyes are usually found in areas of abundant aquatic vegetation (Allen and Cross, 1982). Three Quarter Mile Lake did not appear to have any of the blue-eyes and few rainbows, compared to Scrubby Creek, which is unusual, as they could be expected to move between the two areas. M^c^Culloch's rainbow , Gertrude's blue-eye and delicate blue-eye were only collected from the creek. It is possible that these fish do have limited distribution as they were only caught in one place in the 100 m section of the stream sampled. Investigation of areas both upstream and downstream revealed that there was no more habitat, similar to that in which the fish were found, in the area.

### 8.6 Species of Commercial and Recreational Importance

Due to their small size and comparative remoteness from population centres (compared to estuarine and marine environments) both the Lockhart and Claudie Rivers are little fished recreational or commercially. Some recreational angling and spearing of eeltail catfish/jewfish (*Neosilurus ater*) and freshwater prawns (*Macrobrachium rosenbergii*) does occur near Nundah outstation.

Commercial fishermen probably net the estuaries of both rivers periodically, and estuary areas, particularly the Lockhart, are used by recreational anglers. Fishermen's camps are present on the Chester and Nesbit River mouths, accessed via Silver Plains, and access is limited so that only one party is present at a time.

### 8.7 Breeding Observations

Banded rainbow, chequered rainbow and speckled goby females were all ovigerous.

### 8.8 Water Quality

The water quality at the Lockhart River and West Claudie sites was very similar in many aspects (see Appendix Four). Conductivity, pH, alkalinity, calcium and total hardness were all similar or identical in both sites. Tannin levels were higher in the Lockhart River. Both rivers drain relatively undisturbed areas and sampling locations were above any tidal influence.

The Claudie River site was tidally influenced below the causeway but not above it where sampled. Water quality conditions were vastly different to the west Claudie, with much higher conductivity, total and calcium hardness, alkalinity and pH. These effects may have been due in part to the length over which the water had traveled but they were not observed in the Lockhart. Below the West Claudie site and on all the crossings of Claudie tributaries there was severe turbidity caused by vehicle wash and runoff from the heavy rain in the area during our visit. Although the turbidity had been reduced and sediment loads settled out, solutes in the water from the soil and runoff may have contributed to the differences in water quality observed.

Water quality in Three Quarter Mile Lake was influenced by the peaty substrate. See Appendix Four for water quality parameters. Oxygen readings were low (2.3-2.7 mg/l) as a result of decomposition and heavy biological oxygen demand. Conductivity was measured at 543 µs/cm in December when the lake was very shallow, but had dropped to 75 µs/cm after the wet season flushing. Secchi visibility also rose after

flushing, from about 0.2 to 0.73 m. The pH and tannin was fairly constant at 4.14-4.5 and 4.4-4.8 mg/l, respectively.
These water quality parameters are towards the lower end of the extremes for humic waters occupied by fish. In spite of this, large numbers of Rendahl's catfish (*Porochilus rendahli*) and sailfin glassfish / perchlets (*Ambassis agrammus*) were collected from the lake in December.

Scrubby Creek, flowing from Three Quarter Mile Lake, had substantially lower tannin levels (1 mg/l) and higher pH (5.6) than the lake. These changes could be attributed to aeration and movement of the water and seepage of water from less humic environments. Oxygen level (5.9) was much higher as well, making the environment more suitable for fish.

### 8.9 Habitat Disturbance

As noted above, heavy siltation occurred on the Claudie River system downstream of all road crossings during rain periods and after vehicles had crossed. This effect was noted by Leggett (1990). At a public campsite on the Claudie near Leonard Hill heavy siltation had occurred and conditions were almost anaerobic (no oxygen). No fish except rainbows were observed. The siltation from the road may have major effects on downstream fauna. The water was too turbid and substrate too rocky to sample effectively to document the differences (if any) in fish fauna.
Pig damage was comparatively minor but was widespread. Pigs or evidence of them was not seen at the Lockhart River site near Nundah outstation.

The cleared paddocks south of Nundah bordering the Lockhart were well vegetated and it is doubtful that runoff from them would be turbid.

Habitat disturbance in the Scrubby Creek and Three Quarter Mile Lake area was minimal. There were few cattle in the area and evidence of pig activity was not extensive on both visits. However, the area has been subject to wild flash floods which can cause severe damage to riparian vegetation. Such a flood in the Chester River after 1969 caused extensive damage to the gallery forest (Lavarack and Puniard, 1988). Possibly the sand country acts like a sponge and mitigates these effects in the Scrubby Creek area.

### 8.10 Notes on Other Fauna

File snakes (*Acrochordus* sp.) were found in the Lockhart but not in the Claudie River. Salt water crocodiles and freshwater turtles were reported by locals from the lower reaches of both rivers. Redclaw crayfish (*Cherax quadricarinatus*) were abundant in the West Claudie River and common at the other sites except Three Quarter Mile Lake.

Freshwater prawns (*Macrobrachium rosenbergii*) were collected in both rivers, and large individuals were more common in the West Claudie River. A particularly large individual was closely observed and appeared to have a much larger and heavier tail in relation to its head, compared to other sites. It could be worth following up if commercial rearing of freshwater prawns ever looks like becoming a viable proposition.

## 9.0 CATCHMENT 1040 - M$^{c}$ILWRAITH RANGE AREA

Note: Catchment 1040 has been split into two sections, McIlwraith Range Area and Stewart River. The two areas are vastly different both faunistically and physically and it would be impractical to consider them together.

**Summary**

1. The streams in this area drained the high ranges and rainforest gorges of the McIlwraith Range.
2. No previous fish surveys have been conducted to our knowledge.
3. Two sites, the Rocky River and Massy Creek, were sampled twice.
4. Sixteen species were collected from the Rocky River and 21 at Massy Creek.
5. The fauna of both streams was largely catadromous fish. Striped sleepy cod (*Oxyeleotris selheimi*) was collected in the Massy.
6. Popular recreational fish species were collected, but most recreational fishing is in the estuaries.
7. Juveniles of all small fish (members of the Melanotaeniidae and Atherinidae) were collected on both trips.
8. Water quality differed on the two sampling occasions as one was prior to the rains and the other after. Pre-stormy season water was low in oxygen, which resulted in high levels of disease and some deaths of fish.
9. Habitat disturbance was minimal at the times of sampling. However erosion in the catchment may have some effects in the early wet season through turbidity and export of nutrients from cleared, heavily stocked areas. Gallery forest was preserved, minimising the negative influences from these sources.
10. File snakes and estuarine crocodiles were uncommon in the sections of streams visited by us.

### 9.1 Basin Characteristics

The Rocky River and Massy Creek rise in the heights of the McIlwraith Range and are perennial streams in all but the driest times. Both streams stopped flowing in the lower reaches in 1992 for a few weeks, for the first time in living memory (See Plates 11 & 12). These creeks rise in the rainforests of the McIlwraith Range, and flow through the flats of Silver Plains, to the coast. Much of the woodland to the east of Massy Creek has been cleared for grazing, but most of the catchment and all of the area around Rocky River are virtually untouched. Both watercourses are lined with dense, tall gallery forest. The area has relatively heavy, reliable rainfall (Lavarack and Puniard, 1988) which ensures a constant flow of water for the streams, at least in the upper reaches. No natural lagoons were found near the Rocky River and Massy

Creek. Only one site at each was examined. Those streams are short streams draining the igneous rock ranges.

The area has been well explored, mainly by miners and prospectors, due to the presence of gold (Lavarack and Puniard, 1988), and mining has been periodically conducted there. At the time of sampling, no mines were in operation on any of the streams sampled.

### 9.2 Previous Studies

The McIlwraith Range area fauna, particularly terrestrial vertebrates, has received close attention from scientists. CSIRO, National Parks and Wildlife, and the Royal Australian Ornithologists Union have all conducted studies there. To our knowledge, the fish fauna has not been sampled previously.

### 9.3 Sites Sampled

The sites sampled are listed in Table Five. Both sites were sampled twice due to the extremely dry conditions which prevailed on the first sampling occasion and stopped flow of the streams and which may therefore have affected the distribution of species. Sites sampled are mapped in Figure 6, in Chapter 10.

Table Five. Sites sampled - McIlwraith Range Area. Drainage Basin 1040.

| Map Ref. | Site Code | Name | Date | Latitude | Longitude |
|---|---|---|---|---|---|
| A | 1040 01 01 | Rocky River | 3 Dec 1992 | 13°48.82'S | 143°27.93'E |
| B | 1040 02 01 | Massy Creek | 4 Dec 1992 | 13°55.44'S | 143°30.89'E |
| A | 1040 01 02 | Rocky River | 11 Jun 1993 | 13°48.82'S | 143°27.93'E |
| B | 1040 02 02 | Massy Creek | 12 Jun 1993 | 13°55.44'S | 142°30.89'E |

The Rocky River site was set in dense gallery forest, however the trees grew straight up and did not spread much so did not shade the stream bed in the middle of the day. The stream itself was usually about 2 m broad and meandered through the 10 m wide bed. Much of the stream was sand/gravel substrate, with no cover. A few fallen logs and tree branches, and roots on the margins, provided little cover. The steep banks, comprised of alluvial soil, rise about 3-5 m to a level floodplain area which was covered in dense rainforest. The river mouth was about 9.5 km from the site sampled.

Massy Creek was more complex than the Rocky River in that the area surveyed was very rocky. About 60% of the substrate was bedrock. Flow was more substantial, and the creek filled the whole bed. Deep (2 m) pools were lined with snags, undercut

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Plate 11. Massy Creek, upstream of the road crossing, in December 1992, when it had dried out to a series of pools.

Plate 12. The same location in June 1993, during conditions of "normal" flow.

banks, and rock walls. Leaf litter covered the bedrock or sand substrate. Water was exceptionally clear. Habitat complexity was very high. The river mouth was approximately 10 km from the site sampled.

## 9.4 Fishes Species Present

### *9.4.1 Rocky River*

Fifteen fish species were caught in the Rocky River, 11 on the first trip and 13 on the second. Three species collected on the first trip were not collected on the second, which demonstrates the necessity of repeated sampling to get a full species inventory of a site.

Of the species caught, only red bream (*Lutjanus argentimaculatus*) could be called a marine vagrant, although the fish fauna is largely catadromous (47%). Catadromous species are those which move to the estuaries to breed but move into fresh water to feed and grow. Empire gudgeons (*Hypseleotris compressa*) and pacific blue eyes (*Pseudomugil signifer*) are salt tolerant although able to breed in fresh water.

On the first occasion, all fish were restricted to small pools. Many had ulcers similar to red-spot or EUS (epizootic ulcerative syndrome) observed in fishes commonly after rains or stress. EUS is still a mystery disease, the complete aetiology of infection not fully understood (Roberts *et al.*, 1992). Most commonly affected were jungle perch (*Kuhlia rupestris*), a fish not previously reported as having EUS. Large long finned eels (*Anguilla reinhardtii*), were observed to be either dying or displaying moribund behaviour, lying on the sand out in the open, and were sluggish when handled. Oxygen levels were low. Gross examination of the gills showed signs of anaemia. As eels take a large proportion of oxygen across the skin, the anaemia may have affected the bloodstream and not just the gills. Presumably it was lack of oxygen killing them. No species not generally found on the east coast were collected in the Rocky River.

### *9.4.2 Massy Creek*

In many aspects, the fish fauna of Massy Creek is similar to that of the Rocky River. Massy Creek at the sampling site was deeper and larger, and so was able to support larger fish. Of the 21 species collected, 11 (52%) were catadromous. Diseased fish were also observed at this site, but no dead or moribund fish were seen.

Of special interest was the presence of striped sleepy cod (*Oxyeleotris selheimi*). This sleepy cod was only known from the Carpentaria drainage division prior to this study. Its presence this far south is an anomaly. However, striped sleepy cod were present in the Stewart River to the south, and it is possible that both Massy Creek and the Stewart River join during extreme floods.

The high proportion of catadromous or salt tolerant species is obviously a consequence of the proximity of the site to the sea. All other freshwater species from both the Rocky River and Massy Creek are colonisers, with perhaps the exception of the sleepy cods. These colonisers are those which are found above waterfalls, in areas subject to infrequent inundation, or other areas in which one would expect few or no fish. How they get there is a mystery, but probably involves remarkable powers of migration, especially by eels, and possibly transport by other means (e.g. waterspouts, birds).

## 9.5 Distributions

### *9.5.1 Extent*

Massy Creek and the Rocky River are both short coastal streams. Most of the catadromous species should decrease in abundance as the stream climbs the hills and passes obstacles.

It was of interest that this was the northern most location at which Pacific blue-eyes (*Pseudomugil signifer*) were collected by us. Although they have apparently been observed at Old Lockhart Mission, this area appears to be the northern limit of their distribution, as they were not collected in locations close to estuaries in the Lockhart and Claudie rivers.

One mature specimen of striped sleepy cod (*Oxyeleotris selheimi*) was collected from Massy Creek. It is possible that this was a vagrant which came across from the Stewart River in the record floods of the 1992-1993 wet season. As only one specimen was captured, it is unlikely that a self sustaining population is present in the Massy, as no juveniles were found. Eastern sleepy cod (*Oxyeleotris gyrinoides*) juveniles and adults were abundant. Further surveys would be necessary to confirm this.

### *9.5.2 Habitat dependence*

The fish fauna of both the Rocky River and Massy Creek was largely of catadromous fish, which is a function of the sites' proximity to the sea.

Of interest was the presence of a striped sleepy cod, which is usually found in western river systems and appears to be more abundant in lagoons and sluggish waters. On the Stewart they were only present at Ronnie's Rocky Creek, a sluggish slightly turbid tributary. If they are adapted to such habitats, the crystal clear waters of Massy Creek would not be the ideal environment.

### 9.6 Species of Commercial and Recreational Importance

Barramundi and mangrove jack are very popular sports fish keenly sought after by recreational anglers. However, access to all the river estuaries in the area is gained by sea from Port Stewart, which is heavily used by recreational fishermen and the semi-professional sector (cane farmers and others who fish professionally part-time). Some netting by both professional and amateur fishermen has been reported and probably occurs throughout the area in estuaries.

Legal size barramundi (*Lates calcarifer*) were present in the accessible freshwater reaches of Massy Creek. Oxeye herring / tarpon (*Megalops cyprinoides*) were also present, and these are a game fish. Black catfish / jewfish (*Neosilurus ater*) are popular table fish, and were present in both rivers. Most recreational fishing is, however, confined to the estuaries.

The area could be a potential broodstock source for ornamental fish breeders, or for breeders of food fish for export. Striped sleepy cod are similar in colour and shape to marbled goby (*Oxyeleotris marmoratus*), which fetches extremely high prices in Asian gourmet fish markets.

### 9.7 Breeding Observations

Enormous numbers of juvenile fly specked hardyheads (*Craterocephalus stercusmuscarum*) and rainbows were caught in Massy Creek in December, indicating that breeding was well under way. Ovigerous females of both species were also present. Very few juveniles were caught in June, but they were probably more dispersed due to the flow of the creek. In December, dragging the seine in pools was easy as there were limited areas and the bottom was clear. In June the only dragable areas were riffles and shallow, open water. Some juvenile fish (blue-eyes, hardyheads, rainbows, gudgeons and sleepy cods) were observed on both trips in all locations.

### 9.8 Water Quality

In December 1992, Rocky River was a series of small waterholes. As stated earlier, large fish (eels) were observed dying, dead or in a very moribund state, and many fish were noted with ulcerated sides. These both indicate low water quality. Presumably the eels died of anoxia, as smaller species were present and not displaying symptoms of stress in the same pools. Storms in the area may have contributed to low oxygen levels as when the creek flowed after sampling, large quantities of leaf litter were carried into the pools. Water stopped flowing after a few hours, and the leaf litter would have created a high demand for oxygen.

When water quality parameters were measured, while the river was flowing (June 1993), oxygen levels were up to 8.25 mg/l, which is close to saturation. Conductivity was down from 136 to 61 µs/cm, and alkalinity and total hardness were also reduced. Water quality was excellent.

Massy Creek displayed similar changes with the resumption of flow. The oxygen depletion was even more serious here in December, due to the exposure of the pools to the sun and higher temperatures. Temperature was 29.8°C and oxygen 1.85 mg/l in December, and 20.7 and 8.44 respectively in June. The dark colour of water due to tannin (1.8 mg/l) in December would have exacerbated the problem due to increased absorption of heat. However, fish did not display symptoms of stress, and only a few were ulcerated. Some fish did die after electrofishing, probably due to heat stress and the lack of oxygen upon return to the water.

## 9.9 Habitat Disturbance

Gold prospecting in the Rocky River caused some disturbance to the gallery forest there in the 1980's (Lavarack and Puniard, 1988). We did not gain access to these areas on our visits. The road in to the Rocky River Crossing was severely washed out, with deep gullying and erosion. This would have washed into the river and resulted in some siltation at the time. No effects of siltation or damage were observed during sampling of this river.

Large scale land clearing has occurred east of Massy Creek, but the gallery forest was maintained and has been fenced off from cattle. The creek itself appears to be virtually undisturbed. There is a campsite on the creek bank, which is used frequently, but as numbers are restricted, effects would be minimal.

Pig digging in the gallery forest floors was extensive, and may inhibit forest regeneration or recruitment of some species.

### 9.10 Notes on Other Fauna

File snakes were present in Massy Creek, but were not observed in the other water courses. Estuarine crocodiles were reported by locals and birdwatchers from the Rocky River and Massy Creek but were not seen by us.

Eclectus parrots and palm cockatoos were seen also. The McIlwraith Ranges are noted as being the southernmost distribution of many species of birds and plants also found in New Guinea (Lavarack and Puniard, 1988). This area, along with the Iron range area "contains the Peninsula's richest biological resources" (Stanton, 1976 p. 42).

Pigs were usually seen on the cleared areas near cattle feeding stations. Some were seen in the gallery forest on Massy Creek. Evidence of them was found in the forests of the Rocky River and Massy Creek.

## 10.0 CATCHMENT 1040 - STEWART RIVER

**Summary**

1. The Stewart River is intermittent along its entire length, with very few permanent water holes or lagoons.

2. Only one previous study has been done (Pusey, personal communication), due to the short period of flow of the river.

3. Five sites (one lagoon, two river sites and two tributaries) were sampled.

4. Salt tolerant species comprised half of the twenty fish species collected. Western river species, striped sleepy cod (*Oxyeleotris selheimi*) and chequered rainbows (*Melanotaenia splendida inornata*) were collected in this river, suggesting that it is a stream capture from the Holroyd River.

5. Large numbers of juvenile Hyrtl's tandan (*Neosilurus hyrtlii*) were observed in temporary habitats.

6. As it is dry for most of the year there is little recreational fishery on the Stewart River. However, the estuary is heavily utilised by commercial and amateur fishers.

7. Only chequered rainbows were ovigerous when the river was sampled.

8. Water quality in the creeks was excellent. Fish Hole Lagoon was almost anaerobic (no oxygen) due to heavy aquatic plant growth.

9. In general there was little habitat disturbance observed although there was severe erosion in parts of the catchment. Borrow pits and digging for road works had made one site turbid.

10. Estuarine crocodiles (*Crocodylus porosus*) and freshwater prawns (*Macrobrachium* sp.) were present.

### 10.1 Basin Characteristics

The Stewart River is located east of Coen and rises in the lower, drier end of the McIlwraith Range. It is about 100 km in length, and is intermittent, running for only a few months each year with few permanent pools. The lower area is a broad floodplain with scattered shallow lagoons, all of which dry out in the dry season. The upper reaches are small streams in the McIlwraith range, running through woodland. The streams in the upper reaches are lined with paperbark trees (*Melaleuca*) and bottlebrushes (*Callistemon*). Often there are also small trees in the stream bed. Bed rock is usually in patches, overlaid by sand substrate, in the upper reaches. In lower reaches the substrate is all gravel/sand. The bed widens considerably during the progression down to the sea. At the uppermost sampling point (Station Creek) the stream bed was bout 15-20 m across, and at the bottom station (Terrible Creek junction) it was about 120-150 m across. Most of this is bare sand. Bottlebrushes only grew alongside the flow channel which persists for a month or two after the rains have started to decrease.

Thick gallery forest extends down to the bed of the river and is present on some islands in the bed at the middle point of the river near the Water Resources Commission gauging station. Gallery forest of an open type borders the banks of the river bed in places but probably only near permanent accessible ground water. Very dry areas consisted entirely of scrub or woodland down to the banks.

The river system has very few permanent waterholes. The waterhole at the Water Resources Commission gauging station 1040 01 was inaccessible to us. There is another permanent hole in Terrible Creek. Permanent water is also present at Ronnie's Rocky creek, a tributary of the Stewart River near the Port Stewart Road.

### 10.2 Previous Studies

B. Pusey of Griffith University has done a fish survey in the Stewart River. The results of that are presented in Appendix One. The site studied was near Port Stewart, near the Cook Shire Council camp ground. This area is very close to the estuary. No other surveys have been done, probably because the river is usually dry at easily accessible locations for most of the year.

### 10.3 Sites Sampled

Five sites on the Stewart River, comprising one lagoon, two tributaries and two sites in the river bed, were sampled (See Figure 6). The two river sites were quite different, in that the upper river site on the main road to Port Stewart paperbark trees predominated in the river bed which was completely sand. The river meandered across the whole river bed in the portion studied. The banks were about 15 m above the bed, and the surrounding country hilly.

The second river site was at a crossing on the road to Lily Vale. At this site the bed of the river was about 150 m wide and all sand. Bottlebrushes bordered the channel or rocky areas near it which would have flowed at periods of higher water levels. The stream meandered across the bed but generally ran along one side or the other. Gallery forest was present, especially along Terrible Creek. No aquatic vegetation was present, and there were few snags. Roots of paperbarks or bottlebrushes provided the main cover for fish and crustaceans. There were a few snags and backwaters with leaf litter where fish congregated. Water was clear and shallow, generally 0.2-0.4 m deep.

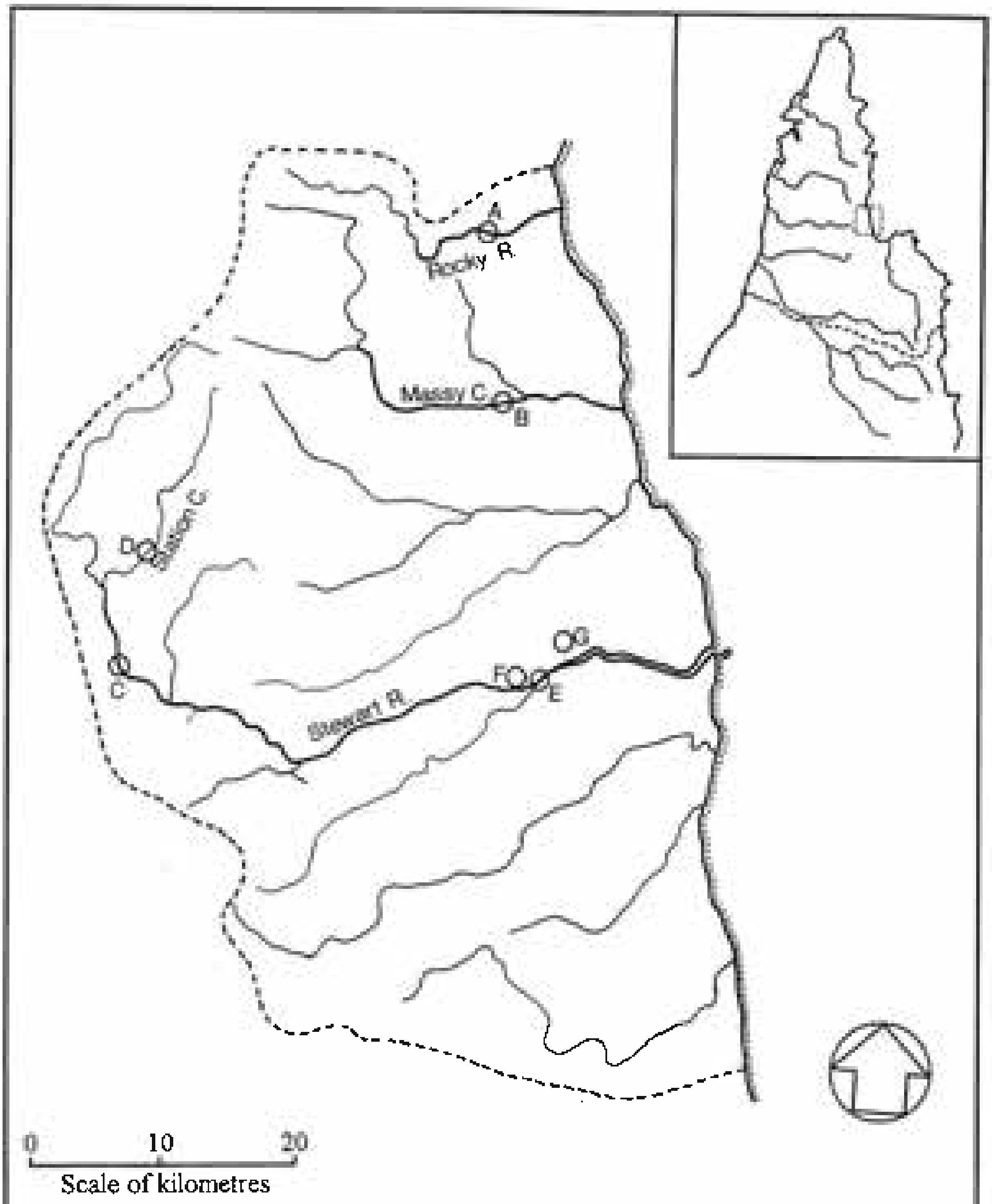


**Figure 6. Stewart River and McIlwraith Range Streams- Drainage Division 1040**
Markers indicate sample sites (refer to Table 6 for date and site names)

The lagoon site was choked with plant life which precluded effective sampling, particularly of bottom dwelling fish. Water lilies (*Nymphaea* sp.)predominated, but water snowflake (*Nymphoides* sp.) was also present. Water nymph (*Najas tenuifolia*) and reeds (*Eleocharis* sp.) were also present, the former completely filling the lagoon and precluding use of secchi or depth measurer. Paperbark trees were distributed around the margins but were small (>7 m tall) and not spreading, so did not shade the lagoon.

Station Creek was a site on the old Coen-Port Stewart road. Station Creek is a major feeder stream and was flowing rapidly at the time of sampling. Riffles, glides and pools were present, and water was up to 1.2 m deep. Substrate was pebbles, sand, or rocks, depending on flow type. This site had the greatest habitat complexity, with rocks, snags and roots providing cover. It completely dries out after the rains.

Ronnie's Rocky Creek is an officially unnamed creek which runs alongside the Port Stewart Road (See Plate 13). It is sited beside old gravel and road material burrow pits. The creek itself is a long gully in the rock, bordered by eucalypts, screw palm (*Pandanus* sp.), tea tree (*Leptospermum* sp.), and other small shrubs. The gully is about 3-4 m across and over 200 m long. It ends at a small (4 m) waterfall below which is a pool. The water was slightly turbid, probably due to runoff from the adjacent road works cleared areas. Some water lilies, *Eriocaulon setaceum* and reeds were present in the water. The substrate was either sand or rock. Few snags were present but there were rock walls which were deeply pitted and fissured.

Table Six. Sites sampled - Stewart River. Drainage Basin 1040

| Map Ref. | Site Code | Name | Date | Latitude | Longitude |
|---|---|---|---|---|---|
| C | 1040 03 01 | Stewart River, Main Crossing | 21 April 1993 | 14° 07.98'S | 143° 16.36'E |
| D | 1040 04 01 | Station Creek | 22 April 1993 | 14° 02.78'S | 143° 17.33'E |
| E | 1040 05 01 | Terrible Creek Crossing | 23 April 1993 | 14° 06.44'S | 143° 34.39'E |
| F | 1040 06 01 | Fish Hole lagoon | 24 April 1993 | 14° 06.41'S | 143° 32.67'E |
| G | 1040 07 01 | Ronnie's Rocky Creek | 24 April 1993 | 14° 04.77'S | 143° 36.53'E |

## 10.4 Fish Species Present

Fish species collected are presented in Appendix Two. The majority of the twenty species were collected from just two sites, the lower (Terrible Creek Crossing) site and the Rocky Creek site. These sites were the only permanent water sites sampled. The lower crossing site was dominated by marine vagrants, or salt tolerant species (50%), but was near permanent water so there was a source of recruitment and a refuge. The Rocky Creek site had a total of thirteen species, only three of which breed in salt water or can tolerate brackish conditions. In the other sites, colonising species which show a strong instinct to migrate upstream were caught. Chequered rainbows (*Melanotaenia splendida inornata*), spangled perch (*Leiopotherapon unicolor*), long finned eels (*Anguilla reinhardtii*), purple spotted gudgeon (*Mogurnda mogurnda*) and eeltail catfish (*Neosilurus hyrtlii*) were common to abundant at all sites but the lagoon. These species display a remarkable ability to rapidly colonise new environments as they become available and they breed rapidly. The instinct to swim upstream is so strong in spangled perch that they will jump out of a pond if a hose is left running into the shallows.

It was interesting to catch chequered rainbows and striped sleepy cod (*Oxyeleotris selheimi*) in the Stewart River, as they are more typical fauna of western streams. They are the only fish species which appear to have any zoogeographical importance in the Stewart River, as the others are either ubiquitous or catadromous. The Stewart River is similar to many of the western streams in that its flow is intermittent, the bed is sand and it is a broad creek bed with extensive flood plains. The difference in the Stewart is the lack of permanent surface water. The only species present are those hardy species which are tolerant of low dissolved oxygen, poor water quality and high temperatures, or those species which can live in brackish or salt water and usually breed there. It is quite possible that over long periods of exceptional drought all surface water disappears.

The presence of these western river species in the Stewart River is explained by the geological history of the area. Uplifts, in the vicinity of the present Port Stewart road crossing, redirected the headwaters of the Holroyd River eastwards, and eventually formed the Stewart River in the late tertiary period (about 1-5 million years before present). The recentness of this event explains why there has been no divergence and penetration of eastern river fauna. The absence of some species of western fish, particularly saratoga (*Scleropages jardinii*), black bream (*Hephaestus fuliginosus*) and leathery grunters (*Scortum hillii* and *S. barcoo*)is interesting as they are present in the Holroyd. Although the headwaters of the Holroyd were not sampled by us, these species, with the exception of black bream, were either rare or absent in the headwaters of other rivers sampled by us. Black bream breed in upstream areas and are invariably present in the uppermost reaches of the rivers they inhabit. One possible explanation for their absence in the Stewart is the intermittent nature of the river and lack of permanent water. It is possible that during the most severe droughts that water quality in the few remaining water bodies along the Stewart become so bad as to permit survival of only the toughest fish, such as sleepy cod.

## 10.5 Distributions

### *10.5.1 Extent*

The "colonising" species appeared to be present throughout the whole system. Large schools of yellow finned tandans (*N. hyrtlii*) (Plate 14) were present in the few areas suitable for aggregations to occur. In the most upstream sites, the five species mentioned in 10.4 were by far the most abundant, although some other species were present in small numbers. Species without strong rheotactic (upstream swimming) instincts are unable to penetrate habitats further away from permanent water. Striped sleepy cod has rheotactic instincts (they were found congregated at the bottom of the waterfall in Rocky Creek), but possibly are not strong enough to swim upstream over great distances and rapidly breed to take advantage of the situation. Sailfin glassfish/perchlet (*Ambassis agrammus*) are probably similar, but can breed up when conditions permit.

*10.5.2 Habitat Dependence*

No particular dependence on specific habitats was noted of any species, although Roman nosed gobies (*Awaous crassilabrus*) were always found burrowed into loose sand in areas of current, either glides or riffles. Eels were, as juveniles, found in sand in riffles but larger ones (>100 mm) tended to shelter in roots or near rocks. Eeltailed catfish congregated in "balls" of up to several hundred individuals in areas of gentle flow behind rocks or logs. However, in pools they spread out and used leaf litter as cover. Striped sleepy cod were only found in a location where water was permanent.

**10.6 Species of Commercial and Recreational Importance**

Because it is dry for most of the year, the Stewart River is of virtually no fishing significance. However, there would be potential for harvest of juvenile eels for growout, or juvenile yellow finned tandans as aquarium fish, as all the fish in the upstream reaches are doomed to perish when the water dries up.

The estuary near Port Stewart is a popular fishing area and Cook Shire Council maintains a camp ground there with electricity and water supplied. Large numbers of recreational anglers go there as soon as the road through is passable. Port Stewart is used to access other rivers and inlets further up or down the coast. Barramundi are the prime fish sought after by anglers.

Plate 13. Ronnie's Rocky Creek, one of the few permanent waterholes near the Stewart River

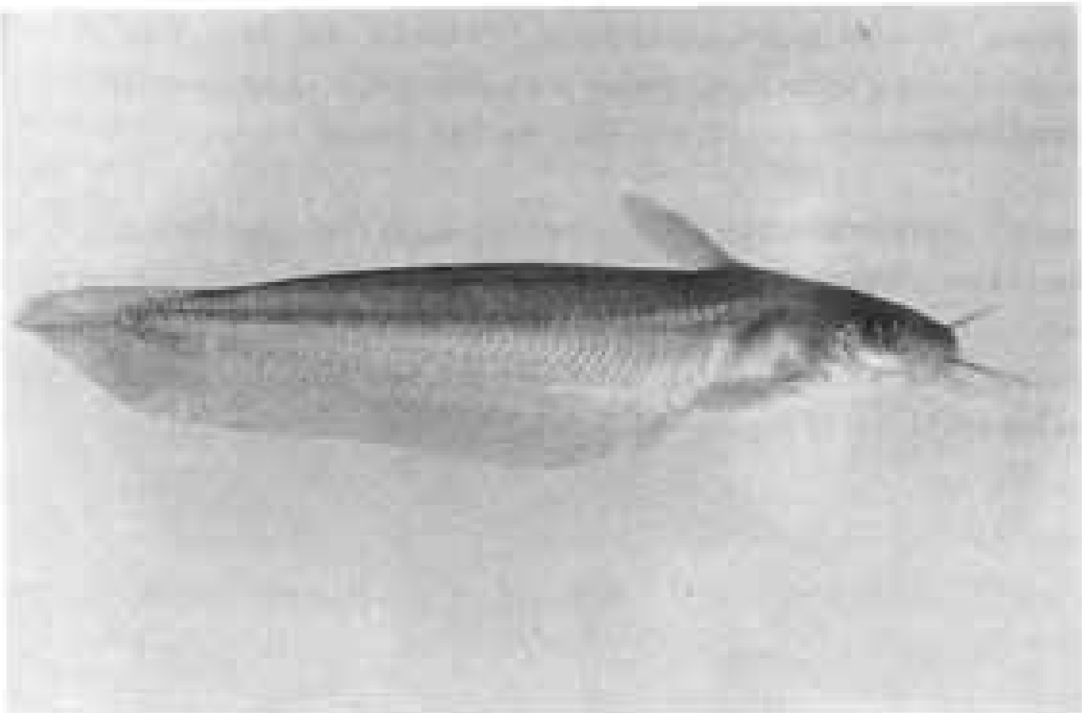

Plate 14. Yellow finned tandan, *Neosilurus hyrtlii*, which were abundant in the intermittent reaches of the Stewart River

### 10.7 Breeding Observations

Only rainbows were observed to be ovigerous at the time of sampling. No adult catfish were caught in the temporary waters, suggesting that they undertake a spawning migration and return to the dry season habitat.

### 10.8 Water Quality

Water quality in the three flowing water sites was excellent, with moderate conductivity, high oxygen and good alkalinity. No tannin was detected. Fish hole lagoon was eutrophic (overgrown with aquatic plants) and slightly acidic, with a pH of 5.88, which is surprising considering the large amount of plant material in there. When measured at 10.30 am, the oxygen level was only 1.55 mg/l, which is very little considering that the sun had been up for about 4-5 hours. This lagoon probably had extremely low oxygen levels in the early morning, possibly enough to kill most fish present, particularly bottom dwellers like catfish and sleepy cod. Some phosphorus was detected, which may have been attributable to the cattle in the area.

The water quality in Rocky Creek was quite good, although the water was turbid with suspended mud and clay particles (secchi of 1m) (secchi is a measure of water clarity). Oxygen was moderately high, at 6.28 mg/l.

### 10.9 Habitat Disturbance

Most habitats observed were little disturbed. The main river crossing had a lot of recreational fishing traffic crossing it but the only effects were wash. The bottom was sandy and any sediment to be disturbed would have been washed away earlier in the season.

The only major habitat disturbance noted was the removal of topsoil and vegetation where borrow pits for building the road up were located. This had resulted in quite severe erosion and sediment going into Ronnie's Rocky creek. Much of this would have occurred during peak flow periods and been carried away. However, the water in the hole was turbid, and this has a direct effect on plant productivity and aquatic system health.

Pig damage was only observed at Terrible Creek; in the alluvial soils and leaf litter beds of the gallery forest. However, the site was only visited recently after the wet season when pigs are dispersed. The damage caused by pigs could only be assumed to be worse in winter when they begin to congregate around water sources.

### 10.10 Notes on Other Fauna

Estuarine crocodiles (*Crocodylus porosus*) were present in the river near the mouth. Palm cockatoos were abundant in the trees on the upper levee banks. Freshwater crabs were collected and deposited in the Queensland Museum. Freshwater prawns (*Macrobrachium* sp.) were present but uncommon.

# 11.0 CATCHMENT 1060 - STARCKE, JEANNIE AND HOWICK RIVERS, AND BATHURST BAY CREEKS


**Summary**

1. The Starcke, Jeannie and Howick Rivers are all short, coastal streams. The Jeannie and Howick are intermittent, and the Starcke perennial. Alex and Palm Creeks are perennial, extremely short (less than 5 km) streams.

2. There is no published data available on previous collections although Allen (1989) has figured specimens from the Starcke River.

3. Seven sites were sampled, road crossings at each of the rivers and Scrub Bull Lagoon near the Howick. One site near the source of each Bathurst Bay creek was sampled, and a lagoon on the marine plains sampled.

4. Twenty-two species were collected from the Starcke River, 6 from the Jeannie and fifteen from the Howick River and lagoon. Only four species from the Starcke were freshwater species. Ten species were collected form the Bathurst Bay creeks. The fish fauna was dominated by catadromous or marine species.

5. The few species collected from the Jeannie was probably due to its distance from the sea compared to the other sites. Spangled perch were apparently absent from the Howick River.

6. The Starcke River is periodically fished by recreational anglers, primarily in the estuary.

7. Fish sizes suggested that breeding takes place early in the monsoon.

8. Water quality was very high in all sites visited except Muck Creek lagoon, water being clear, soft and well oxygenated. Muck Creek lagoon was on acid sulphate soils and consequently had low pH and oxygen levels.

9. Habitat disturbance observed was restricted to road erosion. Pig and cattle disturbance was limited at the time of observation.

10. Estuarine crocodiles, freshwater crabs and freshwater prawns (*Macrobrachium* sp.) were present but not abundant.


## 11.1 Basin Characteristics

The Starcke, Jeannie and Howick Rivers are all relatively short rivers originating from some of the most rugged country on Cape York Peninsula. From the coastal ranges, an area described by Stanton (1976) as a patchwork of various metamorphic rocks with minor basalt and remnants of a former sandstone layer, the rivers fall steeply onto a low sandy alluvial plain of highly erodable sandy clay. The area supports a wide variety of vegetation types ranging from grassland on heavy basaltic soils to a number of types of well developed rainforest and closed sclerophyll communities in the ranges.

Cliff faces and higher sandstone plateaus carry heath and scrubland leading to stringybark (*Eucalyptus tetradonta*) woodlands and grasslands on the coastal plain to extensive swamp forests closer to the coast, particularly in the South of the basin.

The locations sampled on the Jeannie and Howick Rivers were very similar in that they were both intermittent, had a shallow uniform flow over sand with little instream cover and very steep high banks. The perennial Starcke River consists of a number of large shallow sandy pools broken by gently sloping bedrock riffles. Stream profile is less abrupt and the adjoining woodland vegetation is more dense. The lower reaches of the three rivers are tidal and flanked by mangrove communities.

Lagoons are uncommon in the region north of the Cape Flattery sand dune country to the Melville Range, with the existing few located in the swampy coastal areas. The sampled lagoon associated with the Howick river appeared to be spring fed.

The streams in the Bathurst Bay region are fed by springs in the Melville Range, a large granite outcrop. They appear to be permanent in the upper reaches, although Palm Creek only flows for about 2 km from the base of the range, after which the bed is dry sand. Both creeks are sheltered by dense gallery forest, characterised by abundant Alexandra Palms and red beech (*Dillenia alata*) trees. The streams have narrow, sandy channels, with low banks bound by tree roots.

There a numerous lagoons on the Muck Creek floodplain, which appears to be an ancient marine swamp, with acid sulphate soils. The one lagoon sampled had no fish life and a pH of 2.81. Other lagoons observed all had little or no fish life. Insects were abundant.

### 11.2 Previous Studies

Allen (1989) has sampled Starcke River at some stage as he has photos depicting milkfish (*Chanos chanos*), giant herring (*Elops machnata*) and butterfish (*Scatophagus argus*) from here. Flag tailed glassfish (*Ambassis miops*) specimens from the Starcke River have also been examined by Allen (1989). Apart from this no other published data for the three rivers could be located.

R. Mackay of the Queensland Museum has recently sampled some sand dune lakes in the Cape Flattery area south of the Starcke River and 12 species collected were deposited at Queensland Museum. A species list is included in Appendix 1. The poreless gudgeon (*Oxyeleotris nullipora*) is of interest as we have only collected it on the east coast north of the Pascoe River, and in the Endeavour River to the south. It was always associated with humic (tea tree coloured) water. M^cCulloch's rainbow (*Melanotaenia maccullochi*) and pennyfish (*Denariusa bandata*) are also of interest as they are isolated populations.

### 11.3 Sites Sampled

All sites sampled are listed in Table Seven. Each river site was sampled immediately above and below the road crossing. The lagoon was located 500 metres from the Howick river channel with an elevated drainage channel leading to the river. The two creek sites were sampled approximately one kilometre above the road crossings. Muck Creek lagoon was one of a series of lagoons in a channel eventually flowing into the salt flats behind the beach (See Figure 7).

Table Seven - Sites sampled on the Starcke, Jeannie and Howick Rivers, and Bathurst Bay. Drainage Basin 1060

| Map Ref. | Site Code | Name | Date | Latitude | Longitude |
|---|---|---|---|---|---|
| A | 1060 03 01 | Jeannie River - Road Crossing | 13 May 1993 | 14°45.66'S | 145°51.32'E |
| B | 1060 04 01 | Starcke River - Road Crossing | 14 May 1993 | 14°49.05'S | 144°58.20'E |
| C | 1060 05 01 | Howick River - Scrub Bull Lagoon | 12 May 1993 | 14°36.30'S | 144°40.92'E |
| D | 1060 06 01 | Howick River - Road Crossing | 12 May 1993 | 14°36.37'S | 144°41.03'E |
| E | 10600701 | Palm Creek - Foxtail Camp | 6 Jun 1994 | 14°17.02'S | 144°27.39'E |
| F | 10600801 | Muck Creek Lagoon | 7 Jun 1994 | 14°17.86'S | 144°25.89'E |
| G | 10600901 | Alex Creek | 7 Jun 1994 | 14°15.50'S | 144°27.6'E |

The Starcke River site consisted of a large, clear, shallow (1 m) sandy pool about 90 metres long and 25 metres wide with some filamentous algae, large log snags and roots along its banks. A narrow (3 m) gentle flow over cobbles turning to a riffle over algae covered bedrock exited the pool. Numerous large trees lined the gently sloping sandy banks.

At the road crossing the gently flowing Jeannie River meandered and was braided down a 10-15 metre wide sandy river bed. The actual flow varied from 2-4 metres in width and 0.3-0.6 metres in depth. There was no aquatic vegetation present, only some small fibrous roots along the bank, the occasional small and large snags and a little leaf litter.

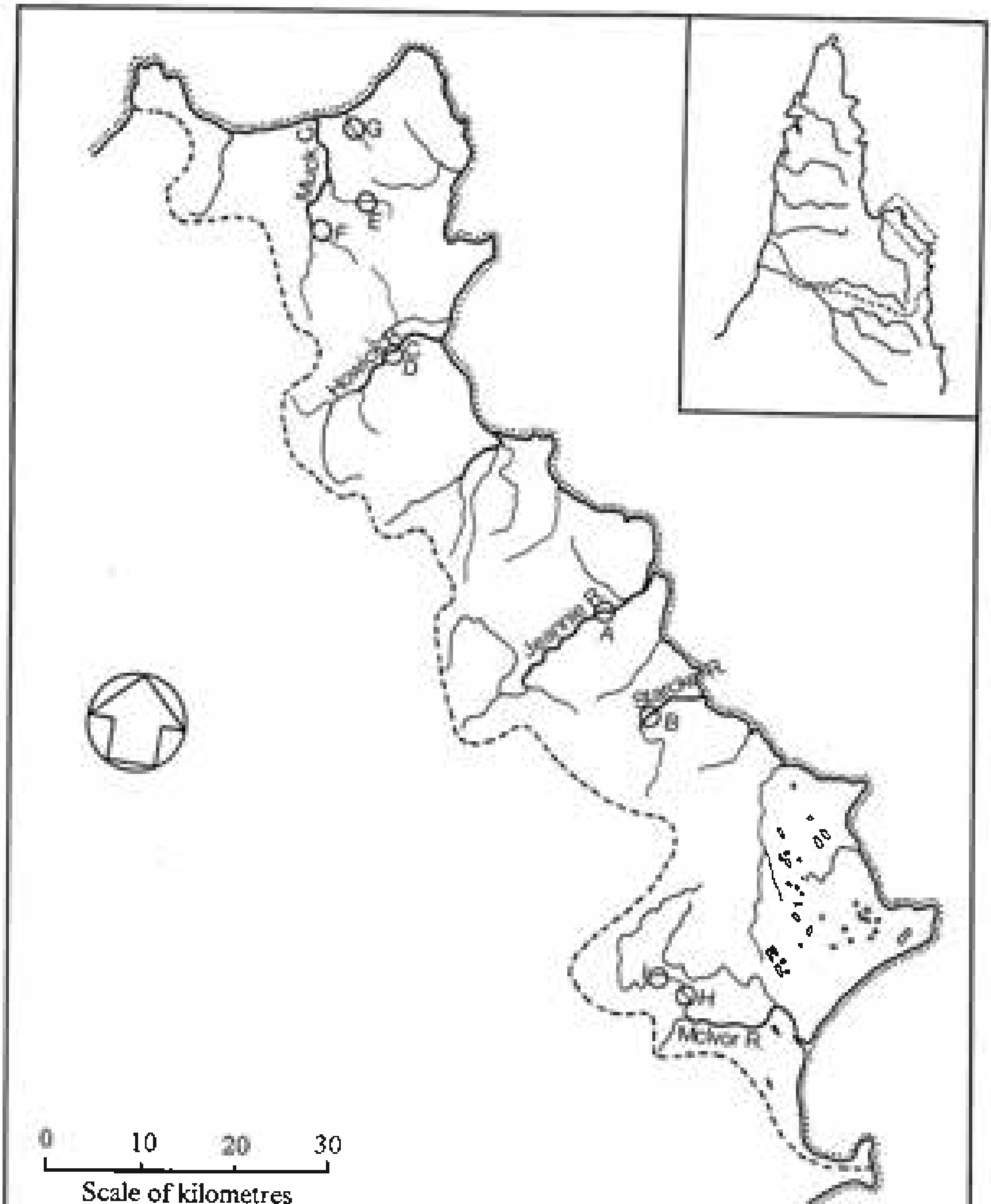


**Figure 7. Howick, Jeannie, Starcke and McIvor Rivers- Drainage Division 1060**
Markers indicate sample sites (refer to Table 7 for date and site names)

Flow in Howick River (Plate 15) was similar to the Jeannie, however the entire 3 metre wide stream bed was submerged with about 20 cm of clear water. It had similar amounts of instream cover, steep banks and flowed through the same flat grassed open woodland country.

Scrub Bull Lagoon (Plate 16) near the Howick River is a small lagoon about 1.5 m deep, 20 m wide and 70 m long and appeared to be fed at the northern end by a small spring. About fifty per cent of the lagoon was covered by water lilies and contained a wide variety of aquatic vegetation with an abundance of bladderwort (*Utricularia gibba*). The lagoon had similar water chemistry to the river sites with soft, neutral (pH 6.91) water with some tannin (1.0 mg/l) content. Soil around the lagoon was a black clay type with moderate disturbance from cattle and feral pigs. A low stand of paperbark (*Melaleuca*) trees and sparse grasses grew around the swampy area.

Palm Creek flowed from the base of the western side of the Melville Range. It was a narrow, small creek, up to 4m wide in places, completely shaded by thick gallery forest dominated by red beech trees. The banks consisted of sand and soil bound by dense masses of tree roots. There was abundant instream cover of snags, leaf litter and roots. The creek flowed in a stream bed which was about 10m wide in places, with banks about 4m high. Gallery forest gave way to woodland at the top of the banks.

Alex Creek was similar to Palm Creek in most characteristics, although there were numerous Alexandra palms in the stream bed and the stream itself. The forest in the stream bed was mostly paperbark trees (*Melaleuca* sp.) and red beeches. Instream cover was mostly palm fronds. This shallow creek was only about 1 km in length. The upper portion consisted of plunge pools in granite boulders.

Muck Lagoon was a shallow (1m) lagoon situated in woodland, in a channel leading to the salt flats behind the beach at Bathurst Bay. It had abundant aquatic vegetation in patches (reeds, *Eleocharis* sp.; water lilies, *Nymphaea violacea*, and eelgrass, *Blyxa*), and the bottom was covered in paperbark tree leaves. Three species of paperbark tree lined the banks. The substrate was largely clay. The banks were stained orange with ferric oxide deposits. The water was exceptionally clear.

### 11.4 Fish Species Present

A total of 22 species were recorded from the Starcke River, 6 species from the Jeannie and 15 species from the combined Howick river and lagoon sites. Twelve of the collected species from the Starcke River were marine vagrants, only four were "freshwater" species (able to complete their life-cycle in freshwater) with the remaining species being diadromous (able to move between freshwater and seawater) (Hart *et al.* 1991). Only six species were collected from the Jeannie River, four being freshwater with the remaining two being catadromous (returning to salt water to breed). No marine vagrants were sampled. This may be because the site was 10 km further

Plate 15. The Howick River, near the ford.

Plate 16. Scrub Bull Lagoon, a permanent lagoon near the Howick River.

from the combined Howick River and lagoon sites, three were freshwater with the remainder being catadromous (6) or marine vagrants (6).

Two spotted scats (*S. argus*) were collected from Scrub Bull Lagoon on the Howick River. This is the only time we recorded a marine vagrant in a freshwater lagoon. The lagoon's close proximity to the coast could explain their presence. Another interesting feature of the Howick sites is the absence of spangled perch (*Leiopotherapon unicolor*), especially considering they were abundant at the very similar Jeannie River site approximately 25 km away. It would be of benefit to sample the Howick River again to determine if the spatial distribution (presence in different river systems) of some fish species varied over time.

In the combined Starcke and Howick river sites we collected flag tailed glassfish (*A. miops*), milkfish (*C. chanos*), bully mullet (*M. cephalus*), silver grunter (*M. argenteus*), butterfish (*S. multifasciata*), giant herring (*E. machnata*) and archerfish (*T. jaculatrix*). All of these species are marine vagrants emphasising the sites' close proximity to the sea.

Eight species were collected from Alex Creek and ten from Palm Creek. No fish were collected from Muck lagoon. As with the other sites, the fish fauna was dominated by catadromous species. Only eastern sleepy cod (*Oxyeleotris gyrinoides*) and purple spotted gudgeons (*Mogurnda adspersa* and *Mogurnda mogurnda*) are freshwater species not breeding in saline water. Snakeheads (*Ophieleotris aporos*) were abundant in Palm Creek, and *Eleotris* spp. were abundant in both creeks.

## 11.5 Distributions

### *11.5.1 Extent*

Due to the constraints of time and limited access, only one site on each river could be surveyed. Therefore the extent to which each species was distributed in each stream could not be assessed. However, the absence of marine vagrants at the Jeannie River site (approximately 10 km further upstream than the other sites) may indicate these species do not penetrate very far upstream. All the species sampled in the area were within their documented distribution.

It was of interest to find both northern trout gudgeons and purple spotted gudgeons in the same location, in Palm Creek. These two very similar species were considered to be separated into east coast (*M. adspersa*) and west coast (*M. mogurnda*) distributions (see Allen, 1989). Only *M. adspersa* has been documented from the adjacent Normanby complex (see Kennard, 1993).

*11.5.2 Habitat dependence*

Celebes goby (*Glossogobius celebius*) adults are found in freshwater but have a marine larval stage. They inhabit clear streams close to the sea (Allen, 1989), and the Starcke, Jeannie and Howick Rivers are ideal habitat for them. Clear coastal streams are also the preferred habitat of jungle perch (*K. rupestris)*. Glassfish, rainbows *(M. spl. splendida*) and spangled perch tolerate a wide range of habitat types that is reflected in their widespread distribution. The catadromous species and marine vagrants are dependent on their access to the estuary. Varying flow rates over the seasons and the associated influx of salt water may dictate species composition along the stream length.

The apparent absence of spangled perch from the Howick River is a mystery. They were abundant in the Jeannie River just to the South, but do not appear to have colonised the Howick River. The habitat seems ideal, and the species is renowned for its ability to colonise areas and is salt tolerant to concentrations up to 35.5 g/L (Hart *et al.*, 1991).

No fish species appeared to be able to tolerate the highly acidic conditions in Muck Creek lagoon. Rainbows and other fish species were present in the creek itself (see Appendix Two), suggesting that colonisation would be possible in the wet season. The oxygen concentration in this lagoon was also extremely low, which would not be conducive to fish survival.

**11.6 Species of Commercial and Recreational Importance**

There does not appear to be any recreational fishing conducted on the Jeannie and Howick Rivers. Periodically, Starcke River is fished by recreational anglers with the main target species being red bream, jungle perch and barramundi. The tidal reaches of all three rivers are at times commercially netted for barramundi and threadfin salmon with some fishing for mud crabs as well.

Bathurst Bay is a popular camping area. Most fishermen camp on the beach and fish the reefs offshore. The area is also used as a harbour for trawlers and smugglers. Alex Creek is used as the source of drinking water by these groups.

### 11.7 Breeding Observations

Judging by the size of most fish species collected, the majority of spawning takes place from the onset of the monsoon rains. This was most pronounced in the marine species. The lower reaches of these rivers would be of particular importance to juvenile catadromous and marine species that rely on this habitat for their food resources (an abundance of small fodder fish and prawns) and lack of larger predators.

### 11.8 Water Quality

At the time of sampling, flow in each stream was relatively high resulting from the previous monsoonal rains. Originating from an undisturbed catchment, water quality was very high in all four sites. The clear soft waters were neutral, well oxygenated, with an average tannin content of 1 mg/L. No phosphate was recorded in the Starcke and Jeannie Rivers, however levels of 1 mg/L along with slightly lower conductivities were found at both Howick River and Scrub Bull Lagoon sites. This could be attributed to runoff from rain at the time.

Palm Creek and Alex Creek had exceptionally clean and pure water, with little tannin and no phosphate. As discussed above, Muck lagoon was exceptionally acidic and was unsuitable for fish life.

### 11.9 Habitat Disturbance

Each stream was in pristine condition with road crossings and some wild pig and cattle access being the only disturbances noted. At Scrub Bull Lagoon there was more disturbance from wild pig and cattle access, however water quality did not appear to be adversely affected. Severe gully and rill erosion along parts of the road through Starcke Holding south of the rivers are cause for concern.

Large numbers of cattle grazed the woodlands and plains near the base of the Melville Range. Extensive pig and cattle damage to aquatic vegetation in many lagoons was observed in the area. Erosion near tracks was minimal.

### 11.10 Notes on Other Fauna

Estuarine crocodiles were reported to be in the tidal reaches of all three rivers, however we did not encounter any at the sites surveyed. Freshwater crabs were observed burrowing in the banks of Howick River. Water going snakes were common in both the Howick and Jeannie Rivers. Young freshwater prawns (*Macrobrachium* sp.) were numerous at each site with some larger specimens present in the Starcke River.

## 12.0 CATCHMENT 1060 (cont.) - McIVOR RIVER


### Summary

1. The McIvor River is a short, perennial stream rising in the hills north of Cooktown. It flows over a limited floodplain which has been largely cleared for agriculture.
2. No previous studies were located but Allen (1989) has referred to fish from the area.
3. Two sites were sampled, at the crossing at Parallana and at Mount Ray about 1 km upstream of the homestead. The causeway site was sampled twice.
4. Nineteen species were collected, of which two were essentially marine.
5. This is the northernmost point in the distribution of eastern sleepy cod (*Oxyeleotris gyrinoides*) on the coast south of Cape Melville. It is also the beginning of the continuous distribution of the pacific blue-eye (*Pseudomugil signifer*) which has outlying populations in the Rocky River and Alex Creek to the north.
6. The McIvor is heavily used for recreational fishing, primarily for eeltail catfish or jewfish (*Neosilurus ater*), eels (*Anguilla* spp.), barramundi (*Lates calcarifer*), jungle perch (*Kuhlia rupestris*), red bream (*Lutjanus argentimaculatus*) and eastern sleepy cod (*O. gyrinoides*).
7. Jungle perch recruitment occurred in January, suggesting marine breeding in December. Empire gudgeons (*Hypseleotris compressa*) were also migrating upstream in January.
8. Water quality was good although there was moderate turbidity at the times of sampling due to runoff from tilled fields.
9. Cultivation of the land for cattle grazing appears to contribute to the turbidity of the river but the effects are mitigated by retention of riparian vegetation.
10. Estuarine crocodiles (*Crocodylus porosus*) were present. Freshwater prawns (*Macrobrachium* sp.) were abundant and breeding in January.


### 12.1 Basin Characteristics

The McIvor River is a short river (55 km long) draining the Audaer Range north-west of Cooktown. The river drains the steep, rocky hilly country of the range, which is largely vegetated with heath or woodland forest, with pockets of rainforest distributed in the river valley (see vegetation mapping NR01 for details). The catchment is small, covering 480 square kilometres. Most of the land in the catchment is under occupational leases or grazing leases, and land is lightly grazed, if at all. The lowlands and floodplain area have been cleared of much of the original rainforest cover for pastoral holdings. In the early days some cropping was done to supply Cooktown but now beef cattle predominate. The river banks have not been cleared and are usually fenced off. The basin receives heavy rainfall due to orographic (mountain caused) effects and the river is usually perennial. In 1992 it did stop flowing for the first time in living memory but remained as a series of pools. The river is also fed from the fractured rock in the hills. There were no floodplain lagoons or swamp systems observed near the areas sampled.

### 12.2 Previous Studies

To our knowledge, no work or surveys of fish done in the area have been published. However, it is believed that ichthyologists have been in the area as Allen (1989) refers to certain fishes as being present in the McIvor River area, in the sand dune country. The results of R. Mackay's surveys in the Cape Flattery area were discussed in 11.2.

### 12.3 Sites Sampled

Two sites were sampled on the McIvor River. Accessibility was restricted in the upper reaches. One site was upstream of the causeway at Parallana, and the other was about 1 km upstream of the crossing at Mt. Ray. The Mt. Ray site (1060 02) was about 7.5 km upstream of the causeway site.

At both sites the riparian vegetation was rainforest, although at Mt. Ray there were tall fringing paperbark (*Melaleuca*) trees (See Plates 17 & 18). Vegetation shaded both sides of the river but the middle was exposed to the sun. The substrate in pools was mud, but in areas of flow it was either rocks or gravel. *Aponogeton* plants grew in rocky areas with gentle flow, wherever there was sufficient sunlight. Bottlebrush (*Callistemon*) trees grew in sand banks or rocky islands in the middle of the river and were also present on sand banks or other open areas on the sides. In the sections sampled the river was long pools separated by short riffles and glides. Snags were not plentiful but there were logs and branches fallen in the water. At both sites water was turbid during sampling, due to rains. Parallana causeway was sampled on one occasion in January but was too turbid to be sure of collecting most species. A return trip in April when water was slightly clearer was necessary.

Table Eight. Sites sampled - McIvor River. Drainage Basin 1060

| Map Ref. | Site Code | Name | Date | Latitude | Longitude |
|---|---|---|---|---|---|
| H | 1060 01 01 | McIvor River - Causeway | 20 Jan 1993 | 15°07.25'S | 145°04.45'E |
| H | 1060 01 02 | McIvor River - Causeway | 26 Apr 1993 | 15°07.25'S | 145°04.45'E |
| I | 1060 02 01 | McIvor River - Mt. Ray | 27 Apr. 1993 | 15°07.27'S | 145°01.81'E |

Plate 17. The McIvor River upstream of Parallana.

Plate 18. Site 10600201 near Mount Ray.

## 12.4 Fish Species Present

Nineteen species of fish were recorded from the McIvor River, of which only two, red bream/mangrove jack (*Lutjanus argentimaculatus*) and brown gudgeon (*Eleotris fusca*) could be considered as marine vagrants. Over half of the fish collected from the river are either catadromous or benefit from salt or brackish water. Empire gudgeons (*Hypseleotris compressa*) and Pacific blue-eyes (*Pseudomugil signifer*), while not requiring brackish water for successful breeding, do breed in brackish water. No unusual species which have not been collected from the area before were collected. Banded rainbow fish (*Melanotaenia trifasciata*) has been recorded from the sand plain country around the McIvor River (Allen, 1989).

Eastern sleepy cod, or green backed gauvina (*Oxyeleotris gyrinoides*), were common near the banks of the river in roots and snags. The McIvor River is the northern most point of their distribution before Alex Creek at Bathurst Bay. Eels were common but only one species, the long finned eel, (*Anguilla reinhardtii*) was caught. These were always caught in either snags or logs, usually near current. Often they were present in rocky rapids. Pacific eels (*Anguilla obscura*) should have been present in the area but none were collected.

Bony bream (*Nematalosa erebi*) were not caught by us at any time on the McIvor River. We heard no references to them by local people, either. Bony bream are an important fodder fish for most large carnivorous species, and their absence or rarity may account in part for the low number of predators caught.

Spangled perch (*Leiopotherapon unicolor*) was also not collected by us, although it is one of the most widespread freshwater fish in Australia and was present in streams to the north and south. They do appear to be uncommon in rainforest streams, perhaps more so just after floods.

## 12.5 Distributions

### *12.5.1 Extent*

Banded rainbow fish were only found in the upper site at Mount Ray, and were predominantly found in the running water at the edges of riffles and glides, where they were common. The yellow finned tandan (*Neosilurus hyrtlii*), which appears to move upstream for breeding, was also only collected from Mt. Ray, in a glide. Only one specimen was collected, which is unusual as where present yellow finned tandans are usually common. A single juvenile red bream, (*L. argentimaculatus*) was also caught at Mt. Ray.

Five species which were caught at Parallana were not present at Mt. Ray at the time of sampling. Pacific blue-eyes were collected only in January and were not found in April. Purple spotted gudgeons (*Mogurnda adspersa*) were not found at Mt. Ray despite their usual presence in upstream environments. Few of them were collected, which was the general trend observed for all fish species.

*12.5.2 Habitat dependence*
As noted earlier, banded rainbow fish were most common in areas of high flow. This agrees with other observations that they are more common in upstream reaches of streams where flow is stronger and water clearer and more oxygenated than sluggish areas in the lowlands.

Roman nosed gobies (*A. crassilabrus*) were only captured from areas with a sandy substrate. They buried into the sand and usually emerged upon shocking with the electrofisher.

Pacific blue-eyes were only found in quiet backwaters when the river level was elevated. When the river level had receded these backwaters dried out and the blue-eyes' main habitat was gone. Blue-eyes could probably recolonise these habitats through upstream migration after floods.

Eastern sleepy cod (*O. gyrinoides*) distribution on the east coast appears to be limited to gallery forest or rainforest habitats as it is absent from the Princess Charlotte Bay area and the Stewart River.

### 12.6 Species of Commercial and Recreational Importance
The McIvor River is used heavily by local people (particularly residents from Hope Vale) for recreational fishing. There is undoubtedly some part time commercial fishing near the river mouth. Recreational fish species caught in the reaches sampled include barramundi, oxeye herring / tarpon, red bream / mangrove jack, sleepy cod, jungle perch, eels and eeltailed catfish / jewfish. Although all species are caught, catfish (*N. ater*) and eels (*A. reinhardtii*) are the most commonly caught species as most people use handlines baited with worms or small prawns. Spears are often used when the water is clear enough. Despite the apparent heavy fishing pressure, large eeltailed catfish were common at all times and locations.

It is difficult to comment about other species due to the small number of locations sampled, but no locals had complaints about fish being harder to catch. Also, most of the species of fish are catadromous (move to sea to spawn but live and grow in freshwater), and numbers would be affected by breeding success and season. No large barramundi, tarpon, jungle perch or mangrove jack were caught in January, but were caught in April.

### 12.7 Breeding Observations

Large numbers of juvenile jungle perch (20-25 mm SL) were observed moving upstream through the riffles and rapids around the causeway at Parallana in January, and none in that size and range were captured in April. This suggests that the adult fish moved downstream to a spawning location and we observed the run upstream of juveniles from the spawning for the wet season. The river only started flowing about one month previously, with the arrival of the first storms in mid December. No evidence of similar recruitment by other catadromous (sea or estuary breeding) species was seen, although none of any catadromous species was caught in January suggesting they had all moved out to breed.

Empire gudgeons, which have been noted for spectacular migrations of juveniles upstream from estuaries, were abundant in January, also suggesting some recruitment.

### 12.8 Water Quality

As noted earlier, the McIvor River was flooded at the time of sampling in January 1993. This created turbid conditions, making electrofishing difficult and less effective. The turbid conditions were exacerbated because surrounding land had been tilled a few days previous to our arrival, prior to rain.

In general, water quality parameters sampled in January were much lower than those sampled in April. This is to be expected as in January much of the river flow was runoff from rains which had started about one month prior. In April much of the flow would have been base flow, contributed by aquifers and seepage which has higher concentrations of dissolved salts and minerals. Conductivity was quite high for a river draining this type of country, but could have been elevated due to clearing and cultivation of surrounding land. Some fertilisation occurs as well. Water quality parameters at Mount Ray were slightly lower than those at Parallana. Much of the river above Mount Ray is relatively undisturbed country. A couple of feeder streams above the Mount Ray site flowed from cleared and tilled paddocks which may have contributed to conductivity, hardness and alkalinity levels.
Oxygen readings were excellent at all sites. pH was close to neutral.

### 12.9 Habitat Disturbance

The major habitat disturbance in the catchment would be the cultivation of land for grazing. The area has high rainfall but because the banks of the river are not cleared, and tilling is seasonal, obvious erosion problems were not noted. The turbidity in the water, while not severe, is not usually observed in little disturbed rainforest streams, so it is presumed that the turbidity present was a direct result of tillage practices.

Pigs were reported to be abundant in the remaining rainforest areas in the lowlands. None were seen, and there was little evidence of their presence in the vicinity of the sites sampled.

### 12.10 Notes on Other Fauna

Estuarine crocodiles were reported to be present in the river up to Parallana but were not regularly seen there. Freshwater prawns (*Macrobrachium* sp.) were extremely abundant and nearly 100% of the females were in berry in January. Southern freshwater prawns (*Macrobrachium australiense)* when gravid may make upstream migrations before spawning (Fielder, pers. comm.) and it is possible that the species observed in the McIvor River was doing the same.

## 13.0 CATCHMENT 1070 - ENDEAVOUR AND ANNAN RIVERS


**Summary**

1. The Endeavour River has three main perennial branches which drain different types of country, tall heath and eucalypt forest on sandstone, low heath on coastal sand flats, and eucalypt and wet sclerophyll forest on alluvial flats. The Annan River is a perennial stream which drains the high rainfall areas to the south of Cooktown. A major set of waterfalls and a gorge prevent movement of most catadromous fish species far upstream. A weir has been built downstream of the gorge.

2. The Endeavour River was surveyed by H. Midgley in 1988, at Isabella Falls, where three species were collected. The Annan has been subject to several investigations due to tin mining and construction of the weir.

3. Five sites on the Endeavour River (one dam, one lagoon, Isabella Creek, the river at the falls and Black Creek) were sampled. Two sites on the Annan were sampled, at the weir and Wallaby Creek.

4. Seventeen species were collected from the Endeavour system. Five species found in the highly tannic water of Black Creek were not found in the main river. Black bream have established a self sustaining population in the Annan.

5. Northern purple spotted gudgeons (*Mogurnda mogurnda*) were probably restricted to the waters of Black Creek, and southern purple spotted gudgeons (*Mogurnda adspersa*) to the other branches of the Endeavour River. Also, McCulloch's rainbows (*Melanotaenia maccullochi*) and poreless gudgeons (*Oxyeleotris nullipora*) were restricted to humic water.

6. Recreational fishing pressure on both rivers is moderate, but focused on estuaries. Eeltailed catfish or jewfish (*Neosilurus ater*), black bream (*Hephaestus fuliginosus*) and eels (*Anguilla* spp.) are targeted in freshwaters.

7. No breeding or ripe fish were collected.

8. Water quality was good for fish, with water being close to neutral pH and high levels of dissolved oxygen. Black Creek had the highest tannin levels recorded by us on the peninsula.

9. Severe habitat disturbance was not observed due to the retention of riparian vegetation, and lack of development in the headwaters.

10. Turtles were abundant. File snakes and estuarine crocodiles were present but uncommon.

### 13.1 Basin Characteristics

The Endeavour River has three main branches, the north branch and right branch, which drain the lands of the Gugu Yimithirr people around Hope Vale, and the south branch which drains the land directly to the west of Cooktown.

The North Branch is a shorter branch draining the dense woodland in the Honeysuckle Flat area. Its main tributary, Isabella Creek, drains the sandstone country in the northern part of the Lookout Range. The country in this area is very rugged and hilly, and covered with woodland. The Isabella and North Branch of the Endeavour meet near Hazelmere. The lower levels of both creeks have surrounding area of gently undulating soils which have been cleared for dairying and beef cattle.

The right branch drains the sand country north of Cooktown, and has tannin stained water. The northern country is very flat and covered in low heath vegetation, or woodland, in the country closer to Hope Vale community. The south branch drains the Henderson Range to the west, and rises in woodland in the hills. It flows through the flat rainforest country near the north of Cooktown. There is a floodplain north of Cooktown near the airport with several lagoons. The floodplain was largely woodland with pockets of rainforest. See NR01 for details of vegetation and NR02 for soils.

Much of the land around the right branch remains relatively undisturbed in the sandy country, but extensive clearing on the country with good soil has occurred for various agricultural projects. Nearly all of the land on the north and south branches of the Endeavour River in the plains has been cleared for pastoral (dairying and beef) and small crops development. Much of the vegetation on the banks has remained in a narrow band along the margins. Barrett's lagoon is a lagoon on the Endeavour flood plains near the lower, tidal reaches of the river. It is surrounded at both ends by paperbark swamp forests in peaty country, but at one side is remnant rainforest.

The Annan River drains the hills to the south of Cooktown and runs in an almost due north course before turning east just south of Cooktown. A limited survey was done of it to establish whether sooty grunter/black bream (*Hephaestus fuliginosus*) stocked in 1979 had successfully established a reproducing population in the Annan. Also, we wanted to document the fauna in the new Annan Weir, before the effect of this as a barrier to upstream movements of fish becomes apparent. Also, there is a possibility that the Annan River originally flowed westwards. The contours of the land and the narrow gap of the gorge suggest this to be the case (Kozicka, 1987).

## 13.2 Previous Studies

### *13.2.1 Endeavour River*

Isabella Creek was surveyed by Hamar Midgley in 1988 (See Appendix One). Three species, spangled perch (*Leiopotherapon unicolor*), Australian rainbows (*Melanotaenia splendida splendida)* and jungle perch (*Kuhlia rupestris*) were collected below the falls. As far as we know, there have been no other surveys of freshwater fishes in the Endeavour River.

### *13.2.2 Annan River*

The Annan River has been the subject of intensive surveys due to the tin mining industry which had major effects on the ecology of parts of the river (Hortle and Pearson, 1990). See Appendix One for the combined results of that survey with the results of a study by Barlow *et al.* 1987 on the fish in the Annan, commissioned by Cook Shire Council to determine the best position for a weir in relation to fish. Additionally, a brief survey by Ray Leggett (1990) found species of fish previously documented by others, and added sleepy cod (*Oxyeleotris lineolatus*) to the list.

## 13.3 Sites Sampled

Five sites were sampled on the Endeavour River and two on the Annan River.

Isabella Creek drains sandstone country north east of Cooktown. The creek flows through heath country and has a slight tannin stain. Isabella Falls are about 7 m high and should form a barrier to upstream movement of some species of catadromous (sea or estuary breeding) fish. We sampled both above and below the falls. The creek was above normal levels and the marginal grass was inundated - below about 30-40 cm of water. No aquatic vegetation was observed. The substrate was either sand or sandstone bedrock. There was some cover in the form of rocks, a few snags, roots and undercuts, and submerged marginal vegetation. The current was quite rapid, but in times of normal flow, is gentle.

Table Nine. Sites sampled - Endeavour and Annan Rivers. Drainage Basin 1070

| Map Ref. | Site Code | Name | Date | Latitude | Longitude |
|---|---|---|---|---|---|
| A | 1070 01 01 | Isabella Creek | 21 Jan 1993 | 15°18.11'S | 145°00.27'E |
| B | 1070 02 01 | Barrett's Lagoon | 22-23 Jan 1993 | 15°25.73'S | 145°09.12'E |
| C | 1070 03 01 | Cooktown Dam | 9 Feb 1993 | 15°29.21'S | 145°14.74'E |
| D | 1070 04 01 | Endeavour Falls | 27-28 Apr 1993 | 15°22.38'S | 145°01.79'E |
| E | 1070 05 01 | Black Creek - Hope Vale | 29 Apr 1993 | 15°16.71'S | 145°11.24'E |

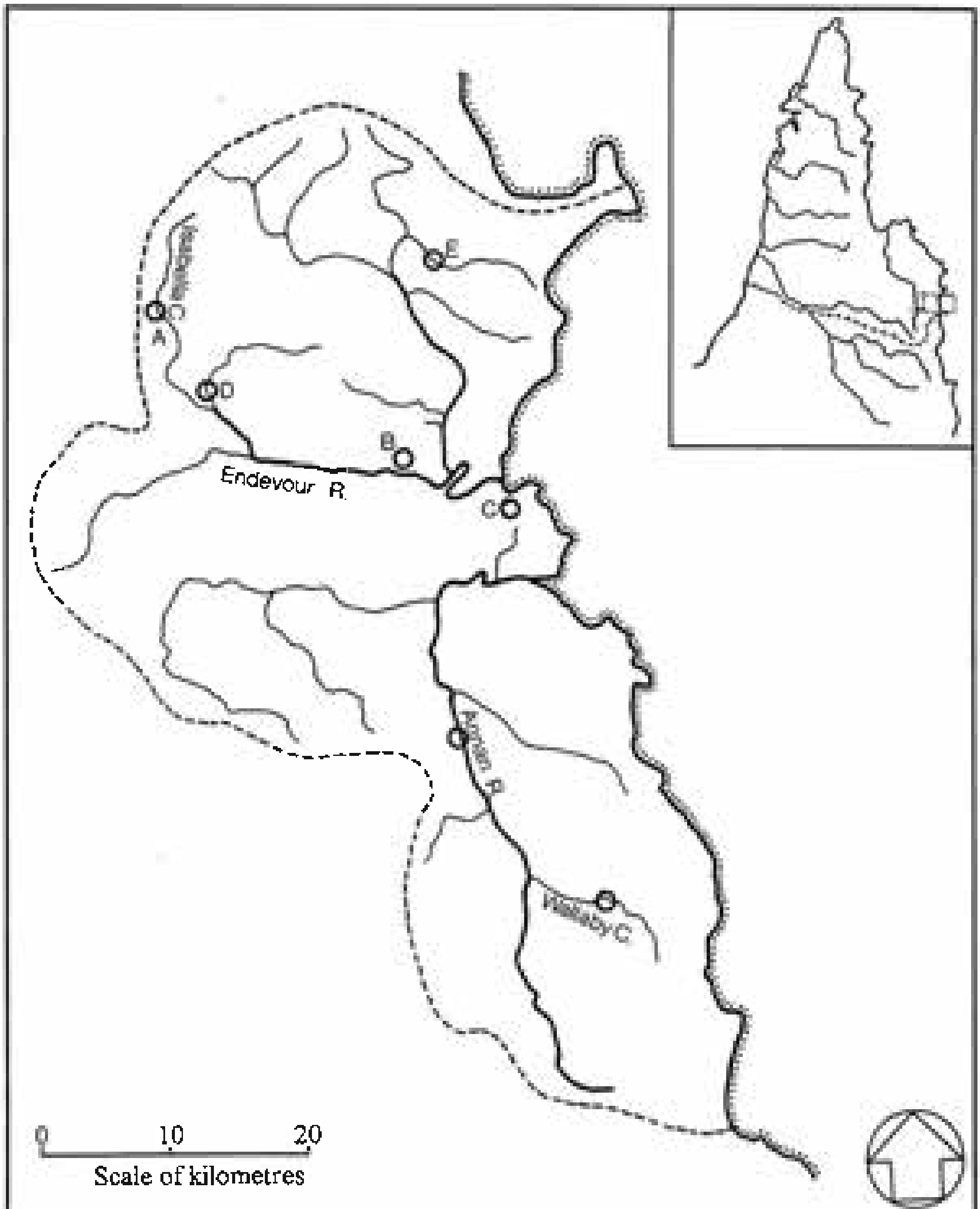


**Figure 8. Endeavour and Annan Rivers- Drainage Division 1070**
Markers indicate sample sites (refer to Table 9 for date and site names)

Barrett's Lagoon is just past the airport on the McIvor River Road out of Cooktown. The lagoon is a long (about 1 km) boomerang shaped lagoon with paperbark (*Melaleuca*) forest on one side and both ends, and rainforest on the southern side. At the time of sampling the paperbark forest was flooded to a depth of approximately 1 m and there was abundant submerged grass and tree branches present. In the rainforest swamp which was flooded were red beech (*Dillenia alata*) trees and some tall paperbarks. The marginal paperbark swamp at the sides of the lagoon extended into the lagoon up to 10 m from the water's edge. The northern side of the lagoon had been cleared for agriculture. Aquatic plant life was abundant, giant waterlilies (*Nymphaea violacea*) covered about 60% of the lake surface and bladderwort (*Utricularia* sp.) was present in the deeper areas of the lagoon, to the level to which it had dried out during the dry year of 1992. Floods swept through the lagoon for 2 weeks about one week prior to our visit.

Four Mile Dam just outside Cooktown which previously served as the town's water supply was also surveyed. This man made structure covered about 1.5 ha when surveyed. No aquatic vegetation was present, and a composite of clay and gravel made up the substrate. There were a few logs and rocks present around the edges, and emergent vegetation (reeds - *Eleocharis* sp) on the margins.

The Endeavour Falls (Plate 20) on the north branch of the river are one of a series of small falls 1-4 m in height along the north branch of the Endeavour River in the upper areas of the floodplain. Marginal vegetation here is rainforest. Bottlebrushes (*Callistemon* sp.) are present along all margins not too densely forested by rainforest trees. There was little instream cover although there were some snags and rocks. Aquatic vegetation consisted of small clumps of stonewort (*Nitella*). The holes below the waterfalls in the area are very heavily fished by residents of Hope Vale, mostly for jewfish (*Neosilurus ater*).

The valley above the falls has been mostly cleared for dairying and beef cattle pasture, but the margins are still forested. Many of the small feeder streams which are dry most of the year have been cleared down to the banks.

"Black Creek" at Hope Vale was 10.5 km east of Hope Vale Community. It was a small tributary of the North Endeavour River running from the sand flat country in the area (Plate 19). The surrounding country was thick, low heath with a few marginal paperbark trees and screw palms (*Pandanus*). The creek was slightly flooded and some clumps of guinea grass (*Panicum* sp.) were submerged. There was no aquatic vegetation but there was submerged marginal vegetation along the edges of the creek. Some Hope Vale residents fish here for dew fish and snakehead gudgeons (*Ophieleotris aporos*).

Plate 19. Black Creek, near Hope Vale. Habitat of poreless gudgeons (*Oxyeleotris nullipora*) and McCulloch's rainbows (*Melanotaenia maccullochi*).

Plate 20. Endeavour Falls, near the Tourist Park

The sites on the Annan River at the weir and Wallaby Creek were chosen to ascertain the species of fish present in the weir just after its construction, and to check if sooty grunter/black bream had established viable breeding populations. As such, the sites will not be treated in detail here, as they were chosen as a basis for future studies should they occur. The fish fauna of the Annan River has been well documented previously.

## 13.4 Fish Species Present

### *13.4.1 Endeavour River*

Most fish species recorded from the Endeavour River have been reported from the area previously. The three species recorded from 4 Mile Dam and Isabella Creek are almost ubiquitous on Cape York Peninsula. Of interest is the record of Rendahl's catfish (*Porochilus rendahli*) in Barrett's lagoon. The distribution of Rendahl's catfish was previously thought to be restricted to the northern tip of Cape York Peninsula and the Northern Territory (Allen, 1989). However, Pusey (personal communication) has documented its presence in the Normanby system and the Burdekin River. The demonstration of its presence in the Endeavour system extends its distribution considerably. The populations appear to be disjunct, though this may be more a reflection of periodic rarity of the species and lack of sampling.

Of special interest was the presence of the supposedly more northern varieties of fish in the strongly humic water in the creek at Hope Vale. Although southern purple spotted gudgeons (*Mogurnda adspersa*) were found in other sites throughout the system, northern purple spotted gudgeons (*M. mogurnda*) were found in Black Creek only. Additionally, poreless gudgeons (*Oxyeleotris nullipora*) were found there as well, which is an extension southwards of the known distribution. It needs to be determined if they are distributed throughout the right branch of the Endeavour River or if they are only in the humic waters of the sand dune country. Northern purple spotted gudgeons have a disjunct distribution, being present in the Carpentaria drainage division, and the Herbert River, in northern Queensland (Allen, 1989), and on the east coast of the Peninsula down to the Stewart River (present study). They appear to be an opportunistic species with a capacity for colonising new environments. However, the origin of stocks for colonising must be quite distinct as the huge Normanby system, inhabited by southern purple spotted gudgeons (Kennard, 1992) virtually surrounds the Endeavour system.

A total of seventeen species were collected from the Endeavour system. As species appeared to be restricted to certain sites, species lists from different sites are presented in Appendix 2. Five species found in the highly tannic waters of black Creek were not found in other parts of the system.
Bony bream (*Nematalosa erebi*) were collected from the Endeavour River in small numbers, one of the few locations on the east coast in which they were found. Although bony bream are widely distributed across Australia, they are most common in slow flowing streams (Allen, 1989). This record represents an extension of the known range of this fish, which was thought to be present as far north as the Burdekin River on the east coast of Australia (Allen, 1989). It has been introduced into the Barron River system successfully (Anonymous, 1988). They were only collected at Endeavour Falls, and not in Barrett's Lagoon, which should have been a better environment. Possibly if bony bream were present they were flushed out in the floods and did not return in numbers sufficient for us to catch.

*13.4.2 Annan River*

Black bream/sooty grunter were present and have apparently successfully established a breeding population in the Annan River at Wallaby Creek. Locals fish for them and catch them consistently when in season and so from a recreational angling point of view the stocking has been successful.

In the new Annan Weir only two catadromous species were collected, eels, (*Anguilla reinhardtii*) and jungle perch (*Kuhlia rupestris*). Other catadromous species which may have been present in the weir when it was built may have moved downstream to spawn, as the river had been flooding for several weeks before sampling. We missed several species in the Annan which were collected by Barlow *et al.* (1987) and Hortle and Pearson (1990). Usually spangled perch (*Leiopotherapon unicolor*) are common where ever they are found and are very successful opportunistic breeders rapidly producing huge populations where conditions are favourable, such as a new dam. Possibly the weir had never had time to establish a bloom or high productivity due to the elevated flow levels after is was completed. Hortle and Pearson (1990) did collect spangled perch near the dam site. The numbers they collected were low compared to the numbers of this species normally collected in other rivers.

## 13.5 Distributions

*13.5.1 Extent*

Northern purple spotted gudgeons were only found in the Right Arm of the Endeavour River in strongly humic water. Southern purple spotted gudgeons were found in other locations sampled. At the time of sampling, it was not realised that the two species were present, and so only small numbers of specimens were collected. It is possible that they were living sympatrically (two closely related species living in the same environment), but we did not notice any differences which could separate the two species in the field, and did not collect sufficient specimens to determine whether both species were present or not.

It was of interest that no black bream were collected from the Annan Weir. However, after rain black bream move upstream for spawning and may have moved upstream to the base of the Annan Falls if they were present.

Eels are noted for their ability to migrate upstream and were found in Wallaby Creek, above the barrier posed by the Annan Gorge and Annan Falls. Eels appear to be able to move considerable distances overland to avoid such obstacles. No South Pacific eels (*Anguilla obscura*) were collected by this or previous collections, suggesting that this species is exceedingly rare or difficult to catch using standard methods. South pacific eels have not been collected previously between Captain Billy Creek and an unnamed creek north of the Daintree River (Beumer *et al.* 1981). Possibly they are naturally uncommon in this range.

*13.5.2 Habitat dependence*

Poreless gudgeons and McCulloch's rainbows (*Melanotaenia maccullochi)* were only found in the humic waters of Black Creek at Hope Vale. All other records of these species from the east coast of Cape York Peninsula are from a similar environment, suggesting that it is necessary for them or provides an environment unsuitable for potential competitors.

Rendahl's catfish was collected from the only lagoon environment sampled in the area. Of the other locations sampled on the eastern Peninsula coast, Rendahl's catfish was only present in Three Quarter Mile Lake at Silver Plains. According to Allen (1989) it inhabits billabongs and streams in slow to fast flowing water. We have never caught Rendahl's catfish in any location with flowing water, only in lagoons.

Bony bream were only caught at Endeavour Falls, which is surprising considering Barrett's Lagoon should have held them. Lagoon environments are preferred environments of bony bream (Allen, 1989). Their presence in the Endeavour may be the northernmost point of their east coast distribution before Princess Charlotte Bay.

They are known from the Tully, Russell, Johnstone and Mulgrave Rivers. Their apparent restricted distribution in the Endeavour is difficult to explain.

### 13.6 Species of Commercial and Recreational Importance

Commercial fishing is not permitted in the Endeavour River, or in the Annan River from 100 m downstream of the bridge. Both rivers are fished quite a lot by tourists and locals, targeting mostly the estuarine areas. Freshwaters are fished more by local people than tourists. The main sought after species are barramundi (*L. calcarifer*), jungle perch (*K. rupestris*), eastern sleepy cod (*O. gyrinoides*) and eel tailed catfish / jewfish (*N. ater*). Generally, most people use the estuary. Some in the Rossville area fish for black bream when weather is not conducive to travel.

### 13.7 Breeding Observations

No gravid or breeding fish were observed at the time of sampling.

### 13.8 Water Quality

Water quality at all sites was good, with high levels of dissolved oxygen and water slightly alkaline, except in Black Creek where the pH was 4.05. This was the lowest recorded pH of all sites sampled on the peninsula where fish were present. As the creek was swollen with flood water, it could be expected that pH could be even lower during times of normal flow. The tannin level in Black Creek was very high, at 5 mg/l one of the highest levels registered in the whole study area. It is surprising that the species diversity (9 species) was as high as it was in this humic water. The most abundant species were northern purple spotted gudgeons, empire gudgeons (*Hypseleotris compressa*), McCulloch's rainbows and poreless gudgeons. Presumably these species are well able to tolerate these conditions.

Phosphate levels in the river on the Annan and in Isabella Creek were comparatively high. Such high readings were not expected for Isabella Creek as it runs through mostly little disturbed country. The Annan, however, has considerable rural development along its course and higher than usually encountered levels of phosphorus are to be expected.

### 13.9 Habitat Disturbance

Habitat disturbance was limited to the effects of extensive clearing of the river valleys. Generally, riparian (bankside) vegetation to within 10 m of the bank was retained. During flood events, siltation was observed and turbidity was high (see Hart, *et al.* 1988 for details of Annan River water quality during a flood). The main effect of a major flood event is to dilute the base flow, and increase suspended solids (Hart *et al.*, 1988).

Habitat disturbance due to mining, and its effect on the fish populations, was documented by Hortle and Pearson (1990). The effects immediately downstream were severe, due to siltation and therefore loss of food sources for fish.

Habitat disturbance in the Endeavour system was much less, as there is no mining and little rural development in the upper reaches. Some sedimentation and erosion occurs in the river valley.

**13.10 Notes on Other Fauna**

Turtles were abundant in the Endeavour River, and one file snake was encountered. Estuarine crocodiles were occasionally present in Barrett's lagoon but none were seen when the lagoon was sampled.

## 14.0 CATCHMENT 9270 - JARDINE RIVER AREA

**Summary**

1. The Jardine is Queensland's largest perennial river. The basin is mostly sandy country with sandstone bedrock.
2. Numerous studies have been conducted in the area previously. Forty two species of freshwater fish have been documented from the river and environs.
3. One site, a lagoon on a drainage channel leading into Cody Creek, was sampled.
4. The lagoon had an abundance of small rainbow fish. They were not observed in such numbers elsewhere on the peninsula.
5. The soft, humic water in this environment may enhance breeding and survival of McCulloch's rainbow, or inhibit potential competitors.
6. There is potential for the fish from this area as broodstock for aquarium fish breeding.
7. The presence of large numbers of juveniles suggested that breeding had occurred recently.
8. Water quality was reasonable, with low pH and oxygen readings. This did not appear to adversely impact on the fish.
9. Disturbance in the area was not observed.
10. Estuarine crocodiles, freshwater prawns and large redclaw crayfish were present.

### 14.1 Basin Characteristics

The Jardine is Queensland's largest perennial river in terms of base flow. It drains a catchment of 2965 square kilometres and has a length of 153 km. All of the catchment east of the developmental road is National Park or Special Purposes Reserve, and the catchment west of the road is Aboriginal lands under the custodianship of the Injinoo people. Due to the sandy nature of the country, there has been little pastoral development in the catchment, with the notable exception of Heathlands. Heathlands was a station leased by Comalco to grow beef for Weipa township. Large areas of low heath were cleared and improved pastures sown. The operation was shifted to Sudley, closer to Weipa, and the land reverted to government control after several years. The basin is virtually entirely sand or sandstone, creating a huge aquifer which maintains the high perennial flow of the river. Lagoons, as seen in river floodplains to the south, are uncommon. However, vast areas of swamps are present at the western end of the river. These are largely brackish within about 10 km of the sea, although surface waters may be fresh. To the north of the Jardine, near Cape York, there are many small lagoons, swamps and creeks, many of which are perennial.

## 14.2 Previous Studies

Due to its proximity to the northernmost tip of Australia, the Jardine has been the subject of numerous surveys. These were covered in Section 1.6.2. A merged species list for the Jardine River and Environs is present in Appendix One.

## 14.3 Sites Sampled

One site, called Blue Valley lagoon, was sampled. See Appendix Four for approximate location. This lies to the north of Bamaga Community. It is in a patch of relatively tall (for the area) eucalypt woodland. The lagoon is bordered by tall paperbark (*Melaleuca* sp.) trees, which overhang and shade much of it. The middle of the lagoon has some growth of lilies (*Nymphaea* sp.) where it receives sunlight. There are numerous branches and logs in the water. At one end of the lagoon are dense stands of *Lepironia* reeds. The floor of the lagoon is covered in dense paperbark tree leaf litter. Some small bladderwort (*Utricularia*) plants were present. The substrate was mud. This lagoon was one of a series of lagoons leading to a dry creek bed, which was a tributary of Cody Creek. The site was sampled on 15 August 1993. The co-ordinates were 10° 50.33' S and 142° 28.2'E. The site code was 9270 01 01.

A second site, on the Jardine River near the pump station, was also sampled. Only fish data was collected and the species collected are listed in Appendix Two.

## 14.4 Fish Species Present

Eleven species of fish were collected at Blue Valley lagoon. Only electrofishing was employed due to the presence of estuarine crocodiles and inability to access the area at night due to live firing in the area. All the species collected have been collected from the Jardine River previously. Of interest was the relative abundance of the fish. McCulloch's rainbows (*Melanotaenia maccullochi*) were present in huge numbers, and were observed in schools of over 100. Threadfin rainbows (*Iriatherina werneri*) and Gertrude's blue eyes (*Pseudomugil gertrudae*) were also abundant and were shocked in their hundreds.

Two species of eel (*Anguilla reinhardtii and A. obscura*) were collected. Both are present in the Jardine system which represents the western extremity of their distribution.

All species of fish collected from the river at the pump station had been collected previously.

### 14.5 Distributions

We believe these to be the northern most records of all species collected except *Oxyeleotris nullipora* and *Mogurnda mogurnda*, which were collected at Lake Bronto, in the Harmer Creek drainage division. There are extensive swamps behind Punsand Bay, and if areas of these are permanent they may harbour some species of the fish collected in Blue Valley Lagoon.

It is interesting that the largest aggregations of McCulloch's rainbows, threadfin rainbows and Gertrude's blue-eyes were collected on the peninsula were collected at this site, as it had very soft and strongly humic water which appears to be the only environment inhabited by these species on the east coast. McCulloch's rainbow appears to be totally restricted to this environment throughout its distribution, which suggests that either it cannot compete with other species, or fares poorly against them, in other environments. They are present in the Jardine River, which often has a humic stain to the water, and is also very soft water. Breeding requirements of this species include soft water (0-50 ppm $CaCO_3$)(Leggett and Merrick, 1987).

### 14.6 Species of Commercial and Recreational Importance

Many of the small species of fish found in this location were attractive aquarium fish. The Gertrude's blue-eyes were the largest ones encountered on the Peninsula, and males had large flowing fins. The other rainbows were all present in abundance. The single Banded rainbow (*Melanotaenia trifasciata*) collected was a superb colour form which could be a popular aquarium subject. There is potential for the fish from this area to be used as broodstock for breeding of fish for the aquarium trade.

Also reported from the lagoon were ox-eye herrings (*Megalops cyprinoides*). These fish are excellent as sports fish, although their flesh is usually considered too bony for the table.

### 14.7 Breeding Observations.

Although no species were observed breeding, the presence of large numbers of juvenile fish suggested that breeding had taken place recently.

### 14.8 Water Quality

Water was very soft, and had a low pH (4.65). Although it was very dark coloured, the tannin level was only 1.8 mg/L, which is comparable to similar locations on the eastern side of the Peninsula. Oxygen levels were not high, probably due to the large amounts of decaying organic matter on the lagoon bed. Water quality parameters are presented in Appendix Four.

### 14.9 Habitat Disturbance

This site was used a little as a camping spot. A firing range is located nearby. It is not often visited. Erosion and pig damage was not observed in the immediate vicinity of the lagoon.

### 14.10 Notes on Other Fauna

Estuarine crocodiles were reported to be present in the lagoon. Freshwater prawns (*Macrobrachium rosenbergii*) and redclaw crayfish (*Cherax quadricarinatus*) were also collected. The redclaw crayfish were of a comparatively large size, when compared to redclaw collected from other northern locations. Specimens were brought to Walkamin Research Station for morphometric and genetics studies.

## 15.0 CATCHMENT 9250 - WENLOCK RIVER

**Summary**

1. The Wenlock River drains a large area of diverse country from sandy heath plains to forested alluvial floodplains. It has many lagoons on the floodplains, and well developed terraces on the banks. It is perennial from its junction with Dry Creek.

2. There have been numerous surveys, mainly close to or at the major road crossings. A lagoon was sampled by Midgley (1985).

3. Seventeen sites were sampled in the Wenlock basin. Nine river sites, six lagoon sites and two tributary sites were surveyed. A lagoon and a river site at Billy's lagoon were sampled twice.

4. Forty-five species were collected. Not previously recorded were threadfin rainbows (*Iriatherina werneri*), Gertrude's blue-eye (*Pseudomugil gertrudae*), freshwater sole fish (*Brachirus salinarum*), Rendahl's catfish (*Porochilus rendahli*), swamp eel (*Ophisternon bengalense*) and Fly River garfish (*Zenarchopterus novaeguineae*). Species not collected by us were snub-nosed garfish (*Arramphus sclerolepis*)and black banded rainbows (*Melanotaenia nigrans*). The area around the Wenlock probably has the highest fish species diversity in Australia.

5. Barramundi (*Lates calcarifer*), stingrays (*Dasyatis* sp.) and ox-eye herring (*Megalops cyprinoides*) were up to 180 km. from the mouth, in perennial waters only. Threadfin rainbows, pennyfish (*Denariusa bandata*) and poreless gudgeons (*Oxyeleotris nullipora*) were only in vegetated lagoons. Freshwater sole fish were found in only one location.

6. The Wenlock River is popular for fishing, especially Stone's Crossing. The main species targeted were barramundi, saratoga (*Scleropages jardinii*) and black bream (*Hephaestus fuliginosus*).

7. Rainbows and hardyheads (*Craterocephalus stercusmuscarum*) appeared to breed all year round. Black bream were ready to spawn in September.

8. Water quality was generally good, except at stagnant waterholes without vegetation.

9. Little disturbance was noted overall. The crossing at Moreton caused heavy siltation and there was reduced fish diversity below the crossing. Some erosion associated with tracks was observed in the catchment. Pigs and horses caused some damage to lagoon habitats.

10. File snakes (*Acrochordus* sp.), freshwater crayfish (*Cherax quadricarinatus*) and freshwater prawns (*Macrobrachium rosenbergii*) were abundant. Freshwater crocodiles (*Crocodylus johnstoni*) were seen at all sites below the waterfall.

### 15.1 Basin Characteristics

The Wenlock River drains a large area (7510 square km) in northern Cape York Peninsula, extending from south-east of Lockhart River to north west of Weipa. It is slightly over 300 km in length from the headwaters to the mouth, and about 270 km from the upper limit of tidal influence. It drains a diversity of country, sandy country in its headwaters on Wolverton to the sandy soils common over much of the northern Peninsula down to the alluvial floodplains at Batavia and Billy's Lagoon. Most of the country in this area is stringybark (*Eucalyptus tetradonta*) woodland (Specht *et al.*, 1977), although in the sandy areas there are substantial areas of heath. See vegetation mapping NR01 for details.

Over much of its length the Wenlock has terraced banks, with terraces 3-4 m wide and slopes of 3-5 m between terraces. Up to four terraces may be present before reaching the floodplain, which may be up to approximately 35 m above the river bed. Terraces are not present in the rocky country at the eastern side of Batavia Downs, near the Wenlock Waterfall, and upstream of the waterfall for several kilometres, where the river flows through a number of cascades and pools over rocky ledges.

The Wenlock River is intermittent down to its junction with Dry Creek, a perennial stream which maintains the base flow of the Wenlock during the dry season. This is about 190 km from the mouth. Other major tributaries (Cox, Lydia and Nimrod Creeks) are all intermittent.

The vegetation on the river banks is usually dominated by a fringe of paperbark trees (*Melaleuca* sp.) which grows out over the river, shading any areas suitable for aquatic plant growth. Gallery forest extends up the terraces to the flood plain level and is usually present on the banks in small intermittent tributaries and inlets. The presence of the dense, shady gallery forest on river banks probably forces the paperbark trees to grow out over the water, whereas on lagoons there is no gallery forest so trees tend to be more erect. In the most upstream location, bottlebrushes (*Callistemon* sp.) trees grew in the river bed in rocky sections and the gallery forest was patchy, sometimes giving way to woodland. Only one or two terraces were apparent at the uppermost sites, which had stopped flowing by August in 1992.

Generally, the river bed width was remarkably constant down the length of the river, being 20-40 m in width with a stream of varying width meandering through the sand/gravel substrate. The stream was usually 5-10 m in width below the junction with Dry Creek, but this varied. Depth was usually less than 1 m, although at some holes near bends water was deeper (to 2 m deep). In the lower reaches above Stone's Crossing, the river broadened out to be about 70-90 m wide, with sand banks in the middle, and deeper channels (to 4 m) either side. The banks were lined with fallen logs and tree trunks, and were largely composed of tree roots and often undercut. No aquatic plants were present.

Downstream of the highest point sampled (at Wolverton) there are extensive areas of lagoons on the flood plain of the river. These lagoons are, as a rule, densely vegetated with water lilies (*Nymphaea* spp.), water snowflake (*Nymphoides* spp.), *Eriocaulon setaceum*, stonewort (*Chara* sp.), waternymph (*Najas tenuifolia*), and reeds (*Eleocharis* spp. and *Lepironia auriculata*). On the margins of these lagoons are usually erect paperbark trees, freshwater mangroves (*Barringtonia racemosa*), and, less frequently, red beech (*Dillenia alata*). Lagoons may be up to several kilometres long. Most appear to be similar in water quality and physical characters, generally being shallow (2-3 m) and slightly turbid. Lagoons are usually in woodland, although a few were present in poor black-boy (*Xanthorrhoea* sp.) sandy country, which can be sparse woodland or heath. Lagoons generally had soil banks, (sandy loam) and mud or clay substrate. The margins were almost invariably heavily vegetated but the middle clear of all aquatic vegetation. Snags around the margins were few, and usually small. Generally the paperbark trees and other trees surrounding lagoons were less than 10 m tall and so did not contribute much timber to them.

### 15.2 Previous Surveys

Due to its proximity to Weipa and because it has four major crossings, the Wenlock has been relatively well studied ichthyologically. However, nearly all investigations have centred on the river, and not on the lagoons. The two habitats are vastly different and, although they share most species in common, there are a number of small species usually found in lagoons and not in the main river channel.

Cyrus and Blaber (1992) studied the fish in the Embley estuary. Due to its proximity to the Embley estuary, many of the diadromous species (those which can live in either fresh or salt water) found there could be in the Wenlock River. See Appendix I for a list of diadromous or potentially diadromous species sampled by Cyrus and Blaber (1992) which could be present in the lower reaches of the Wenlock.

In May 1988, Tait and Pearson studied fish in the Weipa region, as part of a consultancy for the environmental impact study for the air base to be built in the area. Twenty-one species were collected. Although the sampling locations were not exactly described, the site studied was near the limits of tidal influence, as there were a number of marine or estuarine species. See Appendix I for a species list.

Midgley (1985) collected at two river sites and one lagoon on the Wenlock. The two river sites were near road crossings and a lagoon near Moreton telegraph station. Leggett (1990) sampled fish on the Portland Roads road crossing of the Wenlock in 1988. Nine species were collected in a brief visit. Armstrong (1985) collected a number of fish in the Wenlock River, and also collected at a number of lagoons and creeks near Weipa. Midgley's, Armstrong's and Leggett's results are presented in Appendix I.

### 15.3 Sites Sampled

A total of seventeen sites were sampled on the Wenlock (see Table 10). Where possible a section of river and an adjacent lagoon were sampled. The river sites on the Wenlock River were all quite similar. The river itself had a gravel bottom in all sites sampled, and was generally shallow (less than 2 m). At all sites except Stone's Crossing, the waterfall, Dry Creek and Nimrod Creek, the stream meandered through the sandy stream bed. At most sites, a deep (up to 2m) hole was present at a bend or associated with a large snag. No aquatic vegetation was present at any river sites. In most areas gallery forest interspersed with paperbark trees lined the river banks, and gallery forest occupied the terraces up to the flood plain level. Generally paperbark trees were erect, but at most sites several trees leaned out over the river. Above Stone's Crossing, all paperbarks leaned out over the river, some being almost horizontal. Snags were generally common along the edges of the river, and undercut banks were present whenever the river ran against a bank. Habitat complexity was higher in the sections downstream from the junctions with Dry Creek, which included the site called Frenchman's Road crossing. These sites tended to have more deep holes, snags, and undercut banks. Their permanency was an important factor in the high fish diversity observed.

The site upstream from Stone's Crossing was generally a broad, shallow, sand bottomed river, although one section had large boulders present in it, and deep (up to 4 m) water between them. Abundant snags and overhanging vegetation spread out to up to 20 m from the bank, but was more often 5-10 m from the bank. Banks on both sites consisted of undercut root beds, generally of paperbarks.

The waterfall area had two sites, one in the pool below the falls and downstream section, and one in the large pool above the falls. Although the falls are about 8-10 m high, in flood times they are little more than a 'bump' in the river flow. The large, long pool above the falls had either a sand or bedrock substrate, no aquatic vegetation, and numerous large snags. Maximum depth was only 1 m. The site below the waterfall was chosen as it may be a point where fish congregate. The pool below the falls was 1.7 m maximum depth, and had mostly bedrock or rock substrate. Most of the midstream cover was rocks. No snags or vegetation were present at the pool, but there were paperbark trees further downstream at a shallow sandy pool.

Table Ten. Sites sampled - Wenlock River and lagoons. Drainage Basin 9250.

| Map Ref | Site Code | Name | Date | Latitude | Longitude |
|---|---|---|---|---|---|
| A | 9250 01 01 | Wenlock River at Wolverton | 21 Jul 1992 | 13°17.32'S | 142°59.62'E |
| B | 9250 02 01 | Lagoon at Wolverton | 23 Jul 1992 | 13°17.65'S | 142°59.62'E |
| C | 9250 03 01 | Lagoon near Portland Roads road | 25 Jul 1992 | 13°6.8'S | 142°56.33'E |
| D | 9250 04 01 | Portland Roads road crossing | 25 Jul 1992 | 13°5.71'S | 142°56.39'E |
| E | 9250 05 01 | Wenlock River below Falls | 19 Aug 1992 | 12°46.01'S | 142°49.23'E |
| F | 9250 06 01 | Wenlock River above Falls | 20 Aug 1992 | 12°46.62'S | 142°49.83'E |
| G | 9250 07 01 | Wenlock River Stockyards | 22 Aug 1992 | 12°28.81'S | 142°39.92'E |
| H | 9250 08 01 | Bronwyn's Lagoon | 23 Aug 1992 | 12°28.01'S | 142°39.49'E |
| I | 9250 09 01 | Stone's Crossing | 21 Sep 1992 | 12°23.2'S | 142°11.42'E |
| J | 9250 10 01 | Woodford Lagoon | 22 Sep 1992 | 12°23.82'S | 142°12.18'E |
| K | 9250 11 01 | Batavia Downs fenceline | 04 Nov 1992 | 12°29.38'S | 142°29.03'E |
| L | 9250 12 01 | Billy's Lagoon | 05 Nov 1992 | 12°31.34'S | 142°23.30'E |
| L | 9250 12 02 | Billy' Lagoon | 21 Jul 1993 | 12°31.34'S | 142°23.30'E |
| M | 9250 13 01 | River at Billy's Lagoon | 05 Nov 1992 | 12°30.68'S | 142°23.21'E |
| M | 9250 13 02 | River at Billy's Lagoon | 22 Jul 1993 | 12°30.68'S | 142°23.21'E |
| N | 9250 14 01 | Frenchman's Crossing | 19 Jul 1993 | 12°38.34'S | 142°47.95'E |
| O | 9250 15 01 | Frenchman's Crossing Lagoon | 20 Jul 1993 | 12°38.86'S | 142°47.53'E |
| P | 9250 16 01 | Dry Creek | 17 Sep 1993 | 12°39.25'E | 142°49.23'E |
| Q | 9250 17 01 | Nimrod Creek | 22 Sep 1993 | 12°16.30'S | 142°32.3'E |

Dry Creek is a perennial tributary of the Wenlock, running through sandstone country from the east and joining the river almost due east of Batavia Downs. It was sampled because of reports of 'khaki bream' present there as well as 'black bream'. Dry Creek, according to the stockman who informed us of its location, has probably never been visited by people in the last 40 years. Dry Creek is a channel in sandstone, with sheer banks up to 3 m high in narrow sections, and pools at bends. Pools were up to 20 m across and 2.3 m deep. A few plants of eelgrass (*Blyxa* sp.) and some reeds

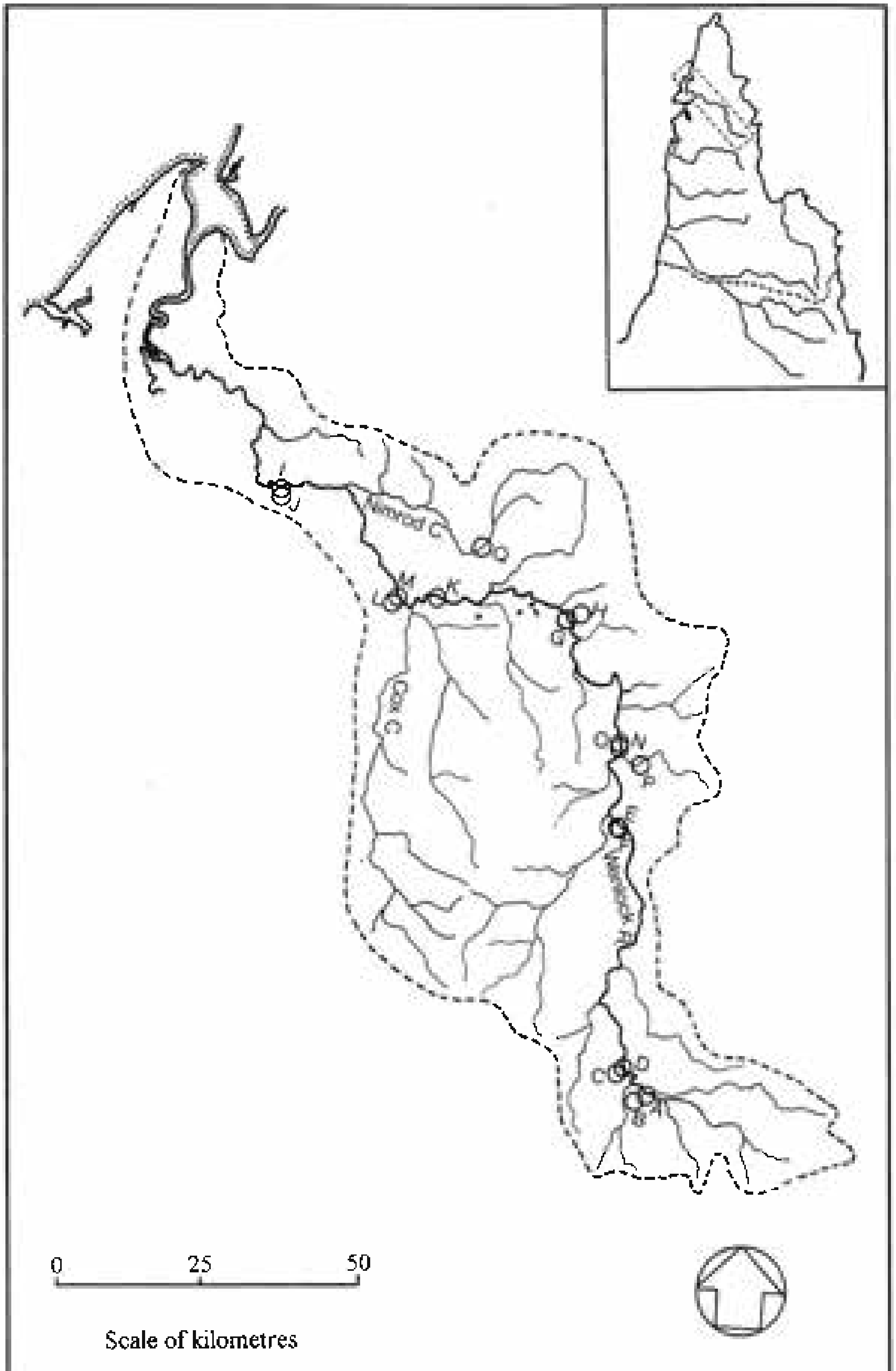


**Figure 9. Wenlock River - Drainage Division 9250**
Markers indicate sample sites (refer to Table 10 for date and site names)

(*Eleocharis* sp.) were present. Surrounding country was heath, dominated by *Grevillea pteridofolia*. It was low heath (to 4 m) but there were bands of *Eucalyptus* trees in patches away from the creek near the Frenchman's Road. The water was remarkably pure and clear.

The site on Nimrod Creek was a dry season pool near the Nimrod outstation site. The pool was in the creek bed and, unlike flowing river 'sites', had a fair growth of eelgrass (*Blyxa* sp.), water milfoil (*Myriophyllum* sp.) and water lilies. It was only 1.3 m deep and had a mud/leaf litter substrate, and dark water. There were several snags present. Bedrock substrate in a small area, aquatic vegetation and a few fallen branches, provided the cover. This waterhole appeared to be permanent but could dry out in exceptionally dry years. In 1992 it had dried out completely, but a small hole upstream was still full. There was little shade from overhanging vegetation.

### 15.4 Fish Species Present

A total of 45 species were collected by us from the Wenlock River system (see Appendix 2). A number of these have not previously been documented from the system, namely threadfin rainbows (*Iriatherina werneri*), Gertrude's blue-eyes, (*Pseudomugil gertrudae*), freshwater sole fish, ( *Brachirus selheimi*), Rendahl's catfish (*Porochilus rendahli*), swamp eel (*Ophisternon bengalense*), and Fly River garfish (*Zenarchopterus novaeguineae*). A number of these species were believed to be present in the Carpentaria drainage division and these collections confirm this distribution. However, Fly River garfish have not been recorded from Australia previously. Specimens submitted to the museum were identified as spoon fin garfish (*Zenarchopterus* cf. *dispar*) but the key of Collette (1974) was used, which does not include Fly River garfish.

Undoubtedly, a number of species were missed. Black banded rainbows (*Melanotaenia nigrans*) and snub-nosed garfish (*Arramphus sclerolepis*) have been collected from or observed in the Wenlock on several occasions (Tait and Pearson, 1988; Armstrong, 1985), but we never collected or observed these fish, nor did we have any reports of snub nosed gar from locals. Presumably they are uncommon or are common near the estuary but do not penetrate upstream further than the Moreton crossing. Snub-nosed garfish are common in the Embley estuary (Blaber *et al.*, 1989) and could be expected to periodically enter freshwater.

The apparent absence of black banded rainbows from our survey is surprising as they have been collected in the area (Tait and Pearson, 1988; Armstrong, 1985). They have not, as far as we know, been collected from the Wenlock River itself. Some specimens of banded rainbows (*M. trifasciata*) superficially resemble black banded rainbows but all key out to be banded rainbows (*M. trifasciata*) according to the characteristics in Allen and Cross (1982). Additionally, elongate glassfish/perchlets (*Ambassis elongatus*) were collected from the Wenlock (Tait and Pearson, 1988). We did not collect elongate glassfish anywhere on the peninsula.

On this survey, two species of large edible sleepy cod were recognised. One was a fairly matt colour all over, and had small mandibular teeth, and the other had broken pale stripes along the lower half of the body, white to cream spots on the underside, and spotted fins (See Plates 21 & 22). Specimens sent to the Queensland Museum were identified by Dr D Hoese as *Oxyeleotris lineolatus* (sleepy cod) and *O. selheimi* (striped sleepy cod), respectively. We believe that striped sleepy cod has not been reported from the rivers of the Peninsula previously, except from the Palmer (Macleay, 1882). Probably this is due to misidentification, although the two species occur side by side down the entire length of the river and are dissimilar.

There are several species of note in the paper of Blaber *et al.* (1988) discussing estuarine dependence of fish in the Embley estuary. Snakehead gudgeons (*Ophieleotris aporos*) which were, to date, believed to be restricted to the east coast south of the Endeavour River (Wager, 1992) were collected in the Embley estuary, well outside the assumed distribution. We have collected them on the east coast up to the Olive River, and Leggett (1987) collected them from the Jardine. The estuaries in the Gulf of Carpentaria, apart from the Embley, have to date been poorly studied.

Of the 45 species collected in the Wenlock, we would only consider the threadfin silver biddy (*Gerres filamentosus*) and the river shark (*Carcharhinus leucas*) to be marine vagrants. Stingrays (*Dasyatis* sp.) were found 180 km from the river mouth, as far as the waterfall. River sawfish (*Pristis pristis*), while only found at Stone's Crossing on the Wenlock, have been seen in the Archer River at Coen, at The Bend, 240 km from the river mouth. These species move as far upstream as other, more accepted diadromous (fresh or salt water) species such as barramundi or oxeye herring. Forty-three species of fish which spend the majority of their life in freshwater were collected in the Wenlock River by us. There are an additional three species which can breed in freshwater documented from the area. Forty-two (and one unusual record) species have been collected from the Jardine catchment (see Appendix I). This compares favourably with the Wenlock River. The Jardine shares a high proportion of species with the Fly River in New Guinea (74%) (Allen and Hoese, 1980). The Wenlock also

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Plate 21. Sleepy cod (*Oxyeleotris lineolatus*) from the Wenlock River.

Plate 22. Striped sleepy cod (*Oxyeleotris selheimi*). Note broken stripes and spots along ventral side of body and head.

shares a high proportion of species with the Fly (69.6%). The Jardine and Wenlock Rivers are very similar, sharing 34 species, about 70% of the total documented species. The "east coast" species which make it around to the Jardine (eels, *Anguilla* spp. and shortfinned catfish, *Neosilurus brevidorsalis*) undoubtedly push the Jardine's species diversity higher. The Jardine has only been sampled at a limited number of sites, mostly in the lower reaches. It is possible that there are a higher number of species there than currently documented. Undoubtedly this is the case with the Wenlock. On the final sampling trip two previously uncollected species were caught. More investigation of tributaries and lagoons will reveal more species. It might take years of sampling in different seasons to document all the species present.

The number of species from these systems compares favourably with other, more intensively studied rivers. The Alligator River system is the most intensively studied tropical freshwater area in Australia (Bishop and Forbes, 1991). Of the 60 species of fish collected from freshwater in that area (Bishop *et al.*, 1986), twelve could be considered as essentially marine. Thus, the number of species so far found in a relatively little studied area (the Wenlock - 47) is approximately the same as that for an intensively studied one (Alligator River - 48), and probably more species are present. Thus, this area may have the highest species diversity of fish of any area in mainland Australia.

No fish species endemic (restricted) to the Wenlock River were collected. Lack of endemicity appears to be usual in Australian rivers, probably due to the lack of primary freshwater species, and generally low topography.

## 15.5 Distributions

### *15.5.1 Extent*

There were a number of fish species which appeared to be spatially separated or displayed distributions correlated with distance from the river mouth.

River sawfish (*Pristis pristis*), river whaler shark (*Carcharhinus leucas*) and threadfin silver biddy (*Gerres filamentosus*) were all restricted to the lower Stone's Crossing site. The shark and sawfish may have been limited to this site by physical restrictions, as in no other sites was there deep water in large pools. Threadfin silver biddies have only been found close to the sea, and could be considered as marine vagrants. Freshwater soles (*Brachirus selheimi*) were only found in one location, at Billy's Lagoon, on successive sampling occasions one year apart. They have been caught occasionally at the Moreton crossing. They were not found anywhere else despite intensive searching in similar environments. Swamp eels, likewise, were only found in Dry Creek. In 1992 no swamp eels were found anywhere on the Peninsula, yet in 1993 they were found in every river system sampled. The apparent absence of swamp eels one year and their abundance the next is a mystery.

Fork tailed catfish were far more common in downstream reaches of the river than upstream, although this may have been a function of habitat availability. They were only common at sites below the falls and the large pool close to the falls, although they were present throughout the river system.

A solitary triangular shield catfish (*Arius leptaspis*) was caught in the Wenlock system at Nimrod Creek. Triangular shield catfish were common when collected by Tait and Pearson (1988) and Midgley (1985), so it is unusual that it was so rare on this occasion. Conversely, lesser salmon catfish (*Arius graeffei*) were common to abundant throughout the entire system, although less numerous in the headwaters.

Banded rainbow fish (*Melanotaenia trifasciata*), were more abundant and generally larger in headwaters than at the lower reaches. None were collected at Stone's Crossing or Woodford Lagoon. Possibly this distribution pattern is related to habitat preferences (see below).

Barramundi (*Lates calcarifer*) and oxeye herring (*Megalops cyprinoides*) were found 180 km upstream of the mouth of the Wenlock River, as were garfish (*Zenarchopterus cf. buffonis*). Fly River garfish (*Zenarchopterus novaeguineae*) were found up to 150 km upstream in Nimrod Creek. This appeared to be the upstream limit of diadromous species in the Wenlock. Barramundi and oxeye herring can travel extensive distances in freshwater, up to 900 km in the Fly River (Allen, 1991). Probably the limited period when the Wenlock flows above the Dry Creek junction limits distribution of these species further upstream. The size of fish sampled in August (350-400 mm) suggests that they are young of the year. Weipa strain barramundi spawn in September to October, so young would have time to migrate upstream to below Dry Creek before the big rains commence.

Empire gudgeons (*Hypseleotris compressa*), were only found at Stone's Crossing and Woodford Lagoon, just upstream from the upper limit of tidal influence. This species therefore appears to require brackish water for breeding, as it was not found at Billy's Lagoon, which is about 50 km upstream from Stone's Crossing.

*15.5.2 Habitat dependence*

The distribution of a number of species within the river system was dependent upon habitat requirements. Banded rainbow fish were found in only two widely dispersed locations on the Wenlock River, in the upper section of the river at Wolverton, and in the river at Billy's Lagoon. They were only found in river habitats, rarely in lagoons or slow flowing water, and were generally present in open water. Chequered rainbow fish (*Melanotaenia splendida inornata*) were common in both river and lagoon environments. Banded rainbow fish may be found in small, stagnant waterholes in large numbers in the dry season. We believe that they may be concentrated there but the environment is not suitable for breeding. Banded rainbow fish in upstream environments are far larger than those in downstream locations.

Although freshwater soles (*Brachirus salinarum*) were only found in one location on the Wenlock, data on collection sites in other rivers suggests that they prefer a sand bottom, open water environment with gentle water flow. We have never found them in lagoons, which often have mud bottoms, or in still parts of the river.

Threadfin rainbow fish (*Iriatherina werneri*), pennyfish (*Denariusa bandata*) and poreless gudgeon (*Oxyeleotris nullipora*) were only found in areas with vegetation (invariably lagoons). Poreless gudgeons were only found in Nimrod Creek and Billy's Lagoon, both in the lower part of the Wenlock. It is surprising that they appeared to have such a limited distribution.

Threadfin rainbows and pennyfish were collected from four of the five lagoon sites sampled. Threadfin rainbows are most common in heavily vegetated areas (Allen and Cross, 1982), and were only found amongst vegetation in lagoons in the Wenlock River. Pennyfish also prefer vegetated environments, where they breed (Merrick and Schmida, 1984).

Gertrude's blue-eye (*Pseudomugil gertrudae*) was only found at one location, in dense aquatic vegetation at Woodford Lagoon. Apparently it is an estuarine fish, as it has been found in the Embley estuary (Blaber *et al.*, 1989). However, it can be successfully bred in freshwater (Leggett and Merrick, 1987). It commonly co-exists with threadfin rainbows in other areas (Allen and Cross, 1982).

*Dasyatis* sp., the stingray, was only observed in the river. No evidence of it was seen in those lagoons where observation of the bottom was possible. Stingrays tend to bury themselves in sand, and may restrict themselves to habitats with a sand substrate.

All other fish species collected from the Wenlock river appeared to be widely distributed over the catchment area, both in lagoons and the river. No particular pattern of distribution was observed in fish regularly caught, although some species (fork tailed catfish, eeltailed catfish, bony bream) appeared to be far more numerous in lagoons than the river. This may have been due to bias in sampling methods.

### 15.6 Species of Commercial and Recreational Importance

The Wenlock River is an important river in terms of species of both commercial and recreational importance. Stone's Crossing, in particular, is a popular camping and fishing spot. Commercial fishers use the navigable part of the Wenlock. No restrictions on commercial fisheries in the Wenlock are in force. Barramundi were present in all parts of the river up to the falls, but were never abundant. Nevertheless, there were several sites at which a 'barra' could be guaranteed for recreational fishers. However, these sites also tend to be closely guarded by land custodians and access is restricted.

Saratoga (*Scleropages jardinii*) were present in all sites but were never numerous. They appear to be vulnerable to overfishing due to their slow breeding habits, surface feeding and thus susceptibility to lures, and their renowned fighting abilities and acrobatics (Lake and Midgley, 1970; Merrick *et al.*, 1983). The only lagoon we studied which had been regularly fished and netted (according to locals) had no saratoga or barramundi in it at all.

Other species caught regularly by recreational fisherman include archer fish (*Toxotes chatareus*), tarpon/oxeye herring (*Megalops cyprinoides*), fork tailed catfish (*Arius* spp.), eel tailed catfish (*Neosilurus ater*) and sleepy cod (*Oxyeleotris* spp.) All these fish are abundant, breed in freshwater (except oxeye herring) and appear to tolerate sustained fishing activity.

### 15.7 Breeding Observations

Rainbow fish (*Melanotaenia* spp.) and hardyheads (*Craterocephalus stercusmuscarum*) appeared to breed year round, judging by presence of juveniles and ovigerous females. Sooty grunter/black bream (*Hephaestus fuliginosus*) males were running ripe when sampled at Dry Creek in September. Black bream appear to hold off spawning until water temperatures reach 23°C and may also be triggered by environmental conditions linked to water flow (A. Hogan, pers. comm. 1994). Observations in other river systems show that black bream spawn in gravelly areas and the eggs need to be well oxygenated during development. In peak flood times water flow and turbidity may kill a majority of eggs. After peak flooding and before it, however, water flow over rapids and riffles would provide ideal spawning grounds. Suitable spawning areas would be present all up and down the Wenlock except in the lower, more sluggish areas.

Black bream were noted to be gravid or ripe and moved upstream at the start of the first storms in November to December by the residents at Moreton. Similar upstream movement of black bream, often in intermittent streams, have been noted by landholders, and are undoubtedly for breeding purposes. Presumably, the majority of larval development occurs when river flow has recommenced or in suitable habitats in perennial reaches, and food is abundant. Juvenile black bream are developed enough to take advantage of the flood plain food resources in January and February, the usual flood months.

### 15.8 Water Quality

Water quality was generally good for fish at all locations, except Nimrod Creek. pH values ranged around neutral at most locations. pH and oxygen levels were lower at Nimrod Creek, where leaf litter from paperbark trees may have contributed to reduced pH and dissolved oxygen. Tannin was either not detected or at low levels at all sites except Nimrod Creek, which was stagnant and had large quantities of leaf litter in it.

Phosphates were only detected in lagoons where cattle access or human activity (camping) was noted. The highest level, 2.5 mg/L, was observed at Billy's Lagoon, where cattle were watered at the lagoon. No signs of eutrophication (overgrowth of aquatic plants) were observed anywhere.

### 15.9 Habitat Disturbance

Overall, there was little disturbance at all the sites sampled along the Wenlock River. However, several crossings were very popular camping sites and use of soaps etc., and cleaning down of vehicles in the river could have impacts during peak visitation periods. Toilets are not provided at any of the road crossings sampled, and many people use the sandy creek bed or banks for that purpose, which may affect potability (drinkability) of water for humans. Toilets are provided at the main crossing at Moreton.

Erosion in the catchment was not noted to be major at any locations, although we were informed that a hole in Nimrod Creek had been silted up due to unrestricted cattle access and consequent runoff along cattle pads bringing excess sediment into the hole.

There was some erosion noted at Stone's Crossing where roadways in the sandy soil had led to severe gullying and washouts in a restricted area.

Although the crossing at Moreton was not sampled, it deserves special mention as it is the most heavily used crossing and an almost obligatory stop for many people on their trek up to "the top". Cook Shire Council installed pit toilets and employed a person on a part-time basis to clean up the camping areas after campers. She also policed, as far as possible, other practices such as washing of vehicles in the river. The crossing at Moreton was 'improved' by laying a clay/sandstone substrate across it to improve stream bed stability. Unfortunately, this resulted in noticeable siltation to 500 m downstream. Observations of fish below and above the crossing found far fewer fish and less species in the silted area below the crossing when compared to the area above the crossing.

Many people also fish at the crossing, but the effect of this would be minimal as it is in a limited area.

Gold mining activities in the past undoubtedly had effects on the river fauna. No evidence of mine related degradation was apparent to us in areas sampled or traversed. Lagoons could be an important source of recruitment for riverine environments if they had been disturbed previously.

Digging of borrow pits for road maintenance and the river crossing may be of concern if not done sufficiently far away from the river to minimise the chances of erosion. If these activities are not conducted judiciously, severe localised erosion problems such as those at Stone's Crossing could result.

### 15.10 Notes on Other Fauna

File snakes (*Acrochordus* sp.) were abundant at all locations in both lagoons and the river, except Nimrod Creek and Dry Creek, where they were not encountered. Small freshwater crocodiles were observed at the waterfall and local residents reported them present in all reaches of the river except Stone's Crossing. Estuarine crocodiles and freshwater crocodiles were reported from Billy's Lagoon. Very large holes in our nets suggested presence of estuarine crocodiles at Stone's Crossing.

Freshwater prawns (*Macrobrachium rosenbergii*) and redclaw crayfish (*Cherax quadricarinatus*) were found in all locations sampled. They were invariably more abundant in the river than in lagoons.

Aquatic birds were not particularly abundant, although night herons were observed at all locations.

Pigs and horses were abundant on Wolverton and Batavia Downs. Horses cause severe damage in lagoons where they eat and tear up much of the vegetation, and muddy the water by splashing it to mix cool bottom water and warm surface water for drinking. Pig diggings were observed at all sites, and mobs of pigs observed at or near most sites. Pig shooters (both recreational and professional) operate out of Weipa and numbers of pigs observed were lower closer to Weipa.

## 16.0 CATCHMENT 9241 - WEIPA AREA LAGOONS

**Summary**

1. Three lagoons near Weipa are sinkholes resulting from dissolution of siliceous sediments underneath the surface. Swamps are in drainage lines at the edges of the bauxite plateau. The area is currently mined for bauxite and kaolin.
2. There have been numerous previous studies of the small creeks near Weipa, but little attention has been paid to lagoons.
3. Four sites (three sinkholes and one swamp) were sampled for fish. These were Andoom Swamp, Botchet Swamp, Willum Swamp (sinkholes) and Kupandhangan Swamp (a drainage channel swamp).
4. All waterbodies had swamp eels (*Ophisternon bengalense*) except Andoom Swamp in which no fish were collected. Of the sinkholes, only Botchet swamp had other fish, including chequered rainbows (*Melanotaenia splendida inornata*), tarpon / ox-eye herring (*Megalops cyprinoides*) and sailfin glassfish / perchlets (*Ambassis agrammus*). Ten species of fish were collected from Kupandhangan Swamp.
5. Black banded rainbows (*Melanotaenia nigrans*) are restricted to this area, and preferred swamp habitat. They were apparently absent from the Wenlock and Archer Rivers. Black banded rainbows, Gertrude's blue-eyes (*Pseudomugil gertrudae*) and northern purple spotted gudgeons (*Mogurnda mogurnda*) colonised temporarily swampy woodlands adjoining Kupandhangan Swamp.
6. Weipa estuaries are famous for fishing, so freshwater fishing is limited. No freshwater fish of major recreational importance were found in the lagoons. Ornamental fish (banded rainbows, *Melanotaenia trifasciata*, and Gertrude's blue eyes) present in creek and lagoons are colour forms with potential as aquarium fish.
7. Swamp eels were gravid, Gertrude's blue eyes were breeding, and empire gudgeons (*Hypseleotris compressa*) were displaying breeding behaviour in March.
8. Water quality was excellent, but favourably influenced by heavy rains.
9. Botchet Swamp had some turbidity due to a nearby road, but effects were mild. All other sites sampled were almost pristine when compared to other locations on the Peninsula.
10. Aquatic insects dominated the fauna of swamps without open water fishes. Freshwater leeches (*Alboglossophonia* sp.) were abundant.

### 16.1 Basin Characteristics

The Weipa lagoons area lies on the bauxite plateau or the eroded Uningan Valley, all of which overlies a sedimentary siltstone and sandstone base (Parker and Schaap, 1988). Uningan Creek formed due to erosion of the bauxite plateau accompanying the drop in sea levels over the past few million years. Most of the area is relatively flat, and covered with woodland dominated by stringybark (*Eucalyptus tetradonta*) (Specht et al., 1977). Most of the area drains well, but there is a water table in a sand aquifer which is subject to large seasonal fluctuations in depth, rising by as much as 6m during the wet season. There are several sink holes in this area. These possibly result from collapse of an area after removal of silica by ground water (Smart, 1977).

The main activity in the vicinity of all the swamps studied is mining for bauxite. This is railed or carted on haul roads to a wharf at Weipa for processing and shipping to Gladstone or overseas. Kaolin is also mined to a smaller extent near the airport.

### 16.2 Previous Studies

Due to its proximity to the bauxite and kaolin mines of Weipa, the vegetation and geology of this area have been very well studied (e.g. Godwin, 1985; Gunness et al, 1987; Specht et al, 1977). Fish have been relatively poorly studied, although Blaber et al (1989) studied the fish in the Embley estuary. Tait and Pearson (pers. comm.) studied fish in creeks and the Wenlock River in the vicinity of the proposed Weipa airforce base as part of the environmental impact statement. The results of that study are presented in Appendix One. No lagoons were studied by Tait and Pearson. Marmoss Creek, Arthur Creek, Cox Creek and Pappan Creek were collected using dip nets, cast nets, gill nets, and angling. A number of species' presence was also observed and noted.

Armstrong (1985) collected freshwater fishes in the Weipa area, in Tentpole Creek. Six species were collected from Tentpole Creek, and six from a lagoon. A total of seven species were collected. Armstrong also collected in a lagoon which, from the description and fish collected, was probably in the Uningan Reserve (made a reserve in 1988). Results of Armstrong's collections are presented in Appendix One. Freshwater species present in Uningan Reserve were documented by Voss (1988). Nine species were reported as present in Uningan Creek. These are listed in Appendix One.

### 16.3 Sites Sampled

Four sites were sampled for fish. See Table Eleven and Figure 10. Water quality was monitored in all sites, and a kaolin mining void.

Three sites were believed to be sinkholes, a result of collapse of surface soils after dissolution of sub surface silica by ground water (Smart, 1977). Botchet swamp, Andoom swamp (= Pine River swamp) and Willum swamp may have been formed by this process. Kupandhangan swamp is a low lying swamp area which may have been mangrove swamp or saline flat when sea levels were slightly higher, but which is now a freshwater swamp fed by ground water and runoff from surrounding bauxite plateau ridges.

Botchet swamp is a large (2 km long) sinkhole situated in the Andoom mining area north of the Mission River. A concrete capped barrage and fish ladder below it was constructed in the late 1980's. This had the effect of retaining flood waters for longer periods in the swamp which is used as a water point for road damping trucks. The fringing vegetation zones have changed as a result of the longer inundation periods (Gunness *et al.* 1987). The bulk of Botchet swamp at our visit in March was open water with reeds (*Lepironia auriculata*) distributed over the entire open water area, in a continuous but sparse stand. The maximum depth measured was 3.43m. This depth was fairly constant throughout the transect taken from the edge of the fringing forest to the centre of the swamp, which is substantially different to lagoons on river floodplains which have gently shelving substrates leading to the deepest point in the middle. Vegetation also differed significantly from floodplain lagoons in that reeds (*L. auriculata*) predominated, and water lilies (*Nymphaea sp.*) and eelgrass, (*Vallisneria gracilis*) were uncommon. Reeds may have a significant advantage over attached aquatic plants, as their buoyant stems permit them to reach the sunlight. Some reeds had stems over 4m in length, of which the top 30-40 cm emerged from the water. The margins of the swamp were mostly *Melaleuca* forest flooded to a depth of up to 2m. This extended to about 30m from the shore edge. The shore side 5-10m of this flooded forest was flooded *Eucalyptus* woodland and grasses. No true aquatic vegetation was present in the forest. The outer margins of this forest were well defined and probably represented the upper limit of flooding during the wet season before the barrage was built. Snags, tree trunks, and submerged grasses provided the main cover in this environment. In the open water, reeds were the main cover and the clay substrate was covered with dead reed stems.

Botchet swamp is used as a water source for water trucks which dampen the mine haul roads. Water is pumped up from a channel dug about 50m out into the open water and to the edge of the flooded forest. Once the swamp recedes past the end of the channel pumping ceases and water is taken from other sources. Water remains in the channel and may be present in the middle of the swamp at the end of the dry season.

There was turbidity in Botchet swamp near the water intake. Runoff from the roads had washed bauxite dust into the swamp, which had settled on the substrate, particularly in the vicinity of the pump and channel. Sediment was also observed to have settled in algae growing on the stems of the reeds in about a quarter of the lake's area closest to the road. This was minor and water clarity at the time of our visit was excellent, with a secchi visibility of greater than 3.43m.

At the outlet to Botchet swamp is a barrage and causeway, which have artificially raised the level of the swamp. A fish ladder constructed at the outflow edge of the barrage leads to the flow channel with flows through grass and woodland. No *Melaleuca* sp. trees, sedges, or other water associated plants grew along this channel. A 100m transect along the margin of the flooded forest was sampled by electrofishing, and sections of flooded forest, drainage channel, open water, above and below the barrage and the fish ladder were sampled.

Andoom swamp (alternatively known as Pine River swamp or Tear Drop) was very similar to Botchet swamp. It is situated close to the Nundah mine area. No mine vehicles have access to the swamp. No turbidity or sedimentation were observed anywhere in the lagoon. Vegetation was very similar to that in Botchet swamp, with a narrower band of flooded forest (about 25m). At the outflow is a swamp of *Pandanus*, razor grass, water vine (*Flagellaria indica*) and ferns. This constricts to a small creek about 200m from the swamp margin (at high level). The creek has a solid clay substrate and receives water overflow from the swamp via a small waterfall. Below this waterfall is a small pool about 1.5m deep and 4m long. The creek bed is narrow and the banks have a thin band of gallery forest. No aquatic vegetation was present. Instream cover consisted of roots and undercuts. The stream had few deep (1m) holes at bends. Andoom swamp dries out completely during the dry season.

Willum swamp is situated about 1.2 km past the airport on the Coen Road. It is not in an area currently mined and at present is not heavily visited, although some people from Napranum do visit on occasion to collect mussels. It is also a story place. Willum swamp differs from Botchet and Andoom in that there is little marginal paperbark forest. Much of the banks is woodland with paperbark trees around the margins of the swamp. At the time of visiting the water's edge was covered in couch grass and sedges (*Cyperus haspan*) which grow to about 10m out from the shore. From there to 25m from the bank was a dense band of reeds (*Eleocharis dulcis*). Most of the middle of the swamp was open water, with a soft mud substrate covered in eelgrass (*Vallisneria gracilis*) and stonewort (*Chara* sp.). Few waterlilies (*Nymphaea violacea*) were present. Snags were few. Maximum depth recorded was 2.1m. This swamp is permanent, although dries out to a very small soak in the dry season.

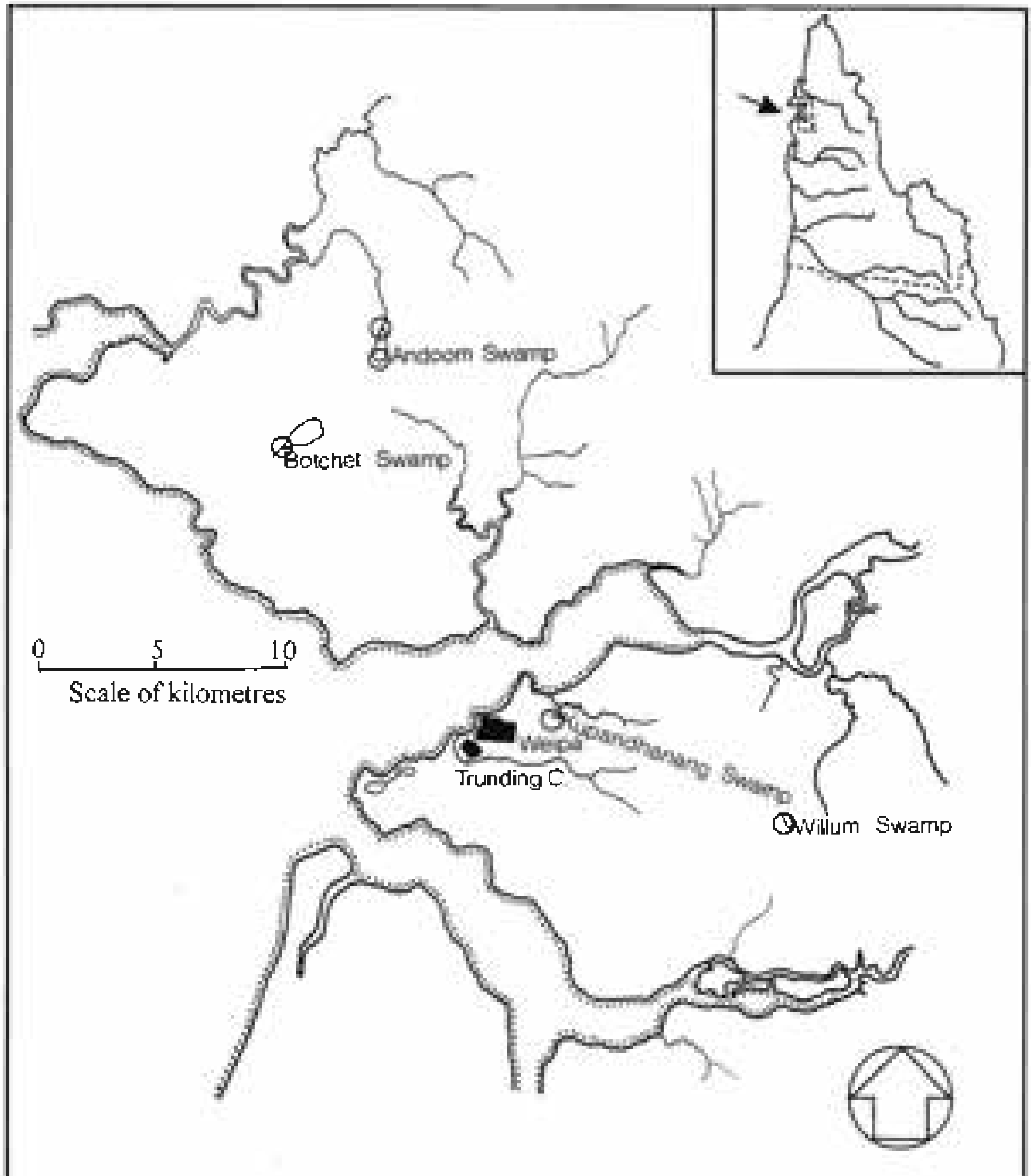


**Figure 10. Weipa Area - Drainage Division 9241 (in part)**
Markers indicate sample sites (refer to Table 11 for date and site names)

Kupandhangan swamp is one of a series of swamps in drainage channels associated with Uningan Creek, and is situated in Uningan reserve. The swamp has two habitat types, the swamp area and the creek which drains it. The swamp is shallow (0.8m maximum depth), mostly densely vegetated with *Eleocharis dulcis*. There are small patches of eelgrass (*Blyxa* sp.) and stonewort. The edges of the swamp and creek are mangrove forest, dominated by ribbed-fruited orange mangrove (*Bruguiera exaristata*), and numerous freshwater vines and ferns (climbing maidenhair, *Lygodium microphyllum*; water vine, *Flagellaria indica*; and mangrove fern, *Acrostichum* *speciosum*). There were a few *Rhizophora stylosa* and *Melaleuca* trees also present. The creek was densely vegetated with *Blyxa* sp. and in slow flowing areas reeds (*Eleocharis dulcis*). Much of the bed was leaf litter.

The marginal mangrove forest was flooded at the time of the visit to a depth of 5-15 cm. Flow in the creek was gentle flow, and the maximum depth was 0.9m. Cover of aquatic plants, mangrove roots, snags, leaf litter, emergent vegetation and branches was abundant. Some lilies (*Nymphaea violacea*) were present in sections of the creek which were not heavily shaded.

The kaolin void was investigated in relation to possible rehabilitation as wetlands. No fish sampling was attempted. No outlets were present. The levels in the kaolin voids reflect the ground water levels and so vary by about 6m. The banks are steep and there is no aquatic vegetation. The substrate is, surprisingly, kaolin.

Table Eleven. Sites sampled - Weipa Area Lagoons, Drainage Basin 9241

| Site Code | Name | Date | Latitude | Longitude |
|---|---|---|---|---|
| 9241 01 01 | Willum Swamp | 10-11 Mar 1994 | 12° 39.59'S | 141° 59.97'E |
| 9241 02 01 | Andoom Swamp | 11,14 Mar 1994 | 12° 29.10'S | 141° 49.70'E |
| 9241 03 01 | Pine River Swamp Outlet | 15 Mar 1994 | 12° 29.10'S | 141° 49.70'E |
| 9241 04 01 | Botchet Swamp | 12-13 Mar 1994 | 12° 30.99'S | 141°48.34'E |
| 9241 05 01 | Kupandhangan Swamp | 15 Mar 1994 | 12° 37.55'S | 141°54.87'E |
| 9241 06 01 | Kaolin Void | 17 Mar 1994 | 12° 39.82'S | 141° 54.45'E |

### 16.4 Fish Species Present

The basin swamps had few fish present. Of the swamps surveyed in the Weipa area, only the fauna of Kupandhangan was of special interest. Willum swamp only produced swamp eels. Botchet swamp had four species of fish, as did the outlet of Andoom swamp. Andoom swamp itself did not appear to have any fish at all in March, but had three species in July. In Kupandhangan swamp we collected 10 species of fish, including black banded rainbow fish (*Melanotaenia nigrans*), Gertrude's blue eye (*Pseudomugil gertrudae*) and banded rainbow fish (*Melanotaenia trifasciata*).

No fish collected in this area had not been collected previously, except for swamp eels (*Ophisternon bengalense*). This probably reflects sampling methods, as swamp eels are difficult to catch by mechanical methods. Also, they appear to be periodically rare and possibly were absent or extremely uncommon when previous studies were conducted.

It is of interest that the only large species of fish collected was tarpon (*Megalops cyprinoides*). These were collected only in Botchet swamp and below Andoom swamp. As they are diadromous (can live in either salt or fresh water) they can move into new environments as they become available during the wet season. The apparent absence of other large fish (particularly fork tailed catfish, bony bream and grunters) is probably a consequence of periodic drying out of most of the environments sampled, and consequent periodic lack of suitable habitat. Although there is some permanent water in Botchet swamp and Kupandhangan, it is possible that the remaining water is not suitable for survival of larger species of fish which have higher oxygen requirements.

The majority of the tarpon collected were young of the year, which display a strong positive rheotaxis (instinct to swim against a current). Also, a small school of subadults were seen above the causeway, indicating that the fish ladder is successful in permitting upstream movement of both small and large fish. Additionally, rainbows (*Melanotaenia splendida inornata*) swamp eels (*Ophisternon bengalense*) and glassfish/perchlets (*Ambassis agrammus*) were collected in the fish ladder.

Below the outflow of Andoom swamp, beneath a small waterfall, four fish species were observed. This was the only location where barramundi (*Lates calcarifer*) were seen in fresh water. These fish were aggregated below a small waterfall which presumably was impassable to them. It is possible that water flows are never enough to permit fish to negotiate this obstacle as no fish were observed in Andoom swamp despite intensive electrofishing and spotlighting. The presence of these fish in this environment suggest that they would also be present in Kupandhangan swamp. Barramundi and tarpon were collected in humic waters (similar to Kupandhangan Swamp) in both Harmer Creek and the Olive River. The barramundi observed were approximately 40 cm long, which suggests that they were young of the year from the 1993 spawning some six months previous.

### 16.5 Distribution

#### *16.5.1 Extent*

Black banded rainbows appear to be restricted to this area of the west coast of the Peninsula. They are found far to the north in the Jardine Basin (Jardine River, Prince of Wales Island) and Jacky Jacky Creek. They have not been collected from the Wenlock River or Archer River, and it appears therefore that they have a very restricted distribution. They have been collected from Tent Pole Creek (Armstrong, 1985) and Pappan Creek (Tait and Pearson, pers. comm., Hansen, 1994). Tent Pole

Creek on our maps flows into the Wenlock River which is of interest as presence of black banded rainbows in that system, close to the sea, suggests a wider distribution than previously thought. No specimens were deposited in the museum from that area. It appears from the results available that *M. nigrans* is restricted to areas close to the Mission River, and possibly in swamps close by which are linked to the Wenlock River.

The banded rainbow collected from Kupandhangan swamp is vastly different in colour to those collected from Archer and Wenlock Rivers. The swamp banded rainbow has red fins and red edging to the scales, forming a beautiful pattern, and is more blue coloured. The Archer and Wenlock species have yellow fins and a greener hue to the body, without red scale edging.

All other species have been collected previously on other locations on the west coast, in the Archer or Wenlock Rivers or both.

### *16.5.2 Habitat dependence*

Apparent habitat dependence was only observed in Kupandhangan swamp, where black banded rainbows appeared to prefer the swamp area and areas of the creek with reeds, whereas chequered rainbows *(M. s. inornata)* were more common in areas with flowing water. However, both species were present in both environments. The swamp area appeared to be a nursery ground for juvenile rainbows as these were abundant in the reeds and weed beds.

Poreless gudgeons *(Oxyeleotris nullipora)* were only caught in shallow water near mangroves. Few of them were collected.

Of special interest was the collection of a juvenile black banded rainbow and a juvenile northern purple spotted gudgeon (*Mogurnda mogurnda*) in the water collected in the tyre tracks made by the vehicle on the track in to the swamp. Gertrude's blue eyes were common in these tyre tracks and were observed spawning there. The presence of these small fish in swampy ground (which had very little surface water) demonstrates the migratory ability of these fish. The temperature of the surface-water (33°C) was quite high and shows a tolerance of high temperatures.

The presence of these fish in a vast temporary environment explains anecdotal reports of huge numbers of rainbows found in small isolated waterholes. These environments are probably colonised by the large members of juveniles which spread out over the temporarily flooded environments and concentrate as water levels fall.

### 16.6 Species of Commercial and Recreational Importance

Weipa is recognised as a "fisherman's Mecca" in several guide books, mainly for its estuarine fish, particularly barramundi. Freshwater fishing in the immediate vicinity of Weipa is uncommon due to the proximity of huge areas of estuary. However, there is some collection of mud mussels (fresh water bivalves) from Willum Swamp by local aborigines.

The rainbow fish of the area do have potential as aquarium fish. The banded rainbow fish (*Melanotaenia trifasciata*) collected at Kupandhangan Swamp closely resembles the Goyder River form of this species which is recognised for its exceptional beauty and colours. The Weipa form outshines the Wenlock and Archer River ones in that it has red fins and scale edging. It has high potential for rearing and sale as an aquarium fish.

Gertrude's blue-eyes (*P. gertrudae*) from the area were different from others collected in the Wenlock River in that they had red leading edges to the pectoral fins. They also have potential as aquarium fish.

### 16.7 Breeding Observations

Female swamp eels from all locations were observed to be gravid. Little is known about the breeding of this species but their presence in a lagoon with no outflow (Willum swamp) does suggest that they may breed in static, freshwater environments. Other members of this genus live in burrows in marsh mud (Lake, 1971).

Gertrude's blue eyes were observed spawning in the water filled tyre tracks of the track through boggy ground about 1 km from the swamp borders. The spawning substrate appeared to be grass roots and grasses exposed by our vehicles' passage.

Empire gudgeon (*Hypseleotris compressa*) males were observed displaying to schools of 20-30 females in beds of submerged vegetation or reeds in the creek. None were observed in the swamp. These aggregations appeared to have been spawning aggregations as females were gravid.

### 16.8 Water Quality

Water quality was remarkably good for aquatic life at all locations. All sites had extremely low conductivity, due to the heavy afternoon storms each day. Most of the sites were probably almost pure rain water, except Kupandhangan swamp, which would have been fed partly by runoff and from seepage from the bauxite plateau. Even there, conductivity was only 16, which is very low by Peninsula standards. As most of the swamps are fed by ground water, levels of ions and dissolved salts could be expected to increase as the water table contracts over the dry season. All other water quality parameters were close to pure water. Oxygen was at saturation due to the high rainfall and quantities of aquatic vegetation in the lagoons.

Kupandhangan swamp was typical of humic swamps due to the peaty substrate and large amounts of decaying vegetation. It is possible that the soft, acidic water is beneficial to Gertrude's blue eyes, poreless gudgeons and black banded rainbows, as these are found in similar locations in the east coast parts of their distributions, and the Jardine catchment. Possibly black banded rainbows fill the niche in the location that McCulloch's rainbows *(Melanotaenia maccullochi)* fill in the east coast humic environments. Kupandhangan swamp had a pH below neutral (5.2) and the tannin level was 2.0 mg/l, which is comparable to similar east coast environments later in the year (see Harmer Creek or Olive River chapters).

**16.9 Habitat Disturbance**

Despite the close proximity of mining operations to the Botchet swamp and the Andoom swamp, and the kaolin void being a result of mining operations, there was remarkably little obvious effect from these activities. The only observable effect in natural environments was noted at Botchet swamp, where there was adherence of sediment to algal slime attached to reeds. However, the water clarity was very high and there was no colouration of the water attributable to runoff from mine haul roads near the swamp.

Water clarity and purity in most swamps was higher than that seen in nearly all other lagoons on the Peninsula, probably due to the heavy, daily rainfall. Also, these swamps fill by seepage from ground water or are exposures of the water table, whereas other Peninsula lagoons (not sand dune lakes) are trapped floodwaters which have had silt (and salts) in them which concentrate progressively over the dry season.

Disturbance from feral animals was much less than that seen elsewhere on the Peninsula, due largely to the season, as pigs use the high ground during the wet season and only work the swamps later, as they dry out. Also numbers of pigs close to Weipa may be lower than other areas due to hunting pressure from residents.

In all swamps except Botchet, there were no indications of any human activity which would impinge on the integrity of the swamp or detract from its natural qualities.

### 16.10 Notes on Other Fauna

Due to the lack of fishes in Willum and Andoom swamps, there appeared to be a larger number of insects and plankton in the open water. Willum swamp had vast numbers of backswimmers (Hemiptera: Notonectidae) in the water, particularly in the open areas. There also appeared to be large numbers of planktonic algae and some arthropods also. Andoom swamp was similar. Botchet swamp did not have such an abundance of aquatic insects. Kupandhangan swamp did not have the similar abundance of insects as the sites with less fish.

Of interest also was the presence of numbers of free swimming aquatic leeches, particularly in the three sinkhole swamp habitats. These leeches were forwarded to the Queensland Museum for identification. The tentative identification was *Alboglossophonia* sp (Family Glossophonidae). They are probably an undescribed species as no collections of leeches have been made from the Peninsula previously. These leeches are saprophytic (feed on decaying plant matter) and do not attack swimmers.

No crocodiles were observed at any site. Waterbirds were scarce, although white breasted sea eagles were occasionally seen.

### 16.11 Acknowledgment

This work is part of a year long study on the ecology of Weipa area lagoons funded by Comalco Minerals and Alumina.

## 17.0 CATCHMENTS 9220 AND 9221 - ARCHER RIVER AND TRIBUTARIES


**Summary**

1. The Archer is the largest river system totally within the CYPLUS study area, rising in the McIlwraith Ranges in the East and draining an area of about 15 230 $km^2$. Upper tributaries were typical mountain streams, but most of the river flowed through flat woodland country. Most of the Archer is intermittent. There are vast areas of lagoons and swamps, particularly neat the mouth of the river.

2. There have been numerous collections on the Archer and Coen Rivers. Most of these have been at the main road crossings. Most did not sample lagoons.

3. Twenty three sites were sampled in the Archer catchment, 13 on the Archer and 10 on the Coen River. Sites were divided into five categories, viz; upstream river sites, holes, river sites, oxbow lakes, and lagoons.

4. Thirty six species of freshwater fish were collected or observed in the Archer River system. Freshwater anchovies (*Thryssa scratchleyi*), not previously documented from the Archer, were collected in several locations. Five other species previously collected in the Archer were not collected by us.

5. Barramundi (*Lates calcarifer*) and ox-eye herring (*Megalops cyprinoides*) were collected up to 220 km upstream of the river mouth.. Freshwater anchovies were patchily distributed. Banded rainbow fish appeared to be restricted to river sites, and fork tailed catfish (Ariids) were more common in downstream locations.

6. Barramundi fishermen fish the Archer River up to Stone Crossing in Aurukun lands. Local residents periodically fish the lagoons and holes, catching enough for personal consumption. Traditional fishing is now permitted in National Parks, but is restricted to aborigines from communities.

7. Most fish species collected in November were breeding or had bred as evidenced by presence of juvenile fish. Most small species of fish appeared to breed all year round.

8. Water quality was generally good with low phosphate levels, high dissolved oxygen readings, neutral pH and soft water.

9. Habitat disturbance was primarily from feral animals. Of particular importance were pigs and horses, the activities of which destroy the aquatic vegetation and reduce water quality in lagoons.

10. Freshwater crocodiles (*Crocodylus johnstoni*) and file snakes (*Acrochordus* sp.)were abundant at all sites downstream of the main road crossing. Turtles, freshwater crayfish (*Cherax quadricarinatus*) and freshwater prawns (*Macrobrachium rosenbergii*) were present in all sites, and crustaceans were particularly abundant in river sites.

### 17.1 Basin Characteristics

The Archer system is the largest river system entirely within the Cape York Peninsula Land Use Strategy study area. It has a total catchment area of 12 020 $km^2$ (Archer) and 3 210 $km^2$ (Coen) totaling 15 230 $km^2$. The Archer River is about 280 km in length. Much of the catchment area is covered in Rokeby and Archer Bend National Parks. The headwaters rise in the McIlwraith Range east of Coen. Much of this area is crown reserve land and a little grazed pastoral lease, Geike Holding. Over its entire length, the Archer is intermittent, drying out to a series of waterholes (often widely separated in the upper reaches) from about September/October through to the start of the monsoonal rains. Early storms contribute nothing to river bed flow. It is possible that in the extreme upper limits of the catchment some streams are perennial, but their flow is not sufficient to keep river surface flow going during the year.

Most of the catchment of the Archer system is eucalypt woodland (*Eucalyptus tetradonta -Eucalyptus nesophilia* forest community). The upper reaches in the McIlwraith Range may have patches of rainforest in mountain gorges and valleys. The lower reaches (the vast majority of the river) pass through gently undulating country with varying types of soils, mostly deep banded silts and loams (Stanton, 1976) (see Land Use Survey NR02 for details). The river itself, anabranches, old channels, and tributaries are lined with gallery forest with several species of deciduous trees not seen on the Wenlock. Terracing was present also, but not as well developed as on the Wenlock, and was usually restricted to only one relatively broad terrace about 3-5 m above the stream bed. The river bed itself was invariably sandy, and the banks lined with paperbark (*Melaleuca*) trees. In some areas, pure stands of one species of paperbark (*Melaleuca argentea*) gallery forest are present (Stanton, 1976). Trees are absent in the bed itself except in the uppermost reaches and the lower reaches where the bed was up to 100 m wide, and small islands of bound sand had paperbark trees. In the upper reaches there were often bottlebrush (*Callistemon*) trees present in the stream bed, and large paperbark trees. The upper Peach Creek site was in rocky country. The creek was studded with boulders and had a rocky/pebbly substrate. Palms and rainforest trees surrounded the creek bank, and grew in the stream bed. Paperbarks and palm trees lined the channel. The creek may have been perennial upstream of this site. Terraces were developed at points along the banks but this was not consistent. The bed in the most upstream reaches was only up to 20 m across, and often filled with paperbark forest. The entire stream bed surface flow is intermittent. There are a number of very large holes in the river itself. There are a few east of the Archer River Roadhouse (e.g. Lily Lagoon) but there are virtually none throughout Rokeby National Park. Long, often deep holes are present in the Archer River from about the Merapah border downstream. These may be several kilometres long and up to 4 m deep. No or little aquatic vegetation is present but vines and gallery forest trees hang in the water along the banks, the banks have masses of tree roots and undercuts, and there are numerous snags and fallen trees. Usually the holes are shallow at either end, and there may be a few sandbanks at the ends. The river bed holes are usually filled with water from bank to bank for most of their length.

The Coen River is similar to the Archer River but is much smaller and narrower. In 1992 no water was present in the river bed anywhere we looked in Rokeby National Park, except for two very small, stagnant waterholes about 2 $m^2$ in size. The river is lined with fringing paperbark trees and gallery forest. Terraces were not developed in the areas sampled, the banks were steep and rose to about 5 m above the river bed. Bottlebrush trees and few small paperbark trees were present in the bed of the river upstream, which at its broadest was only about 40 m wide. Downstream, large paperbark trees grew in the river bed and shaded much of it. There are few permanent holes in the Coen River, and they are widely spread and quite small. The bed is sand.

Lagoons are common on the floodplain of the Archer and Coen Rivers. The lagoons are similar to those on the Wenlock, although there are some oxbow lakes (distinguished from lagoons as they have gallery forest and there is no aquatic vegetation). Lagoons are shallow generally (2-3 m) although in the lower reaches the deepest lagoon we encountered was measured to 12.5 m depth. Most lagoons had a scattering of paperbark and red beech (*Dillenia alata*) trees around the borders, and a marginal band of water lilies and water nymph (*Najas tenuifolia*). Eelgrass (*Vallisneria* sp.) was more common in waterholes but was invariably present and usually dominated sections of a lagoon bed. *Eriocaulon setaceum* was also present. Water snowflake (*Nymphoides sp.*) was the commonest of the lilies, but water lilies (*Nymphaea* sp.) were also present in most lagoons. Giant water lily (*Nymphaea violacea*) was observed only once, near Langi Lagoon. Reeds (*Eleocharis* sp.) were usually present in the shallower parts of lagoons. Generally lagoons had a silt or mud/clay substrate, and few snags, similar to those in the Wenlock Basin.

### 17.2 Previous Studies

Due to its large size and relative ease of access, several collectors have sampled the Archer. Most of those collections have been of the river crossing site or near Coen. A couple of collectors have ventured out to Rokeby, now a ranger station, on the Coen River.

The Archibald expedition collected ten species from the Archer River and Coen River. The expedition was primarily collecting terrestrial mammals, and did not collect extensively for fish (Nichols, 1949). Most of the species collected are identifiable, but we could not locate a modern equivalent of *Therapon bidyana*, which we can only assume is the black bream/sooty grunter (*Hephaestus fuliginosus*). The list of fish collected by the Archibald expedition has been omitted because it is superseded by more recent, more comprehensive studies.

H Midgley conducted surveys on the Archer River in 1985 and 1988. The 1988 study sampled the river near Tea Tree Lagoon, on the western end of Kendall River Holding. Midgley collected 16 species of fish. The species list from that trip is presented in Appendix I. Midgley also collected on the Archer River near Fox Hole, and the Coen River at Rokeby. These species lists are included for comparison with our collections at the same sites.

Leggett (1990) collected briefly in the Archer River, Coen River and Peach Creek, collecting a total of 16 species from the three sites. His results are also presented in Appendix I.

Armstrong (1985) recorded observations on fish of the Coen River and at the Archer River Crossing. Hansen (1988) also recorded his observations on fish of the Archer River at the crossing.

According to museum records (as at December 1992), 21 species of fish were collected from sites on the Archer River road crossing and at Rokeby Station on the Coen (lagoons at Rokeby and probably Vardon's Lagoon) (See Appendix One).

### 17.3 Sites Sampled

A total of 23 sites were sampled on the Archer and Coen Rivers, 12 on the Archer and 10 on the Coen. Those sites spanned from upper Peach Creek to Tea Tree Lagoon, a distance of about 180 km. Access to lands managed by Aurukun Community Inc. was denied, so downstream sites and hence diadromous species (those species which can live in either fresh or salt water) were not able to be studied. See Table 12 for sites sampled.

The sites studied could be divided into five categories - upstream river sites, river sites, lagoons, oxbow lakes and holes.

*17.3.1 Upstream river sites*

Three upstream river sites, two on Peach Creek and one on Attack Creek, were sampled. Lower Peach Creek was about 15 km from the base of the McIlwraith Range, and upper Peach Creek was right at the base of the range. Attack Creek (Plate 23) was in a valley draining Birthday Mountain and the McIlwraith Range, about 22 km north of the Upper Peach Creek site. Peach Creek is called the Archer once it meets the Dry River. Attack Creek feeds into Geike Creek, the main northern tributary of the Archer River.

At each site the stream had a sand bed with shallow water. Only one location had a pool of 1.5 m deep. All others were shallow water, up to 0.5 m deep at bends or logs. There was little midstream cover at each site, usually roots along banks, small snags and leaf litter in backwaters. A few logs were present near banks. No aquatic vegetation was present. At each site, the stream channel was lined with paperbark trees. The stream bed was usually less than 20 m across. Stream channels were not shaded by the overhanging vegetation. Gallery forest was limited (generally) to the banks of the stream bed. Flow in the channel was usually 2-4 m across, and water flow type varied from gentle flow to glides and riffles.

*17.3.2 River sites*

Six river sites were sampled, two on the Archer River and four on the Coen. At 10 Mile Junction (Plate 24), the river was running in a broad meander across a stream bed about 60-70 m wide. For part of the sample site the river broadened out to cover the whole stream bed to a depth of 10-20 cm, and at the edges were channels up to 1 m deep. These were lined with tree roots and often undercut trees on the banks. Logs had accumulated in several places and directed flow to scour out small pools. Fine filamentous green algae covered the gravel. No other aquatic vegetation was present. Flow was gentle, on riffles, over the wide sandbars and there were backwaters behind sandbanks. At this river site, the stream bed was lined with paperbark trees which shaded the margins for part of the day. Gallery forest extended up past a broad terrace up to the channel margins at the floodplain level. There was some input of leaf litter from gallery forest lined tributaries. The water in this site is intermittent, and no waterholes remain after October. This site was about 25 km downstream from the road crossing. The road crossing near the Archer River Roadhouse could be considered similar to this river site.

Plate 23. Attack Creek. An upstream site in the headwaters of the Archer River.

Plate 24. The Archer River at 10 Mile Junction. This is a typical western flowing river site on Cape York Peninsula.

Sites on the Coen River differed in that the river channel was much narrower. No terraces existed, and the banks were generally 4-5 m high. Sandbanks, sometimes vegetated with bottlebrushes, were present in the stream bed. The river course was often braided, with numerous channels and anabranches. At the time of our visits, the stream channel if flowing was usually 3-5 m wide, gentle flow, over sand, with no aquatic vegetation present. Cover consisted solely of bankside roots and small snags. Water was shallow, there were only a few cutaways at the banks near grass which were about 0.5 m deep. Some leaf litter had accumulated at points. Deep holes were present at Rokeby. All other sites lacked refuges for large fish. The Coen River is, as mentioned earlier, completely intermittent, with very few permanent holes.
One site on the Coen River, The Bend (actually Pandanus Creek) differed markedly in that the river bed was rocky, with large rocks and boulders. There was a waterfall at the top of the site, and areas between boulders were sand and gravel. There was little cover apart from rocks and a few small patches of leaf litter.

Running Creek was different to other river sites in that it was much smaller than the other sites and had a canopy of gallery forest covering it and large quantities of timber in the water. Where there was a large pool, it was more similar to the holes described later. The flowing part was similar in other respects to the Coen River.

*17.3.3 Lagoon* sites

In all, six lagoon sites were sampled, four on the Coen River and two on the Archer. All lagoons were similar in many respects. All had a mud substrate, and were generally 2-4 m deep. Most were lined with aquatic vegetation, usually water lilies (*Nymphaea* sp.) and water snowflake (*Nymphoides* spp.), beds of eelgrass (*Vallisneria* sp.) and water nymph (*Najas tenuifolia*), and reeds in places (*Eleocharis* sp., *Juncus* sp.). The middle of most lagoons was clear, and usually logs or snags were present at points around the margins. Banks generally had paperbark trees a short distance from the edge, but at the times of sampling there was rarely very much overhanging vegetation. Aquatic vegetation usually grew around all the margins except those covered by overhanging vegetation. Horses dug up and disturbed a lot of eelgrass (*Vallisneria*) beds in December 1992 in Rokeby, but the damage was not so evident in 1993 after the wet season. Lagoon sites were differentiated from oxbow lakes in that the marginal vegetation never includes gallery forest, the substrate rarely includes sand, and there is an abundance of aquatic plants, at least marginally. Usually trees are set back from the waters' edge, and are a thin band of paperbark trees giving way to eucalypt woodland.

Table Twelve. Sites sampled - Archer River and Tributaries. Drainage Basins 9220 & 9221.

| Map Ref | Site Code | Name | Type | Date | Latitude | Longitude |
|---|---|---|---|---|---|---|
| A | 9220 01 01 | Horsetailer Hole | † | 29 Nov 1992 | 13°24.67'S | 142°18.70'E |
| A | 9220 01 02 | Horsetailer Hole | † | 02 Sep 1993 | 13°27.73'S | 142°18.68'E |
| B | 9220 02 01 | Langi Lagoon | * | 30 Nov 1992 | 13°27.09'S | 142°41.81'E |
| C | 9220 03 01 | Attack Creek Crossing | + | 15 Apr 1993 | 13°31.67'S | 143°13.62'E |
| D | 9220 04 01 | Lower Peach Creek | + | 16 Apr 1993 | 13°40.41'S | 143°07.53'E |
| E | 9220 05 01 | Upper Peach Creek | + | 17 Apr 1993 | 13°43.30'S | 143°14.70'E |
| F | 9220 06 01 | Near Bob's Lagoon | * | 04 Jun 1993 | 13°27.25'S | 142°44.35'E |
| G | 9220 07 01 | Ten Mile Junction | # | 05 Jun 1993 | 13°27.04'S | 142°45.32'E |
| H | 9220 08 01 | Lily Lagoon | † | 31 Aug 1993 | 13°27.06'S | 142°58.72'E |
| I | 9220 09 01 | Vardon's Lagoon | ≡ | 01 Sep 1993 | 13°35.46'S | 142°32.11'E |
| J | 9220 10 01 | Running Creek Lagoon | ≡ | 07 Sep 1993 | 13°44.78'S | 142°13.19'E |
| K | 9220 11 01 | Running Creek | # | 05 Sep 1993 | 13°44.69'S | 142°10.16'E |
| L | 9220 12 01 | Archer River, Kendall River Homestead | # | 06 Sep 1993 | 13°42.20'S | 142°03.34'E |
| M | 9220 13 01 | Tea Tree Lagoon | ≡ | 07 Sep 1993 | 13°44.16'S | 141°59.76'E |
| N | 9221 01 01 | Rokeby Lagoon | * | 26 Nov 1992 | 13°39.83'S | 142°39.42'E |
| O | 9221 02 01 | Jabaroo Lagoon | ≡ | 27 Nov 1992 | 13°49.05'S | 142°50.07'E |
| O | 9221 02 02 | Jabaroo Lagoon | ≡ | 07 Jun 1993 | 13°49.05'S | 142°50.07'E |
| P | 9221 03 01 | Boyd's Lagoon | * | 27 Nov 1992 | 13°42.16'S | 142°47.19'E |
| P | 9221 03 02 | Boyd's Lagoon | * | 08 Jun 1993 | 13°42.16'S | 142°47.19'E |
| Q | 9221 04 01 | Coen River, Lochinvar | # | 19 May 1993 | 13°57.74'S | 143°08.33'E |
| R | 9221 05 01 | Pandanus Creek, The Bend | # | 20 May 1993 | 13°55.34'S | 143°11.88'E |
| S | 9221 06 01 | Coen River, Rokeby | # | 02 Jun 1993 | 13°39.68'S | 142°40.05'E |
| T | 9221 07 01 | Homestead Lagoon, Rokeby | * | 03 Jun 1993 | 13°39.67'S | 142°40.05'E |
| U | 9221 08 01 | Coen River at Jabaroo | # | 06 Jun 1993 | 13°49.47'S | 142°49.69'E |
| V | 9221 09 01 | Coen River overflow, Archer Bend | ≡ | 03 Sep 1993 | 13°29.34'S | 142°19.33'E |
| W | 9221 10 01 | Lagoon, Archer Bend | * | 03 Sep 1993 | 13°29.20'S | 142°19.38'E |

<u>Key to symbols</u> :-

| | | | |
|---|---|---|---|
| Upstream river sites | + | Oxbow lakes | ≡ |
| Holes | † | Lagoons | * |
| River sites | # | | |

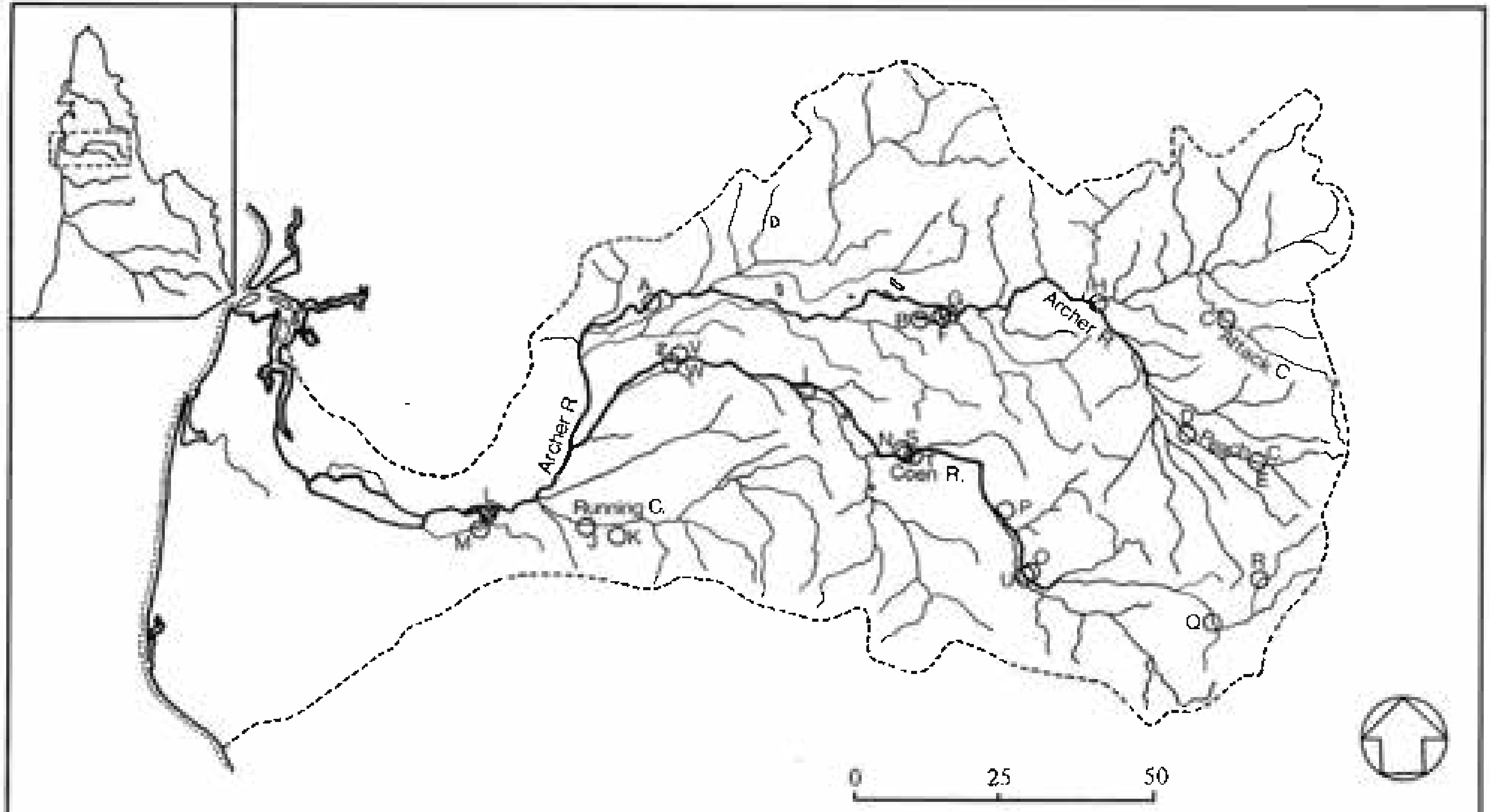


**Figure 11. Archer and Coen Rivers - Drainage Division 9220 and 9221**
Markers indicate sample sites (refer to Table 12 for date and site names)

*17.3.4 Oxbow Lakes*

Five oxbow lake sites were sampled. These differ to lagoons and holes in that they are old parts of the river cut off and not in the main channel. They usually have an inlet and an outlet which connects with the river. Banks are steep and aquatic vegetation, if present, sparse. Substrate is usually sand at the ends but mud in the middle. Water is usually about 3-4 m deep, although a depth of 12.5 m was recorded at Tea Tree Lagoon. Snags were often along the edges, and the banks were usually undercut, stabilised by paperbark and gallery forest tree roots. Leaf litter was common on the bottom. Many oxbow lakes were covered over almost completely by overhanging vegetation of the gallery forest but Tea Tree Lagoon was too large to be covered.

*17.3.5 Holes*

Holes refer to permanent water bodies in the main river bed. Two holes, Horsetailer Hole and Lily Lagoon, were sampled. The Running Creek site was also, in part, a hole. Holes had sandy substrates, no aquatic vegetation, and were lined by paperbark trees and gallery forest. Snags and logs were plentiful, particularly along the edges. Holes were wide and hence the middle usually exposed to the sun.

## 17.4 Fish Species Present

Excepting the freshwater anchovy (*Thryssa scratchleyi*), we did not collect many species not previously collected from other areas on the Peninsula. Freshwater anchovies were collected in two locations on the Coen River and two in the Archer River. They were previously not documented from the CYPLUS study area, although they are present in the Mitchell system (M. MacKinnon, pers. comm.). Juvenile specimens caught in the Archer and elsewhere suggest that some individuals may breed in fresh water (see Herbert *et al.*, for details).

Only three species of fork tailed catfish were collected by us from the Archer River. Lesser salmon catfish (*Arius graeffei*) were abundant (> 20 individuals per site caught) at downstream sites, shovel-headed catfish (*Arius midgleyi*) common (< 10 caught) at downstream sites, and triangular shield catfish (*Arius leptaspis*) rare. Midgley (1988) sampled a site close to our site 9220 12 01 on the Lower Archer River. Of the 16 species caught by Midgley, we collected 13. The total number of species collected by us was 20. Midgley found triangular shield catfish (*A. leptaspis*) abundant (> 20 specimens caught) and the other three species of fork tailed catfish usually found in freshwater common (< 10 species caught). We only caught lesser salmon catfish (*A. graeffei*) and triangular shield catfish in this part of the river, and triangular shield catfish was common. Over the rest of the Archer system, lesser salmon catfish were caught in the Coen River and none in the Archer above Horsetailer Hole. Lesser salmon catfish were abundant in all but the three upstream sites sampled. Also we did not collect flathead goby (*Glossogobius giurus*) (it was not collected by us anywhere in the Peninsula). The only goby we collected at this site was the square blotched goby (*Glossogobius* species C) (*sensu* Allen, 1989).

Species not collected by us but collected by others included Berney's catfish (*Arius berneyi*) (Midgley, 1988); yellow-finned tandan, (*Neosilurus glencoensis*) (Leggett, 1990); elongate perchlets (*Ambassis* cf. *elongatus*); river shark (*Carcharhinus leucas*); and black-banded rainbow fish (*Melanotaenia nigrans*) (Queensland Museum specimen lists as at December 1992). As stated earlier, there was some doubt as to whether all our records of lesser salmon catfish were in fact that or Berney's catfish, as all the distinctive characters differentiating the two species overlapped in our specimens. The oval eye of lesser salmon catfish was used as the diagnostic characteristic and this may not be the best method. To date, no specimens submitted to the museum by us as lesser salmon catfish have been corrected to Berney's catfish.

Yellow finned tandans (*Neosilurus glencoensis*) collected by Leggett (1990) are believed to be synonymous with *Neosilurus hyrtlii* (Allen, 1989). We have examined brilliantly yellow-finned specimens of eel-tailed catfish (similar to *N. glencoensis*) and more plain or large *N. hyrtlii* and found no difference. We agree with Allen synonymising these names and hence Leggett's *N. glencoensis* is the same as our *N. hyrtlii*. Of interest to us were the Queensland Museum's records of elongate perchlets, river sharks, and black banded rainbows (*Melanotaenia nigrans*). We did not collected elongate glassfish from any location on the Peninsula. Allen and Burgess (1990) and Wager (1993) have not reported it from the Archer River. The specimens held by the museum warrant closer investigation to determine if they are elongate glassfish or some other species. Black banded rainbows have only been recorded from the Jardine River and the Weipa area. Presumably we missed them in the Archer River. Only banded rainbows (*M. trifasciata*) (more common in the Archer but not in the museum collection) were found. River sharks (*C. leucas*) would be expected in the lower reaches of the river. They are not always easily netted and we have only caught them infrequently.

## 17.5 Distributions

### *17.5.1 Extent*

Most species were widespread up and down the river although the upper river sites did not have any of the species usually associated with deeper water or lagoons, which is a reflection of habitat requirements. The distribution of some species was limited, though.

Barramundi and oxeye herring were found as far upstream as Lily Lagoon, about 220 km upstream from the mouth of the river. We did not catch barramundi there but locals had. Although there are no significant barriers below the upstream river sites, habitat restrictions may limit the upstream spread of these species.

Freshwater anchovies (*T. scratchleyi*) were only found in four locations, two in the Coen River (both lagoons at Rokeby) and two in the Archer River (Langi Lagoon and Horsetailer Hole). They were collected on two separate occasions from the homestead lagoon at Rokeby. The widely separate locations may be a reflection of patchy distribution within the system which may explain why they were not previously collected.

Fork tailed catfish were not collected at any site above Lily Lagoon on the Archer River or Jabaroo Lagoon on the Coen River. This may be more a reflection of habitat requirements and sampling techniques than presence or absence as these catfish are normally lagoon or open water dwellers and these habitats were lacking above the Lily and Jabaroo Lagoons.

Swamp eels, *Ophisternon bengalense*, were, as discussed elsewhere, only encountered in 1993. They were collected from one site on the Archer (Lily Lagoon) and one on the Coen (Coen River overflow). As already stated, their temporal (over time) distribution needs further research as it appears that they are absent at some times but present at others.

*17.5.2 Habitat dependence*

In some cases, distribution of species was dependent upon availability of suitable habitat which was not present in the most upstream sites. Large fish (e.g. river shark, sawfish and stingray) obviously need large bodies of water in which to live. In the Archer, these habitats are limited to the downstream reaches and the fish's distribution mirrored this. However, in the wet season, sawfish have been seen as far up as the Bend, just outside Coen, which is about 250 km from the mouth of the Archer River. Sawfish have also been caught in Jabaroo Lagoon. We only caught sawfish in river sites, never in lagoons.

Freshwater anchovies were caught in lagoon sites and in a river hole (Horsetailer Hole). In the Northern Territory, freshwater anchovies are only known from very muddy billabongs (Larson and Martin, 1990). We found them in relatively clear water (secchi 0.98 to > 1.4 m). Although not abundant they were moderately common. There did not appear to be any habitat dependence in this distribution, as the size of water bodies they were found in, the amount of cover, aquatic vegetation, etc., all differed markedly between sites. Of interest was the observation that juveniles were present in a lagoon which had not been flushed out for over 20 months, suggesting that freshwater anchovies may breed in freshwater. It is thought that they breed in salt water (Roberts, 1978).

As mentioned in 14.5.2, threadfin rainbow fish (*Iriatherina werneri*), pennyfish (*Denariusa bandata*) and poreless gudgeons (*Oxyeleotris nullipora*) appeared to be dependent upon the presence of vegetation, as they were only found in well vegetated lagoons. All three of these species appear to be entirely dependent upon presence of vegetation for their survival in the Archer system. Gertrude's blue-eye (*Pseudomugil gertrudae*) was not found, possibly because all sites sampled were too far from the estuary.

Banded rainbow fish, (*Melanotaenia trifasciata*), were found almost exclusively in river sites. One individual was found in an oxbow lake (Jabaroo Lagoon). As in the Olive River, banded rainbows appear to prefer flowing water habitats and open, well aerated water. The largest individuals and the greatest numbers of banded rainbow fish were found in the three upstream river sites, particularly upper Peach Creek was noted for large banded rainbows (up to 98 mm standard length, 120 mm total length), which is close to the maximum size stated in Allen and Cross (1982). Even larger individuals were seen in pools upstream from the sampling sites. We did occasionally find some banded rainbows in drying pools, but never encountered juveniles or large numbers in stagnant pools, as observed by Allen and Cross (1982). We believe that although banded rainbows may survive in such pools, to grow to large sizes and breed successfully they need flowing, clean, well oxygenated water. Banded rainbow fish were never collected in lagoons in the Archer, all of which were slightly turbid.

Conversely, fork tailed catfish were never caught in upstream sites. This is probably related more to the water type that they prefer. Fork tailed catfish are open water fish, preferring large bodies of water. The pectoral fin arrangements of fork-tailed catfish is similar to that of demersal (middle to surface waters) sharks, angled to keep the fish swimming upwards. All of the upstream sites were not only intermittent, but lacked areas of open water needed for such fish. Longtom (*Strongylura krefftii*) were also restricted to the same type of habitats. One triangular shield catfish was collected in a river habitat (10 Mile Junction), in a channel at the side of the river. Possibly it was "lost", as no others were observed in the river while spotlighting or electrofishing. Numerous fork-tailed catfish were observed and collected in the lagoons nearby.

### 17.6 Species of Commercial and Recreational Importance

The estuary of the Archer and Watson Rivers is a large area and is used regularly by commercial fishermen. Recently, two residents of Aurukun community were awarded licenses for commercial fishing. Netting is carried out in all navigable parts of the river, and extends above Stone Crossing in the Archer, by punts which operate from a mother ship moored below the rocky bar. Target species are barramundi and threadfin salmon, and other snappers (Lutjanids) as available.

Most of the other areas of the Archer and Coen system are fished infrequently. Local residents usually fish for black bream, barramundi and saratoga. At present, fishing is not permitted in national parks, but some fishing by traditional owners has commenced and will continue once access and hunting rights are worked out between traditional custodians and the government. At the time of writing, no official positions had been communicated to the rangers in charge. Other species also caught by recreational fishers are fork tailed catfish, eeltailed catfish. and sleepy cod. Most recreational fishing is for food. Turtles and file snakes are also taken.

### 17.7 Breeding Observations

On the November 1992 trip to the Archer a number of observations of fish breeding were made. All small fish (rainbows, gudgeons, gobies, pennyfish, hardyheads) were breeding, as evidenced by the presence of ovigerous females and small juveniles. Banded rainbows were not observed breeding in the locations sampled at this time (Horse Tailer Hole was the only site they were found at in November). Bony bream (*Nematalosa erebi*) juveniles were caught in enormous quantities in lagoons and river holes where seine netting was possible. Saratoga (*Scleropages jardinii*) were also breeding, and had juveniles in the mouth at several sites. Shovel-headed catfish were also carrying eggs in November. Juvenile long tom (*S. krefftii*) were observed.

The storms in November wash organic matter into lagoons and holes and may stimulate limited algal blooms and thus plankton and other food source production. Breeding before floods is the ideal time as during floods fish are not congregated and finding partners for spawning may be more difficult, and larvae are more prone to be washed away. Juvenile fish from November spawning would be better able to take advantage of food sources exposed during wet season flooding, and would also be more mobile and thus able to colonise environments during the short flood peaks when flood plains are inundated and lagoons connect to rivers. This pre-flood spawning strategy is quite different to tropical floodplain fishes in other countries which spawn in the flood period (Welcomme, 1985).

In the few sites sampled early in the dry season which had previously been sampled in the stormy season, a comparison of fishes caught showed that numbers of fish were much less early in the dry than in the early wet. This suggests that fish breed up in the lagoons and to a lesser extent, river holes, in the dry season, and progeny of early breedings are ready to spawn in 8-10 months when the storms start again. Obviously, slow developing fish like saratoga may not use this strategy, but smaller fish and more fecund fish probably do. In other rivers, large numbers of juvenile fork tailed catfish, eeltailed catfish, bony bream and sleepy cod were observed in November.

Enormous numbers of eeltailed catfish, Hyrtl's tandan (*N. hyrtlii*), and to a lesser extent black catfish/jewfish (*N. ater*) and toothless catfish (*Anodontiglanis dahli*), were captured in intermittent parts of rivers, particularly the Coen River. Near small creek inflows, thousands of juvenile catfish would aggregate in masses up to 20 m long and 3 m wide. Where water depth permitted, fish would aggregate in "balls" of one hundred to several hundred fish. The vast majority of these small fish would perish when the river dries. They were almost abundant in those rivers which were dry later in the year. In lagoons, numbers of juvenile catfish appeared to be much less.

As on the Wenlock, we found that most small fish species bred all year round, but a higher proportion were breeding in November. Other, large fish may be constrained more closely by flow regimes and temperatures.

### 17.8 Water Quality

Phosphate levels throughout the Archer system were quite low, with no phosphate detected on 18 of 26 sampling occasions. The highest readings were lower down the river, in pools and lagoons.

Oxygen levels were generally high. One low reading was recorded at Jabaroo lagoon, which is a heavily shaded oxbow lake. This was protected from wind and stratification (layers of different temperature water) had occurred in the daytime, although there was only a two degree difference in temperature. Oxygen levels were lower in the November period due to higher temperatures.

Surface water temperatures in November averaged about 30°C, whereas in May, June and September, temperatures were lower, averaging 24.7°C, 23.8°C and 26.9°C, respectively. Diurnal (day/night) thermal stratification was noted in lagoons and oxbow lakes, but temperatures were uniform at night. Observations by locals of fork tailed catfish swimming at the surface in the daytime in November/December suggest that deoxygenation of deeper water occurs in these months.

pH was close to neutral at all sites. Tannin in appreciable quantities was measured in both creeks and lagoons, although but did not appear to be in quantities sufficient to affect fish species diversity. The distribution of tannic waters was patchy, and the presence of tannin did not appear to affect pH noticeably.

Alkalinity and conductivity were generally low throughout the Archer system. Readings tended to be higher in river sites or at the end of the dry season, which agrees with the results of Bishop *et al* 1986.

All sites sampled had water quality conditions conducive to maintenance of good fish health.

### 17.9 Habitat Disturbance

Habitat disturbance in the Archer catchment mainly came from feral animals and erosion. Mining may have had impacts in the past but there is little evidence of it now. Mine tailings dams, which may have high levels of heavy metals and toxic chemicals, are distributed around Coen and may be a concern if water was released during periods of low flow. Cattle are grazed on small areas, but the vast majority of the catchment is National Park, crown reserve, aboriginal land, or grazing leases with low stocking rates. Some erosion and gullying is present around Coen itself, but generally erosion was limited to areas near watercourses where there were roads.

There is heavy camping pressure on the Coen River near the Bend just outside of town. However, provision of basic facilities appears to have limited possible effects as water quality above (at the Bend) and below the camp ground and Coen town (at Lochinvar) was very similar.

The main habitat disturbance is due to feral animals, primarily pigs and horses. These were noted in very large numbers in Rokeby National Park, but were not so numerous at Archer Bend, Kendall River or the upper river sites. Pigs did not appear to use the river much, but did dig around the margins of oxbow lakes. The main areas attacked were the lagoons, a vital habitat for many species of fish, and the only habitat of several species of fish. Lagoons are of special importance in the Archer system as large sections of the river bed are completely dry for much of the year. All lagoons visited had been disturbed by pigs to some degree. This disturbance was more noticeable in November when pigs were concentrated around lagoons. In some locations, virtually all marginal aquatic vegetation had been dug up and eaten or left to dry out and die by pigs. Lagoons and swamps which had dried out were completely dug over by large mobs of pigs, which eat the rhizomes and bulbs and other dry season resistant parts of various water plants. Most swamp beds looked as if they had been ploughed by a disk plough, and many lagoons were observed to be turbid due to the swimming and diving activities of pigs feeding in water up to 1.2 m deep. These lagoons were not sampled for fish as they were mostly temporary. Loss of aquatic vegetation and increased turbidity would, undoubtedly, have some effect on fish species assemblages. Lagoons and swamps which had been heavily worked over by pigs in late 1992 and 1993 had apparently regenerated after floods, as in June 1994 they had thick growth of water lilies and reeds (*Eleocharis* sp.).

Horses were extremely plentiful all over Rokeby, particularly the middle portion. Horses disturb lagoon environments by ripping up and eating aquatic plants, primarily eelgrass (*Vallisneria* sp.). Also, they muddy the water by stirring up cooler bottom water for drinking. Large areas of eelgrass were disturbed by horses, although destruction was not complete.

There is some attempt at reduction of horse and pig numbers in Rokeby by the ranger, but it is a huge area much of which is inaccessible. After the wet season, horses and pigs disperse, and so damage is not as severe. November 1992 was the end of a very long dry time and consequently pigs and horses were congregated around permanent water bodies, intensifying disturbance at that time.

**17.10 Notes on Other Fauna**

Freshwater crocodiles (*Crocodylus johnstoni*) were abundant in all locations downstream of Lochinvar and lower Peach Creek, as were file snakes. Freshwater crocodiles were particularly abundant in holes in the lower reaches, and it was not uncommon to see over 20 in a lagoon in the middle of the National Park (e.g. Langi and Jabaroo lagoons). Estuarine crocodiles (*Crocodylus porosus*) were not observed anywhere by us, but have been seen by the ranger at several locations during helicopter flights.

Turtles were also common in most habitats. Redclaw crayfish (*Cherax quadricarinatus*) and freshwater prawns (*Macrobrachium rosenbergii*) were present in all sites sampled. They were particularly abundant in flowing water environments in June. In the Coen River at Rokeby, almost all fish caught in gill nets were severely damaged by prawns, which swam up to the fish in the nets to eat them. In the Archer River at 10 Mile Junction, both prawns and redclaw were out in the open on sandbanks during the day, and large numbers were caught. Some specimens were brought to Walkamin for morphometric and genetics studies. Prawns and redclaw were not as abundant in any of the lagoons studied.

Palm cockatoos and orange footed jungle fowl were very common in the gallery forests along the Archer River, but palm cockatoos were not observed on the Coen River. Kangaroos and other macropods were plentiful. Only a few waterbirds (egrets and night herons) were observed.

## 18.0 CATCHMENT 9210 - HOLROYD RIVER


**Summary**

1. The Holroyd River flows for 240 km from the broad catchment area at the base of the Bamboo Range through the savannah plains to the Gulf. It is intermittent for all of its length but one tributary (Pretender Creek) is perennial. There are extensive lagoon complexes on the floodplain, particularly in the Strathburn area.

2. The only previous study located was that of Midgley (1988) who collected 25 species from the Holroyd and near Pretender Creek.

3. Eight sites were sampled; two river sites, one oxbow lake, four lagoons and a flood channel. No sites close to the sea were sampled.

4. Thirty two species were collected. The Holroyd represents the northernmost distribution of barcoo grunter (*Scortum cf barcoo*) and leathery grunter(*Scortum cf hillii*). Northern purple spotted gudgeons (*Mogurnda mogurnda*) were not collected. One species of fork tailed catfish (*Arius midgleyi*) was sampled.

5. Threadfin rainbows (*Iriatherina werneri*) and swamp eels (*Ophisternon bengalense*) were not collected in the upstream reaches of Pretender Creek. Rendahl's catfish (*Porochilus rendahli*), threadfin rainbows and pennyfish (*Denariusa bandata*) all appear to have specific habitat requirements, and were only found in lagoons. Striped sleepy cod (*Oxyeleotris selheimi*) were most abundant in lagoons.

6. All popular freshwater food fish were present in the Holroyd. Most stations restrict access to the river and lagoons and fishing pressure is minimal.

7. Several fish species (hardyheads, *Craterocephalus stercusmuscarum;* Macleay's glassfish, *Ambassis macleayi*; sailfin glassfish, *Ambassis agrammus*; and bony bream *Nematalosa erebi*) juveniles were collected at several sites, suggesting that breeding had commenced before the storms.

8. Water quality was generally good. Slight algal blooms (greenish water colour) were observed in all the lagoons. River sites and oxbow lakes were slightly humic. Oxygen levels were low, but were normal considering the temperatures at the time.

9. Habitat disturbance observed was minimal. Some pig digging was observed at lagoons, but was not extensive.

10. Freshwater crocodiles (*Crocodylus johnstoni*) were abundant in all river sites and some lagoons, and had bred in November. No file snakes were caught.

### 18.1 Basin Characteristics

The Holroyd River rises in the Great Dividing Range just south of Coen and flows in an easterly course to the sea, where it shares an outlet with the Kendall River. The Holroyd is about 240 km long from the mouth to the headwaters. The main feeder stream, Pretender Creek, extends to the north about 80 km. Both Pretender Creek and the Holroyd River proper have lagoons associated with them. The Holroyd proper has extensive lagoon systems on the floodplain, particularly well developed downstream of Strathburn station. The entire Holroyd River is intermittent. Pretender Creek is perennial, but flow becomes hyporheic (subsand) at its junction with the Holroyd.

Much of the upper areas of the catchment are in tall eucalypt woodland, some of which is being logged for cane tramway sleepers. The flats on this country are sandy soils, and the ridges rocky or gravel. All the lower flats in the downstream reaches are sandy or clayey soils. The country is all floodplain and is very boggy for much of the year. Around the headwaters and Pretender Creek is tall eucalypt forest, but the floodplain areas are woodland, with some flat, savannah type country in the lower extremes.

Part of the lower Holroyd River area was proposed as a special reserve as it includes three vegetation types not included in other reserve proposals on Cape York Peninsula (Stanton, 1976). This area has a number of small swamps and lagoons. As sand dune country on the east coast at Cape Flattery and Silver Plains has many unusual species for these areas, it is possible that these dune complex areas of the Holroyd are similar, and warrant further investigation. At present, access to the area is limited.

The river bed was usually narrow, only 5-10m across. The pools remaining at the time of the trip covered the whole stream bed, but above and below pools there was evidence that stream channels were small (usually 2-3m across) when the river flows. Pretender Creek had minimal flow at the time visited, but there was about 1m of channel in a stream bed of paperbark forest (*Melaleuca* sp.).

There are vast floodplain areas extending all along the river west of Strathburn Station. These areas have numerous swamps, oxbow lakes and lagoons. Vegetation varies according to elevation; higher areas being woodland and lower areas subject to waterlogging are paperbark savannah country. Gallery forest lines the main watercourse and tributaries, but is mainly restricted to the banks and seldom extends out into the floodplain. See vegetation mapping NR01 for details.

### 18.2 Previous Studies

Midgley (1988) surveyed sites on the upper Pretender Creek (Horseshoe Lagoon), the Holroyd River near Barramundi Swamp in Strathburn, and a small lagoon near the river site. Midgley collected about 25 species. (see Appendix One for merged species list). None of the sites surveyed by Midgley corresponded to our sites, but the sites near Barramundi swamp were about half way between Boomerang lagoon and Silver's Hole. These sites were in the centre of the large floodplain area west of Strathburn.

### 18.3 Sites Sampled

Eight sites were sampled on the Holroyd River, two river sites, four lagoon sites, one oxbow lake and an unclassifiable waterbody. These are presented in Table 13 and Figure 12.

At river sites, dense gallery forest overhung most of the stream bed but usually there was an opening over the middle portion of the river. Large paperbark and red beech (*Dillenia alata*) trees were part of the gallery forest in broader reaches of the river but paperbarks were absent from narrow, more densely forested sections.

The river sites all had a sandy substrate, but the downstream end of each hole studied was bedrock. Fallen timber along the banks was abundant, and the banks were generally steep undercut root beds of the gallery forest trees. The banks rose to about 3-5m above the river bed to the flood plain. Terracing was not obvious at the sites surveyed. Water in river sites was humic stained as a result of the large amounts of leaf litter contributed by the gallery forest.

Lagoons along the Holroyd were similar to those elsewhere in that they were vegetated around the margins. *Eriocaulon setaceum* was not observed in Holroyd River lagoons. Water milfoil (*Myriophyllum* sp.), although uncommon, was observed at several sites. Water snowflake (*Nymphoides* sp.) was the dominant water plant, but waterlilies (*Nymphaea* spp.) were present in most locations. Eelgrasses (*Vallisneria* and *Blyxa*) were present in most lagoons sampled, but beds were not as extensive as in lagoons in the Archer River. Bladderwort (*Utricularia*) was present in a few lagoons. Waternymph (*Najas tenuifolia*) was only found in one lagoon, but was the dominant macrophyte there. Paperbark trees were usually 5-10m from the waters edge at the times of sampling on Holroyd River lagoons. Usually they were the small, large leafed variety common on savannah flood plains. As in all other river systems, the lagoons had a mud substrate and few, if any, snags. Reeds (*Eleocharis* sp.) surrounded the margins of all lagoons.

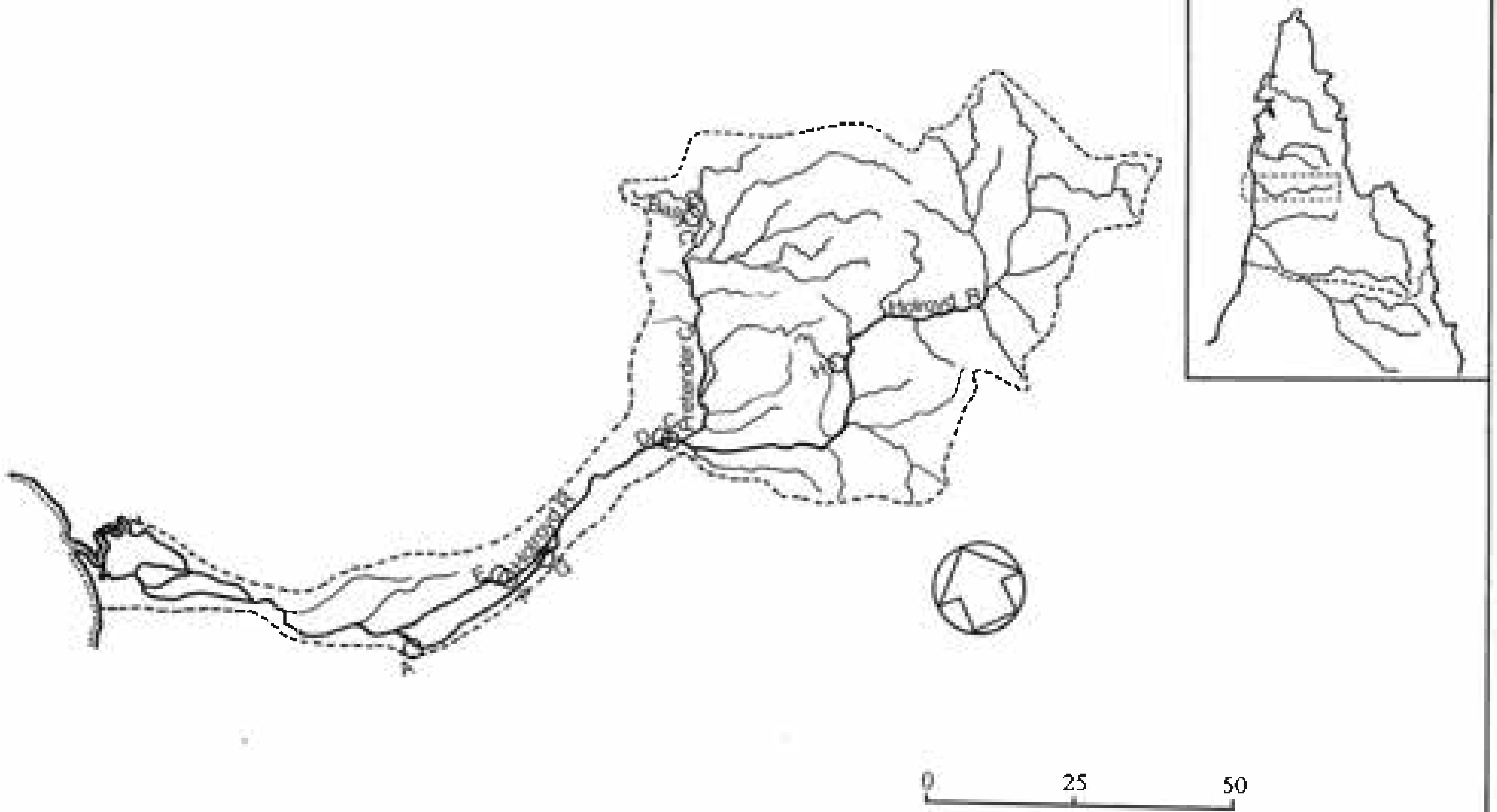


**Figure 12. Holroyd River - Drainage Division 9210**
Markers indicate sample sites (refer to Table 13 for date and site name)

Oxbow lakes were observed particularly between Southwell and Pretender Creek. They were distinguished from lagoons (sometimes called melon holes in this area) by their depth below the flood plain and the presence of gallery forest along the edges. The substrate was sand at the ends but mud in the middle. Gallery forest was sparser than that along the river banks. Bent Lagoon was an oxbow lake, and Toby's Lagoon was probably an old oxbow lake which had silted up and lost its fringing gallery forest. Oxbow lakes had some submerged aquatic vegetation (*Vallisneria, Blyxa*), and lilies in areas exposed to the sun. Fallen timber and snags were usually abundant. Paperbark trees along the edges were few. Only one oxbow lake site (Bent Lagoon) was surveyed.

Table Thirteen. Sites sampled - Holroyd River and lagoons. Drainage Basin 9210.

| Map. Ref | Site Code | Name | Date | Latitude. | Longitude. |
|---|---|---|---|---|---|
| A | 9210 01 01 | Toby's Lagoon | 02 Nov 1994 | 14°31.01'S | 142°2.09'E |
| B | 9210 02 01 | Bally Lagoon | 17 Nov 1994 | 14°7.69'S | 142°38.12'E |
| C | 9210 03 01 | Pretender Junction | 17 Nov 1994 | 14°21.73'S | 142°29.64'E |
| D | 9210 04 01 | Pretender Lagoon | 18 Nov 1994 | 14°21.60'S | 142°27.58'E |
| E | 9210 05 01 | Bent Lagoon | 19 Nov 1994 | 14°26.74'S | 142°14.92'E |
| F | 9210 06 01 | Little Barra Lagoon | 20 Nov 1994 | 14°26.48'S | 142°15.28'E |
| G | 9210 07 01 | Silver's Hole | 21 Nov 1994 | 14°26.01'S | 142°17'E |
| H | 9210 08 01 | Boomerang Lagoon | 22 Nov 1994 | 14°23.65'S | 142°47.34'E |

Boomerang Lagoon on Strathburn Station did not really fit into any of the categories described above. At least it could be described as an oxbow lake, but there was no fringing gallery forest. There appeared to be no gallery forest that far up the Holroyd. The substrate was mud and there was no aquatic vegetation. The banks were steep, unlike those of lagoons but sand substrate, characteristic of other river locations, was absent. Snags were few, a reflection of the paucity of riparian trees. Probably this lagoon is an old flood channel, which for some reason has no gallery forest and only small paperbark trees on the banks. The water in this site was turbid (probably from cattle disturbance) and it was quite shallow (3.4m maximum depth measured).

### 18.4 Fish Species Present

A total of 32 species were collected but locals reported freshwater sawfish and stingrays present in big holes downstream from the areas sampled. The Holroyd was the northern most location where leathery grunter / barcoo grunter (*Scortum* cf *barcoo*) (Plate 25) and leathery grunter (*Scortum* cf *hillii*) (Plate 26) were collected. Gary Cotter, a recreational fisherman, canoed on the Kendall River in 1992 and caught

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Plate 25. Barcoo grunter (*Scortum* cf *barcoo*) from the Holroyd River.

Plate 26. Leathery grunter (*Scortum* cf *hillii*). Note smaller scales and different body shape to Barcoo grunter.

hundreds of black bream (*Hephaestus fuliginosus*) but no leathery grunters (*Scortum* spp.) so it would be fairly safe to assume that either they aren't there or they were not interested in lures at the time.

The leathery grunter referred to here as barcoo grunter (*Scortum* cf *barcoo*) has been identified as *S. barcoo* but there were some differences in scale counts and other measurements. After cataloguing, the museum will forward specimens to the experts for their attention. Barcoo grunters have been collected from river basins south of the Mitchell previously, and so this record extends its continuous distribution from the Mitchell river to the Holroyd. There is a specimen of *S. barcoo* from Cockatoo Creek in the Ducie basin, apparently collected by Midgley in 1988 (Wager, 1993). However, Midgley (1988) did not record this in his report of that site. In the Holroyd, *Scortum* cf *barcoo* was collected from three sites, all of which were markedly different. Bally Lagoon was relatively clear water and well vegetated. Bent Lagoon was an oxbow lake with little aquatic vegetation, slightly humic though clear water, and abundant snags. Boomerang Lagoon was a turbid river flood channel with little cover and no aquatic vegetation. On the latter two locations barcoo grunter was caught near snags or netted in open waters. At Bally Lagoon they were netted in open water and electrofished from submerged vegetation.

Leathery grunter (*Scortum* cf *hillii*) was also collected on the Holroyd River. Allen (1989) states that records of this species from the Gulf of Carpentaria drainages are probably misidentified barcoo grunter. However, barcoo grunter and this one were caught at the same time, and they were definitely different. They are being sent to Dr J. Merrick for identification once they are catalogued in the Queensland Museum collection (J. Johnson, pers. comm.). The *Scortum* cf *hillii* are called that because the diagnostic characters of *S. hillii* do not exactly match those of the fish we have collected. The collection from the Holroyd River also marks the northernmost point of their distribution. Only a few specimens were collected from the Holroyd, from Toby's lagoon and Bally Lagoon. *Scortum* cf *hillii* was also collected from the Edward and Coleman Rivers, giving it two widely separated distributions: in the Fitzroy and Burdekin basins on the east coast of central Queensland, and in the Holroyd, Edward and Coleman basins draining into the Gulf of Carpentaria.

It is highly likely that both leathery grunter species do not extend north to the Kendall River, as none were caught in a fishing expedition to the Kendall in 1993 (Cotter, pers. comm., see Steptoe, 1994 a, b).

It was highly unusual that northern purple spotted gudgeon (*Mogurnda mogurnda*) were not collected from the Holroyd. Midgley did not collect them either. Allen (1989) describes the distribution of northern purple spotted gudgeon as continuous throughout the Gulf of Carpentaria. Wager (1993) also states that northern purple spotted gudgeons occur throughout the Gulf drainage division. However, records of specimens from the Gulf drainage division are only from the Archer, Wenlock and Jardine basins (Wager, 1993). No other records of specimens from rivers south to the Mitchell are available. We have collected northern purple spotted gudgeons from the Palmer River and the Coleman. It would be unusual if northern purple spotted gudgeons were not present in the Holroyd (and Edward), as they are ubiquitous all over the Peninsula, and appear to be primary colonising species. Northern purple spotted gudgeon are usually common in upstream locations in clear water, none of which were sampled in the Holroyd. However, they are not present at all locations, particularly lower in the river and so possibly were missed by us.

Of the four species of fork tailed catfish regularly found in Queensland freshwaters, only shovel-headed catfish (*Arius midgleyi*) has been reported from the Holroyd (Midgley, 1988). All species are believed to occur throughout the Gulf drainage division as some of them inhabit estuaries as well as freshwater (Wager, 1993). In common with many other sites, we did not collect triangular shield catfish (*Arius leptaspis*), which during the two years of this study was very uncommon at most locations sampled.

## 18.5 Distributions

### *18.5.1 Extent*

The uppermost site on the Holroyd sampled was Bally Lagoon. Bally Lagoon did not have threadfin rainbow fish *(Iriatherina werneri)* in it, which is unusual as the habitat (aquatic vegetation) was present and pennyfish *(Denariusa bandata)* which are usually co-existent with threadfin rainbows were present. Midgley (1988) did not collect threadfin rainbows at Horseshoe lagoon (near Bally Lagoon) so it is possible that they are either uncommon or not present this far upstream. They were collected at Pretender Lagoon.

Swamp eels (*Ophisternon bengalense*) were not collected at Bally Lagoon, either. This species has a very patchy distribution and possibly eels were not able to be collected on this occasion.

All other species sampled appeared to be well spread out over the sites sampled. On the Holroyd, with the exception of Bally Lagoon, all sites sampled were on the low floodplain area, and hence restrictions on upstream movement of species due to obstructions or distance were not observed. Locals informed us that barramundi were rarely caught in Pretender Creek above the junction, but apparently some are caught as far up as lagoons on Strathburn Station. Freshwater stingrays and river sawfish were only reported from the lower reaches of the Holroyd River.

*18.5.2 Habitat dependence*

Poreless gudgeons (*Oxyeleotris nullipora*) were found in only one location, Bent Lagoon, in leaf litter. This habitat was quite different to that usually associated with east coast poreless gudgeons, which inhabit humic (tea coloured) waters. Bent Lagoon was almost neutral in pH and no tannin was detected. The poreless gudgeons in the Holroyd were caught from leaf litter, which is different to usual. Normally they are caught in aquatic vegetation, which was also present in this location.

Sleepy cod (*Oxyeleotris lineolatus*) and striped sleepy cod (*O. selheimi*) were both caught from all habitat types, except striped sleepy cod were not collected from river hole habitats. They were collected in the oxbow lake (Bent Lagoon) which is similar in many respects to river hole habitats. Sleepy cod were present in all habitats in which striped sleepy cod were found and they both appeared to use the same cover and habitat.

Threadfin rainbows and pennyfish were only found in lagoon sites. All were found only in heavily vegetated lagoon habitats, as elsewhere. However, pennyfish were only present in two of the four heavily vegetated lagoons, and threadfin rainbows in three. Although they are dependent on aquatic macrophyte habitat, presence of this habitat does not guarantee their presence, at least in numbers enough to be sampled. Threadfin rainbows were seen on several occasions, after all the fishing methods had been used, and sometimes they had to be sighted and then the fine seine employed to catch them in a particular area. It may be possible that there are factors involved with microhabitat that determine their distribution. In the Holroyd River they appeared to be aggregated particularly above the eelgrass (*Vallisneria*) beds and near reeds (*Eleocharis*).

Rendahl's tandan (*Porochilus rendahli*) was only collected from one location, in Pretender Lagoon. As mentioned earlier (Endeavour River Chapter), Rendahl's tandan is only found in lagoon habitats in the Cape York Peninsula locations sampled by us.

Rendahl's tandan has been collected from few locations in the Gulf of Carpentaria and this collection extends the known distribution southwards from the Archer River.

The leathery grunters (*Scortum* spp.) collected did not appear to have any specific habitat preferences, and were collected from widely separated sites. There were no apparent ties to any particular environments.

Swamp eels (*O. bengalense*) were common in all three lagoon sites sampled on the Holroyd and the oxbow lake. This reflects their apparent dependence on mud substrates as habitat.

### 18.6 Species of Commercial and Recreational Importance

At present fishing on properties adjoining the Holroyd is restricted or not encouraged. Fishing pressure on most lagoons and waterholes is limited to subsistence fishing by locals and restricted tourist involvement. Black bream, leathery grunter, saratoga, barramundi, sleepy cod and eel tailed catfish are popular food and sports fish. Oxeye herring *(Megalops cyprinoides)* and fork tailed catfish are also good sport fish, although some people do not like the quality of the flesh.

Commercial and illegal net fishermen do use downstream areas close to the estuary and may set up base camps near the fresh water. It is not known how extensive or permanent these operations are.

The presence of several species of ornamental fish is of interest. Holroyd river threadfin rainbows have a delicate colouration pattern similar to other west coast populations. Pennyfish and yellow finned tandans (*Neosilurus hyrtlii*) are also potential aquarium subjects.

### 18.7 Breeding Observations

Very large numbers of juvenile fly-specked hardyheads (*Craterocephalus stercusmuscarum*), were caught in lagoon locations where the fine seine was used. Large schools of juvenile Macleay's glassfish *(Ambassis macleayi)* and sailfin glassfish *(Ambassis agrammus)* were aggregated about submerged root masses or branches in the water. Juvenile bony bream *(Nematalosa erebi)* were collected at Toby's lagoon and Little Barra lagoon. All these fish were collected in November shortly after the commencement of the storms. The bony bream in particular were large enough to have been spawned over a month previously, before storms began.

In addition, black bream *(H. fuliginosus)* males and females were ready to spawn, as males were running ripe and the females had fully developed ovaries.

### 18.8 Water Quality

Water quality at all sites were generally quite good, pH was generally neutral or slightly acid, water was soft (low alkalinity and total hardness), and moderate turbidity (See Appendix Four). The cause of the turbidity in different waterbodies varied. In Bally Lagoon, Toby's lagoon, Little Barra Lagoon and Pretender Lagoon the water was a greenish colour from algae. Silvers' Hole, Pretender Hole and Bent Lagoon had slightly humic stained water, although this was not reflected in the tannin readings, which were not higher at these sites than others. Boomerang Lagoon was turbid due to suspended solids, clay and mud particles.

Oxygen levels were low at most sites, which may have been partly due to high temperatures and the oxygen meter reading low. When calibrated at the end of the trip it was found to be reading 5.32 mg/l lower than it should have. The results, where adjusted to account for this by adding 5 to the readings obtained. The results in Appendix Four are much closer to the normal conditions one would expect at that time of the year.

A general trend of slightly less pH in deeper water was noted at all sites except Bally Lagoon.

### 18.9 Habitat Disturbance

The Holroyd catchment is largely used for low intensity cattle grazing. However, the upper catchment areas around Pretender Creek are logged for tramway sleepers. The impact of this on the creek is uncertain as logging is only carried out during the dry season. Road construction and associated wet season erosion was not observed on the same scale as seen elsewhere. Farm tracks at some crossings were foci of localised washouts.

Feral pigs were managed by some property owners, as they were harvested and sold to the Edward River Crocodile Farm. Consequently, only boars were shot and sows left for breeding. Feral pig digging around all lagoon sites was observed but was moderate. Horses were also observed and minor damage to aquatic vegetation beds was seen but this, too, was limited.

### 18.10 Notes on Other Fauna

Freshwater crocodiles were abundant at all river sites, Bent Lagoon and Boomerang Lagoon. Freshwater crocodile eggshells were observed near Silver's Hole in late November. Estuarine crocodiles had never been observed upstream of Pretender junction. File snakes were not caught. Aquatic bird life (Jabiru storks, brolgas, egrets) was abundant.

## 19. CATCHMENT 9201 - EDWARD RIVER

**Summary**

1. The Edward River lies almost completely in flat savannah country. Although closely associated with the Coleman, the two rivers are completely separate and do not join in floods.

2. H. Midgley and B. Hansen both collected on the Edward River in 1985, in different locations. Reports of a 'mystery fish' from the area require further investigation. The presence of delicate blue-eyes (*Pseudomugil tenellus*) and small mouthed catfish (*Cinetodus froggatti*) is of special interest. Neither were collected by us.

3. Five sites were sampled, two lagoons, two river sites and one flood channel site. These were all in the lower Edward, on Strathgordon Station.

4. Twenty nine species of fish were collected in the Edward River. Silver tandans (*Neosilurus = Porochilus argenteus*) were collected from one location, which is far outside of their previous known distribution. The Edward appears to be the southern limit in the distribution of threadfin rainbows (*Iriatherina werneri*), sailfin perchlets (*Ambassis agrammus*) and poreless gudgeons (*Oxyeleotris nullipora*).

5. Silver tandans were only collected from a turbid lagoon, and possibly favour this environment. The short period of flow of the Edward probably restricts penetration by catadromous species. Fork tailed catfish (*Arius* spp.) were uncommon on our visits.

6. All favoured recreational fish species were collected from the Edward River, but none were particularly abundant. Overfishing of catadromous species is a potential management concern due to short periods of river flows. Present fishing effort is negligible.

7. Black bream (*Hephaestus fuliginosus*) males and females were running ripe in November. All small fish species (rainbows, ambassids, pennyfish, hardyheads and threadfin rainbows) were breeding at the time of sampling.

8. Water quality was good considering the time of the year and heat. Stratification of lagoons by day was evident. Water was soft and slightly acid. Surface water temperatures were high, up to 39.3°C.

9. Habitat disturbance was low although turbidity at some lagoons, probably increased by pigs and cattle activity, was observed.

10. Freshwater crocodiles (*Crocodylus johnstoni*) were abundant. Freshwater crayfish (*Cherax quadricarinatus*) and freshwater prawns (*Macrobrachium rosenbergii*) were abundant in the most turbid lagoon and common elsewhere.

**19.1 Basin Characteristics**

The Edward River drains a large area (2550 square kilometres) almost completely in the flat Gulf savannah country on the south-western side of Cape York Peninsula. The entire length of the river (about 200 km) is intermittent, and there are holes and lagoons (melon holes) scattered throughout the system. The river itself is a braided channel for most of its length, and consists of long sandy stretches interspersed with rock bars. Most of the upper reaches of the Edward are sandy with little or no rock, but as one progresses downstream the rocky areas and outcrops become more numerous and large sections of river are completely surrounded by rock outcrops and the substrate is bedrock. The surrounding country is savannah woodland and savannah flats. The river itself is about 2-5m below the level of the floodplain. Terracing is not obvious although levee banks are present in some areas. Gallery forest is poorly developed in many sections probably due to the very shallow, sandy soils adjacent to the stream bed. Much of the floodplain is clay like soils which do not feed the river at all, hence it flows for only a short period each year.

The lower part of the Edward River floodplain is a huge area of marine plains with three vegetation complexes not covered in other reserve proposals on the Peninsula (Stanton, 1976). The series of vegetation complexes run parallel to the coast. Inland from the coastal plains is a pattern of broad low ridges and depressions extending over a vast area. Paperbark, *(Melaleuca viridiflora)* dominates the depression areas, and the low ridges support eucalypt (*Eucalyptus tetradonta* and *E. nesophilia*) woodland. At the peak of the wet season perhaps half of the lower floodplain would be submerged (Stanton, 1976).

There is a huge floodplain and numerous anabranches and channels between the lower Edward River and the Coleman. An overflow channel (Brancho Creek) from the Coleman runs northward through low lying country towards the Edward River. However, there is no connection between the two rivers even during times of flood. The Overflow Channel linking the Edward and Coleman Rivers on the 1:100 000 Strathgordon mapsheet is actually the Edward River. Brancho Creek, which is shown on this map to originate from the Edward River, actually flows into the Coleman and has no connection with the Edward River. Brancho Creek only runs due to local rain and not a feeder effect from the Edward. Locals at Strathgordon Station told us that at no time in living memory had there even been a flow from the Edward through to the Coleman, or vice versa. There are differences in the fish faunas of the two systems which appear to confirm that there are no connections between them. All the maps, however, and the vast low lying depressions between the two rivers, would suggest otherwise. Riverside vegetation consists of paperbarks *(Melaleuca* sp.*)* which are usually sparse. There is no aquatic vegetation in river habitats. In rocky areas, there may be very little vegetation near the river. In the lower reaches, woodland extends down to the banks of the river.

Lagoons visited on the Edward River were usually small, and are commonly referred to as 'melon holes', due to their small size and shallow depth (usually less than 2 m depth). These melon holes may be either vegetated or not. Cattle and pig activity may have an effect on this but sometimes adjacent holes are different in that one will be extremely turbid and another vegetated. Most melon holes had a narrow band of paperbark trees of several species around the upper margins where the water level would be just after the wet season. Water levels recede over the dry season and no melon holes were shaded between 10.00 am and 4.00 pm during our visits.

Most of the surrounding area is grazed by cattle. Feral horses are moderately common but are managed to a degree by landholders. Feral pigs are also managed by landowners down to Edward River (Pormpuraaw) crocodile farm. Only boars are shot and sows and piglets allowed to live. Most stations along the river restrict or control access.

**19.2 Previous Studies**

In 1985 Bruce Hansen visited the Edward River to collect threadfin rainbows *(Iriatherina werneri)* which were known to be in the area. A species list compiled from Hansen's visit is in Appendix One. Of special interest was the collection of the delicate blue-eye *(Pseudomugil tenellus)* from the river, which, at the time, had not been documented from Queensland before.

Midgley (1985) also collected in the Edward River basin, at the old Strathgordon lagoon. The species collected there are also presented in Appendix One.

Specimens of delicate blue eyes from Thomson's lagoon on the catchment, collected in 1973, are also in the museum collection (Wager, 1993). To our knowledge, no other collections have been documented.

From discussions with Gordon Stables, a native fish collector, the Edward River area still holds some surprises. Mr Stables reported catching small mouthed catfish *(Cinetodus froggatti)* in the Edward River. He also reported collecting an unusual striped fish which he could not identify. This would probably be an undescribed species as Mr Stables is a very experienced fish collector. Unfortunately the one specimen collected was discarded by a colleague who did not understand its possible significance. This occurred some years ago and the description of the fish is rather vague but it requires further following up to ascertain the identity, distributions and abundance of this fish.

### 19.3 Sites Sampled

Only five sites were sampled on the Edward River - two lagoons, two river sites, and one site between the overflow and the river on the floodplain which doesn't readily fit any category. Reports of an unusual fish in the Coleman, and the belief that the Coleman and Edward Rivers joined together during flooding, made us curtail extra sampling on the Edward in favour of sites on the Coleman from which unusual fish had been reported. See Table 14 for a list of sites sampled.

Table Fourteen. Sites sampled - Edward River and lagoons.. Drainage Basin 9201

| Map Ref | Site Code | Name | Date | Latitude | Longitude |
|---|---|---|---|---|---|
| A | 9201 01 01 | Dark Hole | 27 Oct 1993 | 14°45.68'S | 142°20.02'E |
| A | 9201 01 02 | Dark Hole | 31 May 1994 | 14°45.68'S | 142°20.02'E |
| B | 9201 02 01 | Delaney's Hole | 30 Oct 1993 | 14°40.98'S | 142°16.34'E |
| C | 9201 03 01 | Melon Yard Lagoon | 30 Oct 1993 | 14°41.57'S | 142°18.49'E |
| D | 9201 04 01 | 5 Mile Hole | 31 Oct 1993 | 14°38.07'S | 142°5.98'E |
| E | 9201 05 01 | Lagoon near 5 Mile Hole | 1 Nov 1993 | 14°38.07'S | 142°7.57'E |

Dark Hole is a small hole in one of the Edward River channels to the north of Strathgordon homestead. This hole was very shallow (maximum depth 1.1 m) and only about 100 m long in November 1993. There was limited vegetation around the edges, probably due to the receding water levels. There was no aquatic vegetation observed at the site in 1993, but there were abundant dried *Eriocaulon* flowers on the upper banks. When visited in June 1994, the hole was about twice as large, and there was abundant aquatic vegetation (water lilies, *Nymphaea violacea*; water snowflake, *Nymphoides* sp.; water nymph, *Najas tenuifolia*; bladderwort, *Utricularia* sp.; eelgrass, *Blyxa* sp.; and couch grass) The water was extremely turbid in 1993, the secchi disc reading being only 0.01 m. However, in 1994 the water was clearer, with a secchi of 0.27m. The substrate was mud and clay, overlaying sand in parts. There were a few rocky outcrops in the hole. There were very few snags. There were several freshwater mangrove *(Barringtonia racemosa)* trees on exposed banks and paperbarks *(Melaleuca)* and tea trees *(Leptospermum)* on the high bank. It appeared that in this part of the river there was no gallery forest. The river bed was only about

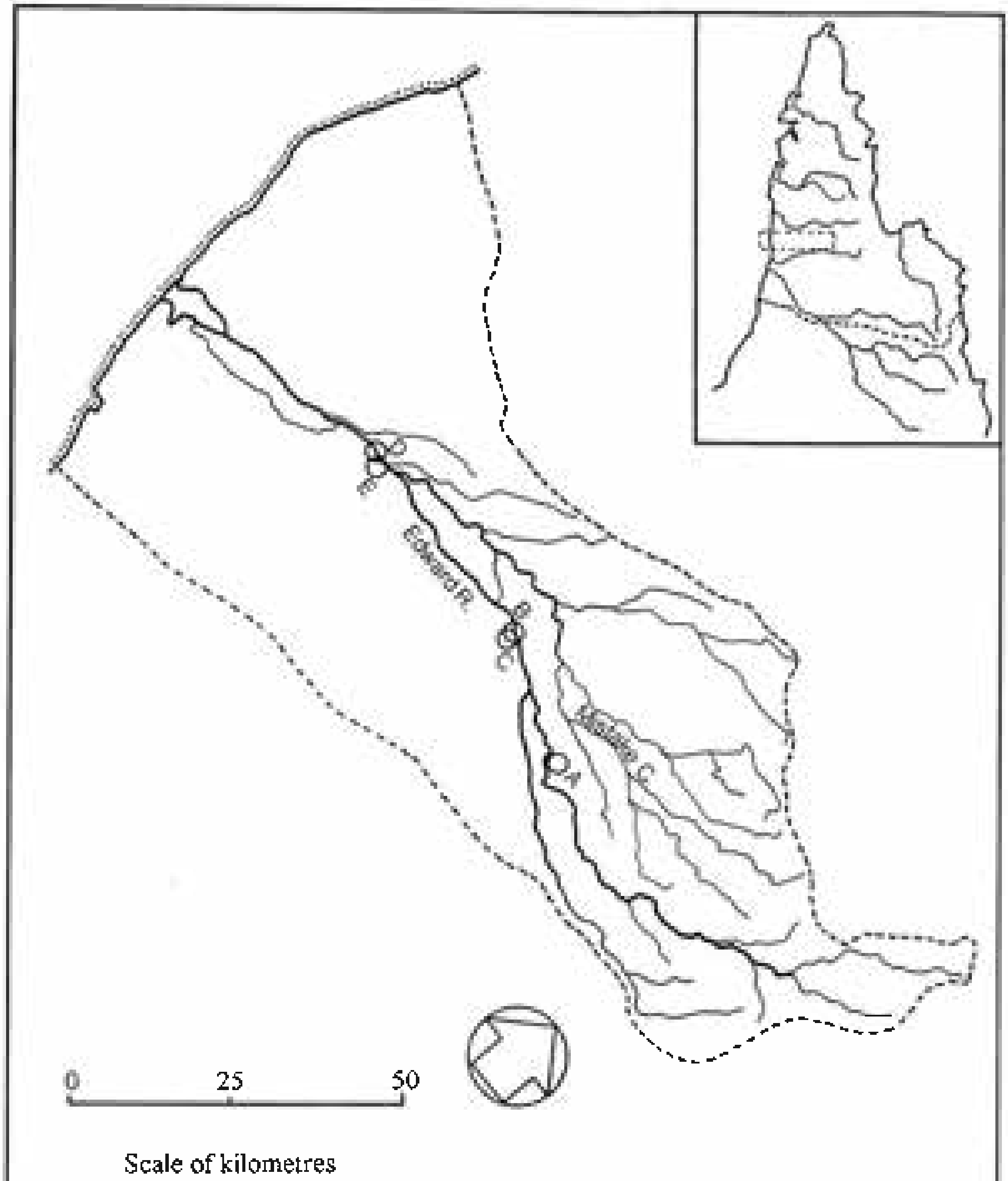


**Figure 13. Edward River - Drainage Division 9201**
Markers indicate sample sites (refer to Table 14 for date and site name).

2-3 m below the level of the floodplain, which was open woodland. Cattle used Dark Hole as a watering place, and some pig digging around the margin was evident.

Delaney's Hole and Melon Yard lagoon were about 15 km downstream from Dark Hole, near where the Edward River channels and the overflow channels run close to each other and meet. Delaney's Hole is a long, deep (3.8 m) river channel hole with numerous snags and branches. Overhanging vegetation (mostly paperbark trees) shades most of the southern side of the hole. No aquatic vegetation is present, although some overhanging paperbark trees have aerial roots in the water. Banks are steep in most places, about 2 m vertical or near vertical slopes at most points on both sides. Paperbark trees *(Melaleuca)*, red beech trees *(Dillenia alata)*, *Eucalyptus* trees and the tea trees *(Leptospermum)* were predominant along the banks, forming a moderately dense forest.

Melon Yard lagoon is a small (100 m long) 'melon hole' lagoon close to Delaney's Hole. It is relatively deep in the middle (3.6 m) and has gentle sloping sides well vegetated with water snowflake, bladderwort, eelgrass *(Vallisneria)* and small reeds *(Eleocharis)*. Small beds of waternymph were scattered around the margins. Individual plants of *Blyxa* (eelgrass), water milfoil *(Myriophyllum)* and eriocaulon (*Eriocaulon setaceum*) were distributed around the edges. Vegetation was thick and dense from about 4 m off the shore. Waternymph was only in water to 1.5 m deep. In the middle of the lagoon bladderwort grew to about 1.5 m below the surface. No snags were present. The lagoon was used by cattle for drinking and the reeds had been grazed. Some horses were present but eelgrass had only been slightly disturbed. The lagoon was slightly turbid. The substrate here was completely mud. There was no fringing vegetation at all. The lagoon was surrounded by sparse woodland with good cover of grasses.

Five Mile Hole was downstream of a large exposed rock area and had many rock bars and ledges along the edges and across it. The substrate was largely fine mud (silt), although beneath this was usually rock. Some small sand banks were present at the upper end of the hole. No aquatic vegetation was present. Snags and branches were numerous along the edges, and large pitted rocks present at the eastern end of the hole. Tall eucalypt woodland extended along the banks and there were some paperbark and red beech trees. Large paperbark and tea trees overhung the hole in places. These trees grew out of the actual banks of the river. The banks were steep and quite high (3-4 m). In places there was terracing but this was irregularly developed due to the rocky nature of the area. The hole itself was quite long (over 1 km long) and shallow (2.1 m). No aquatic vegetation was present.

Five Mile Hole lagoon was a small lagoon about 1 km south east of Five Mile Hole. This small lagoon was surrounded by a dense paperbark forest on two sides and had a fringing ring of small paperbarks around the margins where the high water level would normally be. A few freshwater mangroves were also present on the margins. The hole was irregularly visited by cattle. Waternymph was the most abundant aquatic plant, and with bladderwort filled about 90% of the lagoon. In all areas aquatic plants grew up to the surface. There was little water milfoil *(Myriophyllum)*, water lilies *(Nymphaea spp.)* and water snowflake present. The maximum depth was 2.4 m. This lagoon was very heavily vegetated and possibly at night would become deoxygenated. The shallow margins were not as well vegetated due to cattle and pig activity.

### 19.4 Fish Species Present

Thirty species of freshwater fish were collected from the five sites described above. This compares favourably with the 21 species collected or observed by Hansen (1987), two of which were not collected by us. We did not collect any delicate blue eyes (*Pseudomugil tenellus)* but they have been collected by the Museum previously. This collection was recognised as an extension of the distribution and prompted Wager (1993) to speculate that delicate blue eyes could be more widely distributed throughout the Gulf than previously thought. Our results do not support this and we believe that this fish has a number of disjunct distributions.

The other record of Hansen, snakehead gudgeon (*Ophieleotris sp.),* is doubtful. This species is usually caught close to the sea and no voucher specimens were collected. It has been recorded from as far south as the Embley estuary (Blaber et al, 1989), and because of its presumed marine life cycle there is no reason not for it to be found this far south. However, all other collectors have missed it. Snakehead gudgeons are extremely sensitive to electrofishing, and we are quite sure that if they were present at the time of sampling we would have caught them.

Of special interest was the collection of the silver tandan (*Neosilurus argenteus*), for the first time from a Gulf of Carpentaria stream. They have only been collected from inland drainages in the Northern Territory (Larson and Martin, 1990) and Queensland (Wager 1993). They were abundant at Dark Hole, in an extremely turbid pool. None were collected from any other locations.

The Coleman, Holroyd and Edward Rivers all have barcoo grunter *(Scortum cf barcoo)* and leathery grunter *(Scortum cf hillii)*, which are more inland species (cf means that the fish were close to but not identical to that species). Leathery grunter have only been recorded from the Burdekin and Fitzroy areas before. It is interesting that two species from areas with no connection to the Edward River should turn up here, and puts the area in a distinct biological bracket separate from the more northerly Gulf Rivers. The absence of coal grunter/golden bream *(Hephaestus carbo)* from these rivers further separates them from the more southerly Mitchell and the Archer to the north. If small mouthed catfish are also present in the area, this is another aberrant record for the area which sets it apart.

It appears that the Edward River is the southern limit on the west coast of poreless gudgeon *(Oxyeleotris nullipora)*, sailfin glassfish/perchlets (*Ambassis agrammus*) and threadfin rainbows *(Iriatherina werneri)*. These species have not been collected from the Coleman River in this study or previously. The preferred habitat certainly exists there, as pennyfish *(Denariusa bandata)* are abundant in the Coleman. It would appear that the Edward River, and the Holroyd and Coleman, represent a zoogeographic area of change, where some species have their northernmost distributions and others their southernmost.

The apparent absence of northern trout gudgeon *(Mogurnda mogurnda)* may be a reflection of sampling sites. Although this species has not been collected in the Edward or Holroyd Rivers previously, it could be that it is more common in the upstream reaches of these rivers, and so uncommon in the downstream sites sampled that we miss it. This species is found in virtually all locations on the peninsula and its apparent absence from the Edward River is surprising.

Banded rainbow fish, *Melanotaenia trifasciata* were not collected by us on the Edward River. As discussed elsewhere, they appear to be on upstream fish preferring moving water. It is doubtful whether such sites exist on the Edward permanently, and it is possible that banded rainbow fish are absent from this system.

Small mouthed catfish are not well documented in Australia, only being reported from the Roper River in the Northern Territory. Very few specimens have been collected. There is no reason for them not to be found in Queensland. Another species previously poorly known, freshwater anchovy, has been recently found to be quite widely distributed (Herbert *et al.* in press). The `mystery fish' described by Mr Stables is possibly the giant perchlet, *Parambassis gulliveri*. A similar, striped fish was reported from the Coleman River by John Price of Strathgordon. The giant perchlet is present in rivers to the south (Flinders, Leichhardt) and it is conceivable that it could be found in the Edward River.

## 19.5 Distributions

### *19.5.1 Extent*

Silver tandan *(N. argenteus)* was present in one location, Dark Hole. Unfortunately, not enough locations were sampled to be sure if this species was restricted to certain parts of the river or not. It was not collected on a subsequent visit in June 1994. It would be worth following up with more extensive surveys to determine the distribution of this fish.

Barcoo grunter were caught in three locations sampled, both upstream and downstream. No particular habitat preferences or abundances were observed. There appeared to be two size classes, young of the year (around 70-90 mm SL) and adults (140-190 mm SL). Only one adult, leathery grunter was caught in Melon Yard Hole.

Little else can be said about distributions as so few sites were sampled. Tarpon/oxeye herring *(Megalops cyprinoides)* and barramundi *(Lates calcarifer)* were not caught at Dark Hole but were caught at other sites. The barramundi caught at 5 Mile Hole were young of the year (250-290 mm SL). Possibly barramundi are not as strong upstream movers as tarpon, as tarpon were caught above 5 Mile Hole but barramundi weren't. As the Edward flows for such a short period possibly this restricts upstream movement of catadromous (sea spawning) fish. Further sampling would be necessary to determine if this is the case.

Fork tailed catfish (*Arius midgleyi* and *Arius graeffei*) were relatively uncommon in the Edward, only being collected at two locations. This is most unusual as normally they are caught in hundreds. They are very easily caught in nets due to their pelagic (open water) swimming habits and the spines which tangle easily. Fork tailed catfish, if present, were abundant in all other rivers sampled. They were only collected from the two most upstream sites, Dark Hole and Delaney's Hole.

*19.5.2 Habitat dependence*

Although silver tandans *(Neosilurus argenteus)* were only present in Dark Hole, it is interesting to note that this habitat is similar to that of most of the inland rivers where silver tandans have been found previously. Possibly they have a requirement for, or at least favour, turbid waters. Again, further work would be needed to clarify whether silver tandans are restricted to Dark Hole and similar (turbid) habitats, or if it was just by chance that they were caught at Dark Hole. They were not collected in June 1994 when Dark Hole was well vegetated and clearer, suggesting that they may breed over the dry season.

As in other western flowing rivers threadfin rainbows, pennyfish and poreless gudgeons were only found in lagoons with abundant vegetation. None of the sites sampled on the Edward were humic (tea coloured).

Possibly it was a function of the small number of sites collected, but it in the two "normal lagoons" sampled only striped sleepy cod (*Oxyeleotris selheimi*) were caught. Sleepy cod (*Oxyeleotris lineolatus*) were caught in the river sites. Both species were caught at Dark Hole. It is unusual that there was an apparent division between the river and lagoon habitats as in the other western rivers both species were found in all habitats.

### 19.6 Species of Commercial and Recreational Importance

The Edward River was not noted for its numbers of prime recreational fish species but all the favoured species (barramundi, saratoga, black bream, fork tailed catfish, eel tailed catfish) were present, although not caught in all sites. Only barramundi from the years' spawning were caught at 5 Mile Hole, but larger ones had been caught earlier in the year. Large numbers of black bream were not captured, probably because temperatures were too high for optimal electrofishing. The Edward River was described as an angler's paradise by Hansen (1987). The fish described by Hansen as similar to *Bidyanus* sp was probably *Scortum cf hillii*, some of which don't have spots, particularly when small. Although the Edward is definitely rewarding for sports fishermen (catch and release) or those who only take what they can eat, it could be vulnerable to overfishing because of the short period of flow and the limited number of easily accessed lagoons and water holes. If large numbers of people were to use the area numbers of fish highly vulnerable to overfishing (saratoga in particular) could be severely depleted. At present station managers and aboriginal councils try to restrict numbers of visitors or direct them to specific areas, but there are always those who go where they please.

Ornamental fish, as noted by Hansen (1987), were abundant in the well vegetated melon holes. Threadfin rainbow fish, pennyfish, poreless gudgeons and chequered rainbow fish were all abundant in vegetated lagoons. The threadfin rainbows were beautifully coloured. Hansen noted that specimens maintained in aquaria lost their colours and appeared to be the same as those from elsewhere. He believed that colouration in the wild was due to food, and water conditions affect colour. We have observed that the environment the fish comes from influences colour greatly. Nevertheless, the Edward does represent a source of genetic variation for fish breeders to use.

### 19.7 Breeding Observations

Black bream females and males were observed to be ready for breeding, with males 'running ripe' and females gravid. However, as they need flowing water to spawn, they would need to wait for the floods before breeding. Black bream could not breed in lagoons as the eggs would be smothered in mud. They need gravel or rocky bottoms and flowing water to breed successfully.

Small fish (especially threadfin rainbows, perchlets, rainbow fish, pennyfish and hardyheads, (*Craterocephalus stercusmuscarum*) appeared to be breeding at the time of the study, as evidenced by large numbers of juveniles, and adults in breeding colours.

**19.8 Water Quality**

Water quality was quite good considering the time of year and the conditions. See Appendix Four. All sites had moderate amounts of oxygen, particularly at the surface. On hot, still days stratification (layering of the water in hot and cold layers) was observed and lower layers were often deoxygenated. In 5 Mile Lagoon oxygen at 2 m depth was only 0.16 mg/l, as opposed to 2.86 at the surface. At night (10 pm) all the water was the same temperature.

Total hardness recorded by us was very low, only 2.1 to 8.3 mg/l as Ca $CO_3$. This is in contrast to Hansen's results of 70 ppm. We recorded generally lower pH, which would be in part attributable to the lower buffering capacity of the water. pH in lagoons was higher, due to the presence of plants. Phosphate and tannin levels were low.

One small melon hole near Melon Hole Yard was briefly examined to check for an unusual fish seen there (these turned out to be threadfin rainbows). The temperature of the water was high and yet the fish were active, but generally at low depths. The surface temperature and oxygen was 39.3°C and 6.03 mg/l, respectively. At 40 cm depth (the maximum in the pool), temperature was 32.3°C and oxygen 1.12 mg/.l. That fish could survive and be active in this environment is surprising. This layering of water breaks down at night. The reason for the comparatively high oxygen levels was that aquatic vegetation was abundant (particularly water nymph) and oxygenated the water during the day. At night, when the surface temperature drops and plants use up oxygen, fish would need to be near the surface to get oxygen.

Water conditions in general reflected a little disturbed system. However, low hardness and alkalinity levels could mean that wild fluctuations in pH could occur, particularly during the wet season.

## 19.9 Habitat Disturbance

Habitat disturbance was low at all sites sampled, although undoubtedly turbidity at Dark Hole was compounded by the presence of cattle around it. There had been little pig digging there around the margins. Both river sites were virtually untouched by pigs, but this could have been due to topography and due to recent rains which would have dispersed pigs. Pigs were noted at wallows near other lagoons, which were often turbid. Little camping or other activities occur in the Edward River. Cattle are stocked at low rates, and erosion was only observed near 5 Mile Hole.

## 19.10 Notes on Other Fauna

Freshwater crocodiles, *Crocodylus johnstoni*, were abundant at Delaney's Hole and 5 Mile Hole. One was reported present at Dark Hole but was not observed by us. Bird life (Jabiru, egrets, herons etc.) was plentiful. Pigs were often seen but were not abundant. Horses were not commonly seen. Crocodiles appeared to replace file snakes as predators of netted fish, although a few file snakes were caught.

Freshwater crayfish *(Cherax quadricarinatus)* and freshwater prawns *(Macrobrachium rosenbergii)* were abundant at Dark Hole but uncommon at other sites. The turbid water at Dark Hole may have assisted in promoting growth of the animals, as they feed when light levels are low, and it is always dark at the bottom of turbid waters.

## 20.0 CATCHMENT 9200 - COLEMAN RIVER AND LAGOONS

**Summary**

1. The Coleman River has a large catchment area and rises in the Bamboo Range in the east and runs through flat gulf savannah country for most of its length.
2. Midgley (1988) collected eleven species from Drover's lagoon.
3. Nine sites on the Coleman were sampled, 5 lagoons and four river holes. Some lagoon sites were extremely turbid.
4. Twenty seven species were recorded, one of which was essentially marine. Gilbert's grunter (*Pingalla gilberti*), silver tandan (*Neosilurus argenteus*), and northern purple spotted gudgeon (*Mogurnda mogurnda*), not previously collected, were sampled. Striped sleepy cod (*Oxyeleotris selheimi*) were most abundant in lagoons and rare in the river channel. Lagoons which were turbid had fewer species of fish than clear ones.
5. The Coleman appears to be the northern limit in the distribution of Gilbert's grunter.
6. Recreational fishing is limited due to restrictions on access. However, locals do fish and all the favoured species are present.
7. Black bream (*Hephaestus fuliginosus*) sampled were running ripe. Most large fish species sampled appeared to be in distinct size classes, suggesting a limited breeding season.
8. Water quality was quite good although some lagoons were turbid and had tannin content. Oxygen levels were reasonable considering the high water temperatures.
9. Moderate cattle and pig disturbance was noted.
10. Freshwater crocodiles (*Crocodylus johnstoni*) were abundant. Freshwater crayfish (*Cherax quadricarinatus*) and freshwater prawns (*Macrobrachium rosenbergii*) were common.

### 20.1 Basin Characteristics

The Coleman River is 257 km in length and its major tributaries are the King and Lukin Rivers. The Coleman River has a catchment area of 5285 square kilometres, fan shaped at the origin in the Bamboo ranges then running narrowly through flat country to the Gulf of Carpentaria. For details of vegetation and soils data of the area please refer to NR01 and NR02 reports respectively.

During periods of high flow the Coleman travels through a number of anabranches and floods over the adjoining flat flood plains. From local information Coleman and Edward River waters do not connect during floods. Over the dry season the river ceases to flow and is reduced to a few pools along the stream bed and a series of associated lagoons and swamps. Stream channel morphology varies from high steep banks of hard clay or rock to low gently sloping sandy areas. Lagoons, even within close proximity of each other, exhibited a wide variety of physical characteristics. Some are well vegetated, clear and deep with others being devoid of vegetation, very turbid and shallow. Many lagoons had been scoured out down to a bedrock base.

Much of the area consisted of low open forest with areas of cleared grassland used for cattle grazing. Patches of gallery forest were present on the stream banks where the gradient was not too steep.

### 20.2 Previous Studies

Midgley (1988) sampled the same Drovers Lagoon site as us and collected 11 species of freshwater fish. See Appendix One for Midgley's species list.

### 20.3 Sites Sampled

Sites sampled on the Coleman River and associated lagoons are listed in Table Fifteen. Four lagoon sites were selected in the upper half of the river as no water in the river channel could be found. Five isolated pools in the lower reaches were also sampled.

Our first site on the Coleman, located immediately upstream of the Musgrave Road Crossing, is a small, shallow (1.3m) lagoon ten metres in diameter 25 metres from the main stream channel. This is our highest Coleman site approximately 233 km from the river mouth. Receding water level had exposed boulders and a solitary log snag. Substrate comprised of gravel, sand and mud with a few water snowflakes (*Nymphoides* sp.) and water lilies (*Nymphaea* sp.) growing in it. The lagoon was surrounded by small scattered trees and grasses with some leaf litter around its immediate perimeter.

Drovers Lagoon (Plate 27) was one of a succession of pools in a flood channel adjacent to the main river channel. It was about 500 metres long and 30 metres wide with a bedrock and mud bottom and maximum recorded depth of 3.8 metres. Water lilies and bladderwort (*Utricularia* sp.) grew around the edges of the clear lagoon. A medium stand of low trees and grasses comprised the surrounding vegetation.

Approximately four kilometres upstream of Drovers Lagoon in the same flood channel is the location of the small and turbid Krochie Hole Lagoon. This Hole was only 100 m long and 2 m deep with no aquatic vegetation and less riparian (bank) vegetation.

Table Fifteen. Sites sampled - Coleman River and associated lagoons. Drainage Basin 9200.

| Map Ref | Site Code | Name | Date | Latitude. | Longitude. |
|---|---|---|---|---|---|
| A | 9200 01 01 | Coleman Road Crossing lagoon | 6 Oct 1993 | 14°47.91'S | 143°21.59'E |
| B | 9200 02 01 | Drovers Lagoon | 7 Oct 1993 | 14°55.43'S | 142°54.66'E |
| C | 9200 03 01 | Krochie Hole | 8 Oct 1993 | 14°53.91'S | 142°57.16'E |
| D | 9200 04 01 | Muddy Waters Lagoon | 9 Oct 1993 | 14°52.88'S | 142°45.88'E |
| E | 9200 05 01 | Island Yards | 9 Oct 1993 | 14°52.64'S | 142°40.49'E |
| F | 9200 06 01 | Looking Glass Yards | 10 Oct 1993 | 14°51.05'S | 142°32.82'E |
| G | 9200 07 01 | Swordfish Hole | 11 Oct 1993 | 14°54.22'S | 142°28.23'E |
| H | 9200 08 01 | Boundary Fence Hole | 27 Oct 1993 | 14°52.90'S | 142°30.34'E |
| I | 9200 09 01 | Blazeaway Hole | 28 Oct 1993 | 14°58.81'S | 142°08.65'E |
| J | 9200 10 01 | Overflow Channel | 31 May 1994 | 14°48.9'S | 142°28.8'E |

Downstream of Drovers Lagoon on the opposite side of the main river channel lies Muddy Waters Lagoon (Plate 28). It has extremely high turbidity (secchi .02 m) and had very little instream cover with steep banks and bulldust around the perimeter. This long thin lagoon was only 1.5 m deep with small paperbark (*Melaleuca* sp.) trees and sparse grasses around it.

With the exception of the uppermost Island Yard site being a small pool and the lowermost Blazeaway Hole having a muddy substrate each of the river sites was similar being large in size with sand and bedrock substrates. Each site had high steep banks lined with large overhanging trees, and many log snags. River sites were between 75 and 135 kilometres from the river mouth.

Water quality was similar at each site being soft, close to neutral with an average visibility of around 0.8 metres. The small receding Island Yard site had a higher tannin content of 2.5 mg/l, with slightly higher conductivity and less visibility than the other larger river sites.

No aquatic vegetation was recorded at any river site, however each had a wide variety of instream cover. A combination of rocks, small and large log snags, roots, undercuts and leaf litter were recorded at each site.

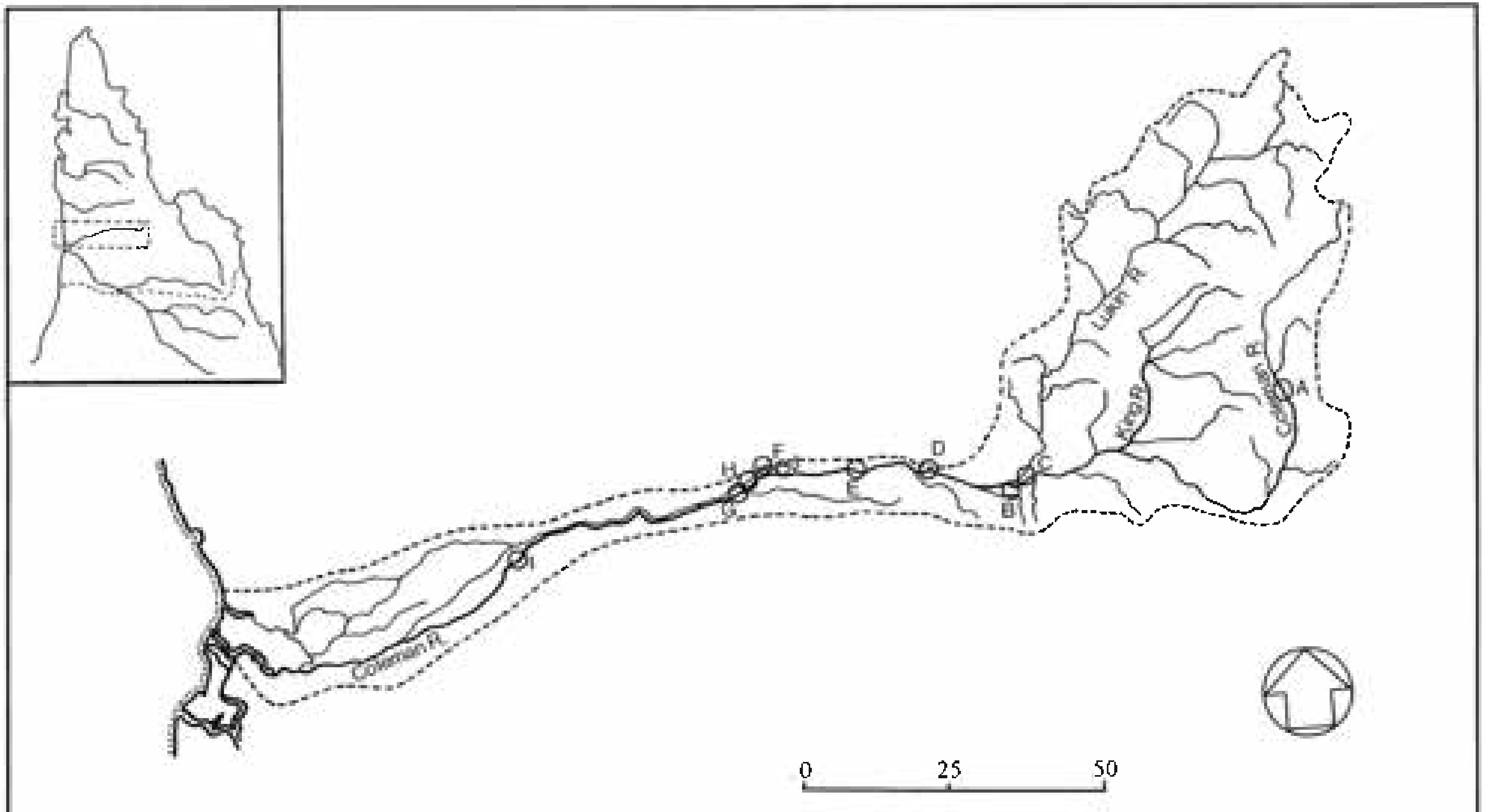


**Figure 14. Coleman River - Drainage Division 9200**
Markers indicate sample sites (refer to Table 15 for date and site name)

Plate 27. Drover's lagoon, near the Coleman River. This is typical of most lagoons on the Peninsula.

Plate 28. Muddy Waters lagoon. Turbid lagoons such as this were only found in the Gulf savannah country.

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A small hole in what is termed as the Overflow, approximately 50m long, was sampled briefly in May 1994. This lagoon had little aquatic vegetation (some *Najas tenuifolia*) and very little cover. It was quite turbid (estimated secchi of about 0.3m), and had heavy cattle visitation. Due to time constraints habitat data was not collected at this site. Silver tandans were common in this turbid lagoon.

### 20.4 Fish Species Present

A total of 30 species were recorded from the Coleman River and associated lagoons. Only one essentially marine species was found, the giant trevally/turrum *(Caranx sexfasciatus)*, in Blazeaway Hole, approximately 75 km from the sea. Local residents have reported the presence of river sharks *(Carcharhinus leucas)*, freshwater stingrays *(Dasyatis sp.)* and river sawfish *(Pristis pristis)* in Blazeaway hole. Most species were sampled in abundance, with species diversity generally being higher in the river sites than in the lagoons.

Pennyfish (*Denariusa bandata*) were not collected by us at any site on the Coleman. However Midgley (1988) reported it as common in Drovers Lagoon. Threadfin rainbows (*Iriatherina werneri*) and poreless gudgeons (*Oxyeleotris nullipora*) were not recorded in the Coleman but were common in Edward River Lagoons. It is interesting that their distribution ends here as both river systems are quite similar with no major geographic barriers between them. However, locals say that there are no connections between the two rivers even during the highest floods.

Gilbert's grunter (*Pingalla gilberti*) was collected in the Coleman. This is the first record of it from this river (see Wager, 1993), and extends its distribution northwards from the Mitchell River. Two individuals of northern purple spotted gudgeon (*Mogurnda mogurnda*) were sampled from a single site, Krochie Hole Lagoon. These have not previously been collected in this area, either. It is unusual that they were uncommon, as in other sites where they are present they are usually abundant. Three types of fork tailed catfish were sampled, Berney's catfish (*Arius berneyi*), lesser salmon catfish (*A. graeffei*) and shovel headed catfish (*A. midgleyi*). Of these, only shovel headed catfish have been collected from the Coleman previously (Midgley, 1988). A red-finned variety of reticulated glassfish / perchlet (*Ambassis macleayi*) was recorded in lagoon sites. This variety has red coloured pectoral, pelvic and anal fins.

Sleepy cod (*Oxyeleotris lineolatus*) and striped sleepy cod (*O. selheimi*) were collected but only one striped sleepy cod was collected from a river site, the rest being in lagoons. Barcoo grunter (*Scortum cf barcoo*) and leathery grunter (*Scortum cf hillii*) were also recorded.

Silver tandans were only collected in one turbid lagoon site, similar to that in which they were collected in abundance in the Edward River to the north. They were abundant in this small lagoon.

## 20.5 Distributions

### *20.5.1 Extent*

The Edward and Coleman River systems represent the upper and lower limits on the western Peninsular coast in the distribution of a number of species.. No poreless gudgeons and threadfin rainbows were collected by us south of the Edward River system and no Gilbert's grunter (*P. gilberti*) have been reported north of the Coleman River System.

The occurrence of northern purple spotted gudgeon in Krochie Hole Lagoon is unusual. This species is most often found in abundance and prefers sandy river sites. The closest location they previously have been recorded by us is the Archer River system. They are also present in the Mitchell River system.

Of the fork tailed catfish shovel headed catfish (*A. midgleyi*) was found the furthest upstream in Drovers Lagoon. Only one individual Berney's catfish (*A. berneyi*) was collected by us in the Coleman system, in Blazeaway Hole where it occurred with both lesser salmon catfish and shovel headed catfish. This was our only record of Berney's catfish from the Peninsula, although it has been collected by others in the Archer, Wenlock and Mitchell river systems.

### *20.5.2 Habitat dependence*

The observed high species richness at sites with a high diversity of instream cover agrees with observations by Pusey *et al.* (1993) in the Mary River, Queensland, which show a high correlation between species richness and habitat complexity. Our observations of high species richness in the sampled river sites agree with this. Sites with less complex habitats appear to contain lower number of fish species. Obviously other parameters such as water quality, water body size, access and predation have an effect on the number and type of species present at any location. The smaller, more turbid sites with less instream cover, such as Muddy Waters and Krochie Hole lagoons exhibited lower species diversity than other sites in the Coleman River system. Silver tandans were only found in a turbid lagoon, suggesting that they may be more suited to turbid environments

### 20.6 Species of Commercial and Recreational Importance

There are no commercial netting restrictions on the Coleman River. Professional fishing for barramundi and threadfin salmon is likely to occur in the lower reaches of the river. Recreational fishing in the rivers and lagoons of the Coleman is popular with the target species being barramundi (*Lates calcarifer*), red bream (*Lutjanus argentimaculatus*), sooty grunter/black bream (*Hephaestus fuliginosus*), fork and eel-tailed catfish (particularly *Neosilurus ater*) and saratoga (*Scleropages jardinii*).

### 20.7 Breeding Observations

Fish seem to have a short breeding season in the Coleman as most of the species sampled appear to be in quite distinct size classes. This was most pronounced in the black bream and leathery grunters where two or three distinct size classes were be observed. Some black bream were 'running ripe' at the time of sampling, suggesting that they were ready to spawn with the arrival of the first rains.

### 20.8 Water Quality

Water quality in the Coleman was generally quite good considering all sites were isolated pools with no flow. Most sites were well oxygenated with levels dropping only when temperatures began to exceed 30°C. Tannin levels of 1 mg/l were recorded at most sites with higher levels found in the smaller receding waterholes at the Road Crossing Lagoon and the Island Yard site. Secchi disc readings (a measure of clarity) at lagoon sites varied greatly with values between 0.02 m at Muddy Waters Lagoon and 1.4 m at Drovers Lagoon. Clarity in the river sites was between 0.7m and 0.95m. All fish species sampled at Muddy Waters Lagoon were very pale in colour, as is normal in fish from very turbid locations.

### 20.9 Habitat Disturbance

The only observed disturbance in the Coleman River system was some moderate trampling and associated erosion from cattle and wild pig access at some of the watering points on the water holes.

### 20.10 Notes on Other Fauna

Freshwater crocodiles were abundant in the Coleman. We encountered more here than in any other river system we sampled in Cape York Peninsula. Local residents also reported the presence of several large salt water crocodiles. Wild pigs were common in the area. Bird life was prolific around the waterholes and several eagle species were observed. Freshwater prawns (*Macrobrachium rosenbergii*) and redclaw crayfish (*Cherax quadricarinatus*) were common in most water holes.

# 21.0 CATCHMENT 9192 - PALMER RIVER

**Summary**

1. The Palmer is part of one of Australia's largest rivers, the Mitchell. It is the most disturbed river in the CYPLUS study area, with over 100 years of gold, slate and tin mining in the catchment.
2. Two previous studies, by Macleay (1882) and Midgley (1988) were located. There have been other studies in tributaries of the Mitchell River.
3. Nine sites upstream of Strathleven were sampled. Four upper tributaries, three river holes, one dam and one lagoon were sampled.
4. Fish were absent from Mount Windsor Tableland. The intermittent upstream tributaries had up to eight species of fish. Twenty four species were collected from perennial waters in the lower reaches.
5. Only species with strong rheotactic instincts were found in the headwater habitats. Snub nosed garfish (*Arramphus sclerolepis*) were encountered at only one location. Striped sleepy cod (*Oxyeleotris selheimi*) were restricted to perennial water holes.
6. Barramundi (*Lates calcarifer*) were found 380 km upstream of the mouth of the Mitchell. Fork tailed catfish were plentiful in permanent water holes. Saratoga, present in the Mitchell, were absent from the sampled reaches of the Palmer.
7. Black bream (*Hephaestus fuliginosus*) were observed in breeding aggregations at Prospect Creek in March. Juvenile fork tailed catfish (*Arius graeffei*) and sleepy cod (*Oxyeleotris lineolatus*) were also collected in large numbers.
8. Water quality was good, with high dissolved oxygen and low phosphate levels. Siltation caused by mining activities was not observed.
9. Mining altered stream bed geography considerably. Catchment erosion is severe in some areas.
10. Freshwater crayfish (*Cherax quadricarinatus*), freshwater crabs (*Paratelphusa* sp.) and freshwater prawns (*Macrobrachium rosenbergii*) were present in permanent water holes. Crabs were most abundant in temporary habitats. Freshwater crocodiles (*Crocodylus johnstoni*) were abundant in the river holes.

## 21.1 Basin Characteristics

The Palmer is a tributary of one of Australia's largest rivers, the Mitchell (920). The annual discharge from the Mitchell on average is about 90% of that of the Murray River. The Palmer River is about 350 km from its headwaters to the junction with the Mitchell River. From the junction it is about 185 km to the mouth of the Mitchell. The catchment of the Palmer is 9170 square kilometres.

The Palmer is the southernmost western river catchment within the CYPLUS study area. Its headwaters rise in the Mt. Windsor Tableland, north-east of Mareeba. A perennial creek, Picaninny Creek, rises on the northern side of the tableland in rainforest country. It drops over 200 m down to a waterhole on the Palmer floodplain below, where a perennial waterhole is present. Downstream from this the Palmer is intermittent for its entire length. The upper reaches of the Palmer down to Palmerville flow through undulating country of low rises and hills. The river cuts a winding course through these. The majority of the area is used for grazing but there has been in the past and still is mining for gold and slate.

The lowland catchment area is mostly open woodland. Extensive flats form a floodplain from near King Junction westwards. Rubber vine (*Cryptostegia grandiflora*) is present along the whole downstream length of the Palmer, and is particularly abundant on islands in the main channel. Exotic grasses (e.g. *Panicum* sp.) are also common. Gallery forest was absent at most sites sampled, but a thin band on the steep banks near King Junction was observed. There was gallery forest present on some tributaries sampled.

The Palmer is undoubtedly the most disturbed river in the CYPLUS study area and possibly one of the most disturbed rivers in Queensland. Gold mining commenced in the area in 1872 and continues to the current day. The entire length of the river from Picaninny Creek to Strathleven has been heavily settled and/or mined at some time during this period. Both alluvial and reef gold were mined and, during its peak the area, centred on Maytown (on the banks of the Palmer) had a population of 20-35 000 people. The Chinese were banished from this area periodically and at various times had camps on Mt. Windsor Tableland or downstream of the main town area down as far as Strathleven. There are still numerous historical relics of mining all over this area.

The river topography has been dramatically altered. Large sections have been scoured down to bedrock by alluvial miners. There are still several companies which operate alluvial mines in the river bed, and there is considerable turbidity downstream of these sites. Tailings dams holding silt from the reef mines usually break during the wet season and release a huge volume of silt into the river. In areas, the river is still sandy, but large areas are bedrock and boulders. Shoreline vegetation is non-existent or limited to paperbark (*Melaleuca* sp.) and bottlebrush (*Callistemon* sp.) trees and rubber vine thickets. Small remnants of what may have been gallery forest remain in small pockets on the banks but do not extend out over the plain. Any terracing previously present would have largely been obliterated by mining activity.

Banks on the river are high, generally 15-30 m above the channel bed. The channel bed broadens progressively as one progresses downstream, but width varied from about 20 m upstream at Maitland Downs to over 100 m in places downstream near Strathleven. Large, heavily vegetated sandbanks were present in areas of the river channel which had not been disturbed recently. Generally, these are dominated by rubbervine. Paperbark trees appeared to be more abundant in sandy areas and bottlebrushes were commonest in rocky areas.

### 21.2 Previous Studies

We only located two earlier studies of the Palmer, by William Macleay (1882) and S. H. Midgley (1988). Macleay identified a small collection of fish collected by Dr Selheim and R. W. Tenison-Woods. Seven species were collected. One of them, named *Eleotris planiceps* by Macleay, has been renamed *Oxyeleotris selheimi* after its collector (Johnson, pers. comm.). We have called this striped sleepy cod as it has broken, off white stripes along the lower sides. Presumably the area near Maytown was collected, although no details were given.

Midgley collected on the Palmer at King Junction Hole in 1988. Fifteen species were collected, all but barramundi (*Lates calcarifer*) were common. See Appendix One for his species list.

Several studies by various people have been conducted in various other tributaries on the Mitchell. However, these are fragmented and difficult to locate. As the Mitchell covers such a large area, it is probable that there are differences in species composition and abundance over the whole catchment.

### 21.3 Sites Sampled

A total of 9 sites were sampled on the Palmer River, all upstream of Strathleven. (See Table 16 and Figure 15). A total of 24 species were collected, and six more reported from lagoons or large holes in the river. See Appendix Two for a species list of fish collected from or reported from the Palmer River.

Picaninny Creek on Mt. Windsor Tableland was unique in the catchment in that it is a perennial stream flowing through dense wet sclerophyll and rainforest, and a tall heath type of country on granite. The area had seen some tin mining in the early days. The creek is now little disturbed, being in unlogged state forest which is a grazing lease. No cattle were seen in the vicinity of the creek while we were there. The creek at the sample site was completely shaded by the eucalypts of the tall heath forest, and

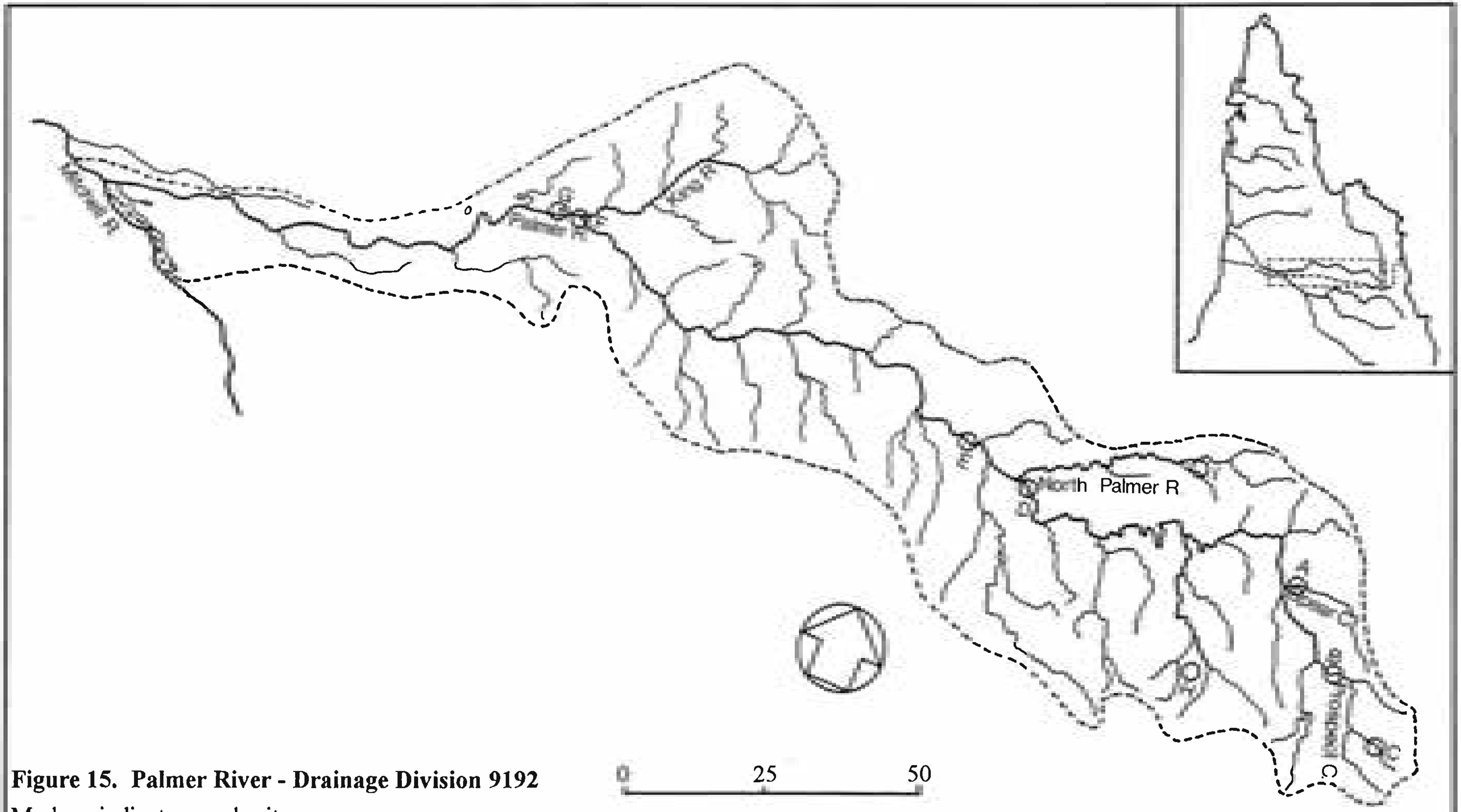


**Figure 15. Palmer River - Drainage Division 9192**
Markers indicate sample sites.
Drains into Mitchell River

banksias and other understorey heath trees. No aquatic vegetation was present. The bottom was mostly bedrock and there were small sand patches. Bottlebrush trees grew in shallow parts of the stream or in the margins. The stream had well defined banks

Spear Creek and Prospect Creek are both tributaries of the Palmer which are intermittent. They were sampled while flowing in March 1993. Both creeks have a rocky bottom, and riffles and shallow rocky areas. Spear Creek has dense forest above the creek channel, but the channel bed is wide with bare rock margins of up to 5m. A slate mine was sited at Spear Creek.

Prospect Creek is a wider, sandy bed creek with riffles and pools. There were several log jams and snags present. Parts of the bank were lined with paperbark trees, and some trees were growing out of the log jams. Both sites were dried out to a series of waterholes by May and totally dry by July.

The site at Maytown was a broad waterhole with a scoured out rock bottom and sandy patches near the old causeway. The water flowed out via a small riffle at the end. There were numerous rocks emerging from the water and submerged vegetation (couch grass and paperbark tree branches) around the banks. There were small beds of hydrilla/water thyme (*Hydrilla verticillata*) and eelgrass (*Vallisneria* sp.). The maximum depth measured was 2.5m. There was evidence that cattle used the area regularly. This site was directly below the hill on which Maytown was established.

The Palmerville site was different in that it was mostly sandy bottom with riffles and glides, a large sandy bottomed shallow pool and a deep hole at the end (1.5m deep). This hole was permanent water and may have been one of the more permanent waterholes this far upstream. The habitat available was not complex but there were areas of rock outcrops and some snags. No aquatic vegetation was present. A few paperbarks and bottlebrushes were present on the sand banks and rock outcrops.

King Junction Hole, the hole just below the junction of the King River with the Palmer, is a large, permanent hole. The King River is intermittent but was flowing in to the Palmer when the site was visited in March. It was a large hole, covering much of the river bed but at both the top and bottom ends were wide sand banks with paperbark and bottlebrush trees on them. There was a rock wall on one side of the sample area. A backwater and part of the main river channel were sampled. The backwater and one side of the river had many paperbark trees leaning out over the river. Some paperbark trees were on the northern side but that was either rock ledge or sandbars with less vegetation. The maximum measured depth of the hole was 7.18m. The substrate over the sampled area was all mud, but at the top of the hole near the inflows of the King River and the Palmer, it was sand. No aquatic vegetation was present.

Artella Lagoon near King Junction was a small lagoon about 120m long. As with most lagoons, it was shallow (2.28m), had a mud substrate, and abundant aquatic vegetation occurred along the margins. Two species of water snowflake (*Nymphoides* spp.), (white and yellow coloured flowers), one water lily (*Nymphaea* sp.) and a lot of submerged couch grass were present near the edges. No trees were present close to the water's edge. There were a few paperbarks at the swampy outlet of the lagoon but woodland was present down to the high level of the lagoon. No snags were seen. There was open water in the middle. Cattle and pig access was not obvious although there is a holding yard and mustering camp there. At the time of sampling cattle were not actively managed but improvements were being made for grazing to recommence.

Table Sixteen. Sites sampled - Palmer River and tributaries. Drainage basin 9192.

| Map Ref | Site code | Name | Date | Latitude | Longitude |
|---|---|---|---|---|---|
| A | 9192 01 01 | Spear Creek | 8 Mar 1993 | 16°02.74'S | 144°45.31'E |
| B | 9192 02 01 | Prospect Creek | 9 Mar 1993 | 16°09.53'S | 144°50.28'E |
| C | 9192 03 01 | Picaninny Creek | 15 Mar 1993 | 16°12.77'S | 144°57.76'E |
| D | 9192 04 01 | Maytown, Palmer River | 1 Apr 1993 | 16°03.29'S | 144°17.04'E |
| E | 9192 05 01 | Palmerville, Palmer River | 2 Apr 1993 | 15°59.98'S | 144°05.83'E |
| F | 9192 06 01 | King Junction, Palmer River | 3 Apr 1993 | 15°52.85'S | 144°27.82'E |
| G | 9192 07 01 | Artella Lagoon | 4 Apr 1993 | 15°52.24'S | 143°26.43'E |
| H | 9192 08 01 | Adam's Mine Dam (near South Palmer) | 18 June 1993 | 16°12.21'S | 144°34.49'E |
| I | 9192 09 01 | Near North Palmer River, Bonny Glen | 20 June 1993 | 15°54.48'S | 144°33.16'E |

Adams Mine dam drains into the South Palmer River. It is about 10m deep and 1.2 km long. It is similar to a typical lagoon except that there were substantial amounts of standing timber in the dam, particularly around the margins. It is also much deeper than a normal lagoon. The substrate is mud. Water snowflake (*Nymphoides* sp.) and water lilies (*Nymphaea* sp.) were present around the margins, and reeds (*Eleocharis* sp.) were in shallow areas. The dam is surrounded by woodland.

A tributary of the North Palmer River was also sampled. This was a rocky tributary which had stopped flowing and probably dries out completely in May or June. There were a couple of small pools and in one portion overhanging paperbark trees. No aquatic vegetation was present. Small snags, roots, boulders and leaf litter provided cover in this pool. The maximum depth measured was 1.2m.

### 21.4 Fish Species Present

No fish or crustaceans at all were collected from Picaninny Creek on Mount Windsor Tableland. Only insect larvae and tadpoles were collected. The lack of fish is surprising, as usually fish colonise even the most hostile and isolated environments (e.g. hot springs in arid central Queensland colonised by red finned blue-eye, (*Scaturgichthys vermillipennis*). Birds are possibly the route of some colonisers. Others display remarkable prowess at navigating obstacles. It is doubtful that many could overcome the 200m Picaninny Falls, a sheer drop, or even the chute above it. Aquatic birds were not observed on Picaninny Creek. Their presence cannot be discounted after one short visit, but it was surprising not to see evidence (bird shit on rocks etc.) of them. Picaninny Creek can support fish as trout were introduced there in the 1970's. They have not survived. According to a local resident they were hybrids and couldn't have bred. However, they did grow. Trout réquire several weeks at <10°C for ovarian maturation to occur and it is doubtful that temperatures would remain that low for long enough to permit successful breeding.

The three intermittent stream sites (Spear Creek, Prospect Creek, North Palmer tributary) all had a limited fauna which is not surprising due to the transient nature of these habitats. Of the three, Spear Creek had the most species (8). This creek could be colonised by both upstream colonisers and downstream drift from fish living in the permanent hole at the base of Picaninny Falls. Prospect Creek had seven species, all in common with Spear Creek except black bream (*Hephaestus fuliginosus*) were breeding at Prospect Creek. Only adults were caught. North Palmer, which was sampled when creeks started to dry up, lacked many of the species found in other areas, only having rainbow fish (*Melanotaenia splendida inornata*), spangled perch (*Leiopotherapon unicolor*) and sleepy cod (*Oxyeleotris lineolatus*). These fish all have strong rheotactic responses (upstream swimming), particularly prior to spawning. All the other species caught from these three sites could be considered as colonisers, which move into new environments and habitats as they form with seasonal changes. Not all of them manage to make it out in time when the waters start to dry up.

In the areas with deeper, more permanent water, and greater habitat complexity, more species were found. All species collected by us in the Palmer were found at King

Junction or nearby Artella Lagoon. A total of 24 species were collected on the lower reaches of the Palmer.

Most species were common to abundant throughout the range. All species identified by Macleay (1882) were caught by us at the Palmer River, except the freshwater sole fish (*Brachirus salinarum*). This was probably not caught because areas which it favours were not sampled. Also, the distribution of salt pan soles appears to be patchy. On the Wenlock River, they were only caught at one location, although many similar habitats were sampled. It is possible that mining activities have altered the habitat and the soles are no longer present, but at the time of Selheim's sampling it is probable that mining disturbances were far worse than anything produced today. Freshwater soles have been collected from other areas of the Mitchell catchment (McLeod River, Walsh River) recently (Leggett 1990; Rodgers, 1994 pers. comm.).

Artella Lagoon was surprising for the lack of species in it. Only six species were collected, all of which were collected elsewhere. This is most unusual, as most other lagoons studied in other river systems provide habitat for species of fish which do not appear to be able to live in river habitats. Artella Lagoon was inhabited by species which could be called colonisers, as they colonise new habitats regularly.

River sharks (*Carcharhinus leucas*), sawfish (*Pristis pristis*) and stingrays (*Dasyatis* sp. probably *fluviorum*) were reported from King Junction Hole. Although none were collected, these fish are known to penetrate freshwaters long distances. Some of these fish (sawfish especially) may be able to breed in freshwater. There are usually uncommon in river holes except very large ones. King Junction hole was not very big in relation to other holes sampled in other rivers, being only about 2 km in length.

## 21.5 Distributions

### *21.5.1 Extent*

As discussed earlier, only those species which have a strong instinct to swim upstream were found in upstream areas, with the possible exception of bony bream (*Nematalosa erebi*). The results of the study suggests that they do move upstream to spawn, as juveniles (SL 24-53 mm) were collected there. It is possible, however, that juveniles swim upstream to colonise potentially new habitats and spawning occurs prior to the floods as was observed in the Archer and Holroyd River.

The absence of northern purple spotted gudgeon *(Mogurnda mogurnda)* from the upstream sites were surprising as these were noted as primary colonisers in other studies and are one of the few species of fish regularly found above waterfalls and other obstacles. They were also common in intermittent flow parts of the Stewart River. The distances and obstacles involved may be too great for this little benthic dwelling fish to overcome.

Striped sleepy cod *(O. selheimi)* were only caught in more permanent water sites. Possibly, they do not have migratory instincts as strong as their close relatives sleepy cod *(O. lineolatus)*. Striped sleepy cod were far less common than sleepy cod in both numbers and distribution. They were collected at only two sites (Maytown and Palmerville). Sleepy cod were collected at all sites other than Prospect Creek. Striped sleepy cod were collected by Selheim, possibly in the Maytown area (Macleay 1882).

Snub nosed gar were only collected in one location, at King Junction. They were very conspicuous by their presence but were only caught using a seine net as they are very nervous and sensitive to the electrofisher. They were not seen anywhere else. Snub nosed gar have been reported from flowing water environments most commonly (e.g. Armstrong 1985) and congregate below weirs, presumably while attempting to move upstream (Hogan, pers comm.). We did not collect them in the Wenlock despite several previous recordings, so it is possible that they are patchily distributed along a river course.

Fish diversity increased with progression downstream, which corresponded with more stable and more complex habitat.

*21.5.2 Habitat dependence*

Fork tailed catfish were only caught in permanent waters. As they are demersal (middle to surface water) this is hardly surprising, as the temporary waters are generally too shallow to support such fish.

Rendahl's catfish was found in the only lagoon sampled, Artella Lagoon. On the Peninsula, this species was only collected in lagoon habitats, usually associated with vegetation. It appears that this habitat is essential for it to inhabit a river system.

Species normally associated with vegetation (e.g. pennyfish, *Denariusa bandata*) were absent from Artella Lagoon but were present in the Mitchell. Specimens have been collected from lagoons at Kowanyama (Sinnamon, pers. comm.). The low number of species collected from this lagoon is unusual and perhaps suggests that it may dry out completely on occasions, or provides a poor habitat for fish when it is full. The low number of species was surprising.

### 21.6 Species of Commercial and Recreational Importance

Barramundi (*L. calcarifer*), while not abundant, were only found as far upstream as Palmerville (380 km from the Mitchell River mouth). This may in part reflect catchability as good habitat for them was present at Maytown. Barramundi movement upstream may be limited by habitat requirements. Barramundi move up to 700 km inland in the Fly River in New Guinea (Allen, 1991). That system is much larger and is perennial. Barramundi were only found in permanent water on the Palmer and this was only available up to 200 km from its junction with the Mitchell. The distribution of oxeye herring/tarpon (*Megalops cyprinoides*) was similar.

Fork tailed catfish were plentiful on the Palmer at King Junction Hole, but, in common with barramundi and tarpon, were not common further upstream. A "taste test" between barramundi and fork tailed catfish was performed. As heads had to be collected for the Queensland Museum, carcasses were filleted and the meat cooked for several local graziers visiting King Junction at the time. They were not told that they were having catfish as well as barramundi, and did not complain of any difference in taste! Possibly this was an unfair test, as these people usually eat beef, and only have fish as a change of diet. However, it does demonstrate that the sometimes maligned catfish can be a culinary delight. Certainly Americans think so, and a successful gillnet fishing of the pelagic (open water) catfish resource in Lake Argyle (Western Australia) demonstrates potential for markets here.

Saratoga *(Scleropages jardinii)* were not collected anywhere. Locals had heard of them being present in lagoons downstream from King Junction (at Drumduff) but had no reliable information and were not sure if they were still there. Certainly, saratoga are caught in lagoons and the river along the Mitchell, so it is entirely possible that they are present in the lower Palmer.

The Palmer did not have any species of particular ornamental significance.

### 21.7 Breeding Observations

Breeding aggregations of black bream *(Hephaestus fuliginosus)* were observed at Prospect Creek. Running ripe male fish and a recently spent female, as well as aggregations of fish in an area similar to those used for spawning in the Tully River, all point to a March spawning time. In perennial creeks black bream spawning is triggered by rising temperature (Hogan, unpublished). In intermittent streams black bream spawning may be more reliant on flow regimes. Running ripe (ready to spawn) black bream have been observed by local residents migrating upstream in the Wenlock River at the start of the stormy season (Bews, pers. comm.). They have also been observed moving up the King River (a sandy bottomed river with no permanent water), and do spawn there as juveniles were observed. This river only flows a few months each year. Upstream riffle habitats may be very important, if not essential, for black bream breeding success. Siltation during this period would be disastrous for the fish.

Many juvenile fork tailed catfish (*Arius graeffei*) were caught at King Junction Hole, demonstrating that they had bred recently. Small bony bream were common in the river. In Artella Lagoon, large numbers of juvenile sleepy cod *(Oxyeleotris lineolatus)* were caught, suggesting that they had recently bred.

### 21.8 Water Quality

Water quality in the Palmer was generally good at all sites sampled. Oxygen levels were high (close to saturation for the temperatures measured), and tannin and phosphates low. Secchi disc readings were quite high. Mining observed later in the year (from the air) did add appreciably to turbidity in remaining water in the river, but as flow had ceased this was localised. Alluvial mining stops during the wet season and does not recommence until river levels have dropped. However, in the past massive siltation has been observed down the length of the Palmer to the Mitchell junction (Barlow, pers. comm.). This apparently must have had an effect on fish and all biota (life) but to our knowledge no studies were done.

### 21.9 Habitat Disturbance

As noted earlier, mining has had a great impact on the river through both the increased turbidity and the removal of sediments (sand) from the river bed. Additionally, if there was gallery forest along the length of the Palmer initially, it has been totally removed in gold mining processes and demand for timber related to it. Gallery forest was noted down at King River Junction, which is west of the main mining activity. Local residents report that the river recovers quickly from mining. However, colonisation of disturbed areas by rubber vine may prevent regeneration of native species which provide habitat for fish, such as paperbark trees.

Erosion in the catchment is severe at places, particularly near roads, which were close to the Palmer along much of its length. Large breakaways covering hundreds of square metres were observed. This appears to be mainly concentrated around roads and tracks, but was observed in areas away from obvious tracks from the air. Some old timers from the area say that breakaways have been a character of this country even white settlement, and it is probable that the soil structure is such that it erodes easily, especially once disturbed in any way, by natural means or others.

Some feral pig activity was observed but this was very restricted compared to other areas. No pigs and few pig diggings were observed, but pigs disperse during the wet season so their activity around swamps and rivers is limited.

Stricter mine regulations involving the putting down of a bond to cover rehabilitation processes may help minimise disturbance related to mining. Previously, many miners used to go bankrupt just prior to expiry of a lease or when the gold ran out, meaning that they could not pay for rehabilitation of mined areas. Bonding hopefully will reduce the problem of mined areas being left as is.

### 21.10 Notes on Other Fauna

In Picaninny Creek, the niche normally occupied by fish appeared to be occupied by tadpoles, which were very large and abundant. The majority of tadpoles were those of the northern barred frog (*Mixophyes schevilli*) but there are other varieties there as well. They were abundant in the creeks sampled by us.

Freshwater prawns *(Macrobrachium rosenbergii)* and redclaw crayfish *(Cherax quadricarinatus)* were common throughout the Palmer except the uppermost sites. Freshwater crabs *(Paratelphusa sp.)* were present but not abundant.

Freshwater crocodiles were common and were observed at King Junction Hole. A salt water crocodile was believed to live at one end of the hole, and freshwater crocodiles at the other end. We did not see any crocodiles at the western end of the hole but observed numerous freshwater crocodiles at the eastern end.

## 22.0 SYNOPSIS - EASTERN RIVER SYSTEMS

**Summary**

1. East coast rivers can be classified as perennial rainforest streams, humic sand country streams and short, intermittent coastal plain country streams. All are relatively short with small catchments, with the exception of the Pascoe.

2. Eastern sleepy cod (*Oxyeleotris gyrinoides*) were not documented from the east coast streams prior to this study. Striped sleepy cod (*Oxyeleotris selheimi*) are present in some east coast rivers due to stream captures. East coast rivers have a higher proportion of catadromous fish species in them than western rivers.

3. 'West coast' faunas closely related to the Fly River fauna extend around the tip of the Peninsula to the Olive River, but elements of these faunas extend as far south as the Stewart River. The fauna of the Pascoe is different, suggesting that it is a relatively 'new' (geologically) river. Disjunct distributions of fish species down the coast suggest that climatic changes have affected distribution patterns of some species. Several species appeared to be restricted to humic water environments, and others had specific habitat requirements.

4. Most eastern streams are too small to support full time barramundi fishermen. Freshwater recreational fishing is popular and eeltailed catfish/jewfish (*Neosilurus ater*), jungle perch (*Kuhlia rupestris*), barramundi (*Lates calcarifer*) and eels (*Anguilla* spp.) are most often caught. Eeltailed catfish and eels were common or abundant even in heavily fished areas. There is potential to use some fish varieties as broodstock for the aquarium fish trade, and others as live export for the Asian restaurant market.

5. Seasonal breeding of jungle perch was associated with the wet season. Most small fish species bred all year round.

6. Water quality in most areas was virtually pristine, except in the West Claudie River.

7. Habitat disturbance in the south of the study area was minimised by retention of riparian vegetation. In the north there was little disturbance, except from feral pigs.

### 22.1 Basin Characteristics

On the basis of basin characteristics, the east coast rivers can be split into several different categories. These do not correspond to the water resources scheme of catchment basins. Not all of any of the river systems fits into one particular category, the descriptions below are generalisations. The Pascoe, Claudie, Lockhart, Massy, Rocky, M$^{c}$Ivor, Endeavour, and Annan Rivers all drain rainforest country and are perennial rivers in areas of high rainfall. There is some vegetation in the stream bed and few lagoons on the floodplain. Harmer Creek, the Olive River and the North arm of the Endeavour (at Black Creek) are typical sand dune country streams with humic water and tannin. Lagoon systems are present. Little vegetation grows on the sandy bottom. The surrounding country receives typical monsoonal rainfall, with most rain in December to March, and little for the rest of the year. The third category of streams include those intermittent ones which usually drain relatively flat, poor country. The Stewart, Howick, Jeannie and Starcke Rivers fit this category. They are short rivers with poorly developed lagoon systems and lack much permanent fresh water.

All east coast rivers sampled by us were comparatively short, the shortest one being the Starcke (35 km) and the longest being the Pascoe (125 km). The catchments are also small, generally less than 1000 square kilometres, with the notable exception of the Pascoe. Some sampled streams were very small; the creeks sampled at Bolt Head and Bathurst Bay were less than two kilometres long and only had catchments of a few square kilometres. Generally catchments were small due to the proximity of the mountains to the coast. The only large river on the east coast, the Normanby Complex, was not studied by us as it is the subject of intensive research by students from Griffith University (see M. Kennard, M. Sc. Thesis, Griffith University 1994).

All of the rivers studied had gallery forests, more well developed in the perennial streams but present along all east coast streams. Generally, some aquatic vegetation was present in east coast rivers, aponogeton (*Aponogeton* sp.) in the rivers south of the Pascoe and eelgrass (*Blyxa* sp.) in the Olive River.

A feature of the area on the east coast is the general paucity of lagoons (due to the short course and small floodplain areas). The Olive and Stewart Rivers had some, generally temporary, lagoons. There were few permanent lagoons on the east coast when compared to the west coast. However, there are several dune fields with vast numbers of lakes - Cape York, Oxford Ness, Shelburne Bay, Cape Flattery and Hope Vale all have lakes, some of which are very large. These are an important feature of the east coast geography, and definitely require more research. Often they are `windows' on the water table, although some are perched, above the water table but with a basin of sealed sand called humicrete.

Humic (tea coloured) waters are a feature of the east coast and the `tip' - those areas with sand or sandstone soils and numerous tea trees (paperbarks - *Melaleuca*) and heath scrubs. This special environment is not as extensive on the western coast except for the Jardine River area, which drains the vast dune fields on the east coast.

## 22.2 Fish Species Sampled

Green back gauvina/eastern sleepy cod (*Oxyeleotris gyrinoides*) have not been reported from east coast rivers of Cape York Peninsula in published reports prior to this study. Presumably, most people have misidentified them or confused them with sleepy cod (*Oxyeleotris lineolatus*). Eastern sleepy cod are distinct and are obviously different to sleepy cod in coloration and pattern. They inhabited all east coast streams we sampled. We presume that there is a discontinuous distribution down the east coast, with no eastern sleepy cod between Massy Creek and the McIvor River, except for one outlying population at Cape Melville.

It was surprising to find striped sleepy cod (*Oxyeleotris selheimi*) in the Stewart River and Massy Creek. This species was collected in all west coast streams. It co-exists with sleepy cod (*Oxyeleotris lineolatus*) on the west coast. As explained earlier (Stewart River section) the presence of this species and other elements of west coast fauna in the Stewart River suggests that there was a stream capture. Geological studies agree with this (see regolith survey, CYPLUS project NR 12). Part of the headwaters of the Holroyd River were directed eastwards by geological uplifting (at a point near the main Port Stewart road crossing), which explains why the Stewart River has a west coast fauna. This stream capture, caused by uplifting, probably occurred during the late quaternary period, less than 2 million years ago. It is also possible that eastern sleepy cod have distinct requirements which prohibit their survival in the intermittent Stewart River. Whether striped sleepy cod are established in Massy Creek remains to be seen.

In all, the east coast streams appeared to have a higher proportion of catadromous (breed in salt water but usually live in fresh water) species than west coast rivers. There were a number of species only found in east coast rivers (See Table 17).

A few of the species recorded (short finned catfish, long finned eel, McCulloch's rainbow) are also found in the Jardine River. However, as they are found nowhere else on the west coast they were more `eastern' than `western' fish. The Jardine occupies a unique position in which it receives recruitment of marine breeding species from the Coral Sea whereas rivers located further south do not get this. The Jardine catchment also includes much of the humic country which is more a feature of the east coast than the west.

Table Seventeen. Fish Species found on the East Coast of Cape York Peninsula (but not on the West).

| Common Name | Scientific Name |
|---|---|
| Agassiz's glassfish | *Ambassis agassizi* |
| Flag tailed glassfish* | *Ambassis miops* |
| South Pacific eel* | *Anguilla obscura* |
| Long finned eel *+ | *Anguilla reinhardtii* |
| Roman Nosed Goby* | *Awaous crassilabrus* |
| Golden Goby | *Glossogobius aureus* |
| Jungle Perch | *Kuhlia rupestris* |
| McCulloch's Rainbow fish + | *Melanotaenia maccullochi* |
| Australian Rainbow fish | *Melanotaenia splendida splendida* |
| Southern Purple Spotted Gudgeon | *Mogurnda adspersa* |
| Belut | *Monopterus albus* |
| Short finned catfish + | *Neosilurus brevidorsalis* |
| Eastern sleepy cod/Green backed gauvina | *Oxyeleotris gyrinoides* |
| Pacific Blue Eye | *Pseudomugil signifer* |
| Spotted/bug eyed goby | *Redigobius bikolanus* |
| Spot finned goby* | *Redigobius chrysosoma* |
| Archer fish | *Toxotes jaculatrix* |

N.B. Does not include essentially marine species

+ Recorded from Jardine River

* Marine breeding

## 22.3 Distributions

### *22.3.1 Extent*

The distributions of fish faunas along the east coast is not as would be expected based on drainage and catchment basins. The northernmost two basins, the Harmer (1010) and Olive (1020) Rivers have faunas closely related to the Jardine and Fly River fauna of New Guinea. The indicator species for the close relationships between the three Australian rivers are the saratoga, coal grunter, and rich Eleotrid (sleepy cod) fauna. The saratoga (*Scleropages jardinii*) is a primary freshwater fish, believed to have evolved in fresh water and intolerant of salt water. Thus, they could not migrate between river systems and their presence in river systems should indicate close relationships between those rivers in the past. The coal grunter (*Hephaestus carbo*) in the Jardine, Harmer and Olive Rivers is a form different to that in other rivers as it has reddish markings, particularly obvious on the operculum and head. This form is quite distinct and is restricted to these three drainage basins. The colour variety from the Claudie and Wenlock Rivers has more yellow markings (Plate 29). These three rivers (Jardine, Harmer and Olive) also have a rich Eleotrid fauna - containing fimbriate gudgeon (*Oxyeleotris fimbriatus*), poreless gudgeon (*O. nullipora*), Aru gudgeon (*O. aruensis*), northern purple spotted gudgeon (*Mogurnda mogurnda*) and empire gudgeon (*Hypseleotris compressa*). Although these are found in other rivers in the Peninsula, their commonness and abundance in these rivers suggests a close link between them. The Olive and Harmer and their catchment divisions could be considered to be one zoogeographic area, with the southernmost eastward distributions of saratoga, red coal grunter, fimbriate gudgeon and swamp eel (*Ophisternon bengalense*). They do share "typically" east coast species (jungle perch *Kuhlia rupestris*; eels, *Anguilla spp*; eastern sleepy cod/green backed gauvina *Oxyeleotris gyrinoides*) with more southerly rivers. The Olive River should be considered as the most southerly extent of a "Jardinean" fish fauna on the east coast.

The "west coast" fish do not "stop" at the Olive River. Chequered rainbow fish (*Melanotaenia splendida inornata*) extend all the way down the east coast to the Lockhart River, and there is a population in the Stewart River also. Chequered rainbow fish appear to have spread down the coast to the rainforest habitats of Iron Range, but do not extend past the Stewart River. Australian rainbow fish (*Melanotaenia splendida splendida*) inhabit the rivers south of and including the Normanby system. The Lockhart and Claudie Rivers share similarities in fish fauna with the Olive and Harmer Rivers, in that they have coal grunter, a distinctive fish, which is absent in the Pascoe River. Short finned catfish (*Neosilurus brevidorsalis*) are also present in the Lockhart and Claudie. It appears that the Jardinean fauna may have partially penetrated as far south as the Lockhart River, but that primary freshwater fish (i.e. saratoga) for some reason did not extend this far south. From the distributions of fish species, we would suggest that initially the Lockhart and Claudie may have had a closer relationship with the Olive at times when the sea level was lower. Possibly the Pascoe was formed after or during one of the low sea level periods and it did not ever have connections with either the Olive or Claudie Rivers. Land uplifts associated with the formation of the Pascoe could have diverted the Claudie to the south. The fauna of the Pascoe suggests that it is a relatively 'new' river, with comparatively low species diversity, dominated by catadromous (sea breeding) species and the ubiquitous, common species of fish found all up and down the east coast. Research into the geological history of the region may be able to determine if this is the case. Current radiometric evidence suggests the Pascoe was originally part of the

Wenlock River. Bathymetric studies suggest that the Lockhart, Claudie and Pascoe all shared a common outflow when sea levels were lower (see Maxwell, 1968). The fish fauna definitely does not reflect this.

The presence of "west coast" fish in the Stewart River (rather those absent elsewhere on the east coast) suggests it has stronger affiliations with the west coast rivers than east coast ones. Certainly the environment is more similar to the west coast rivers than other east coast rivers covered in this study. Of special interest is that the Stewart River (and Massy Creek) and the Annan River have the only east coast populations of striped sleepy cod (*Oxyeleotris selheimi*) in Cape York Peninsula. All the other east coast systems studied by us have eastern sleepy cod/green backed gauvina (*O. gyrinoides*) instead. As discussed earlier, the headwaters of the Stewart River once flowed into the Holroyd. It is probable also that the Annan once flowed westwards and so has elements of western river fauna. There are several more unusual instances where fish distributions defy explanation. The delicate blue-eye (*Pseudomugil tenellus*) was found in only one location on the east coast, at Scrubby Creek. We can think of no explanation why it should have been there but not elsewhere. Presumably there must be a combination of environmental factors which contribute to its survival in that area. Banded rainbow fish (*Melanotaenia trifasciata*) (Plate 30) were found as far south as the Lockhart River, and then there was a huge gap in distribution down to the McIvor River. There are other isolated populations of fish documented in the area too. Penny fish (*Denariusa bandata*) have only been found on the west coast from the Jardine River south but have been collected from sand dune lakes at Cape Flattery by the Queensland Museum, and another isolated population occurs in the Murray swamps far to the South (Allen, 1989). Presumably, these relict or isolated populations of fish must establish by introduction from outside (by natural means such as birds ?). Alternatively, species may have been originally more widespread but changes to the environment over time might have decimated nearby populations, or led to isolated pockets in stable or most favourable habitats.

Also of interest was the distribution of the northern trout gudgeon (*M. mogurnda*). These were distributed down the east coast to the right arm of the Endeavour River, which appears to be their southernmost extent of distribution on Cape York Peninsula. Southern trout gudgeon (*Mogurnda adspersa*) are present in the Normanby complex (Kennard, pers. comm.) and at Bathurst Bay.

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Plate 29. Coal grunter (*Hephaestus carbo*) from the Wenlock River. This is similar in colouration to specimens from the Lockhart River.

Plate 30. A banded rainbow fish (*Melanotaenia trifasciata*)from Brown Creek, a tributary of the Pascoe River.

*22.3.2. Habitat dependence*

Presence or absence of some species appeared to be dependent on availability of certain habitat types. The freshwater elasmobranchs (sharks, rays and sawfish) commonly encountered in western rivers were never recorded or reported from any of the east coast river systems sampled. The main reason we did not encounter them is probably because the areas sampled did not have suitable habitat for most of them. The main places these fish were common were in the large holes in rivers on the lower reaches of the major western flowing rivers. Most of the eastern rivers are short and considerably smaller than the western ones, and hence these species may either stay in salt or estuarine areas all the time or they may be absent altogether if living in fresh water is essential to them. Possibly, also, they are less likely to be stranded in east coast river holes as all of the larger rivers covered in our study are perennial and access to the estuaries is always available. In any case, the apparently necessary habitat of large river holes with abundant fodder fish (bony bream, catfish etc.) appeared to be absent from the east coast streams sampled.

The humic (tea tree coloured) habitats common in the dune fields and heath lands were apparently necessary for several species of fish which were exclusively found in these habitats on the east coast. Poreless gudgeon (*O. nullipora*), Gertrude's blue-eye (*P. gertrudae*) and McCulloch's rainbow (*M. maccullochi*) were only found in humic creeks or lakes. All these species were found as far south as Scrubby Creek at Silver Plains. An isolated population of McCulloch's rainbow and poreless gudgeons was found at Hope Vale, in one of the most highly tannic creeks studied. The distribution of these species was totally limited to humic waters on the east coast in the streams and water bodies sampled. Soft water may be beneficial to them, as McCulloch's' rainbow and Gertrude's' blue eye are also found in other pockets of swampy land further south (e.g. Murray swamps) and in the Jardine River to the north. Only the New Guinea form (green finned variety) of McCulloch's' rainbow was found by us as far south as Hope Vale.

Banded rainbow fish (*Melanotaenia trifasciata*) were only ever collected from flowing waters or in creek beds where flow would be present for much of the year. They were absent from lagoons in all east coast sites sampled. In streams, they predominated over chequered rainbows (*M. spl. inornata*) or Australian rainbows (*M. spl. splendida*) in both numbers and size. The faster flowing streams, or areas of streams, invariably had much bigger numbers of banded rainbows in them. Although other people have found them in stagnant pools in great numbers, we believe that unlike many other rainbows, wild banded rainbows need flowing water to breed successfully. This may help separate them from other rainbows which live in the same creeks and help prevent crossbreeding which can occur in aquarium kept specimens. Although they live and thrive in aquariums, it appears as though in the wild clear, flowing water is essential for successful reproduction and optimal growth.

Another species of interest was the empire gudgeon (*Hypseleotris compressa*). It was only found in habitats within 10 km of the estuaries. Empire gudgeon juveniles have been observed migrating upstream in their millions after rains in the Tully River system south of Cairns (Hogan, pers. comm.), and in Gap Creek, north of the Bloomfield River. They were traced down to the mangroves. The restriction of empire gudgeons to a narrow band of habitats near the sea suggests that on the east coast, in the areas observed, empire gudgeons need saline water to breed. Attempts at breeding in fresh water have failed, due to death of larvae. (Leggett and Merrick, 1987). Possibly larval survival requires some salinity, as natural spawning aggregations occur in estuarine areas.

### 22.4 Species of Commercial and Recreational Importance

The most sought after commercial fish which penetrate freshwater are barramundi. These are undoubtedly netted in the estuarine reaches of most east coast rivers at some time of the year. The only eastern streams which do support full time net fisherman are those in the Normanby Complex. All other rivers are fished periodically, usually after the closed season is lifted (in March) and in September.

Recreational fishing in freshwater is limited. Most people living or visiting the east coast have access to the estuaries or the reef so most fishing effort is concentrated there. However, locals do regularly fish for eel tailed catfish (*N. ater*), jungle perch (*K. rupestris*), barramundi (*L. calcarifer*) and eels (*Anguilla reinhardtii* and *A. obscura*). In the Annan River, local people also fish for sooty grunter/black bream (*H. fuliginosus*) which have established a breeding population there. All these species were regularly caught in all rivers sampled. Eeltailed catfish and eels were abundant at all sites sampled, despite heavy local fishing pressure in some locations. Jungle perch were common, but large numbers were only encountered from the Pascoe River south. Few were present in the Olive River and Harmer Creek. Spotted flagtail (*Kuhlia marginata*), found to the south near Cape Tribulation (Hogan, pers. comm.), were not collected or seen anywhere on the Peninsula. Large jungle perch were only collected in unfished areas of Hann Creek in the Pascoe River. In all rivers where access was possible, only small jungle perch were present. Jungle perch are vulnerable to overfishing, as they are open water swimmers, usually highly visible and easy to catch on lines or with baits.

Ornamental fish were common throughout the area. Of particular interest were the Olive River threadfin rainbow, northern coal grunters, snakehead gudgeons, banded rainbows, blue-eyes and McCullochs' rainbows. Threadfin rainbows (*Iriatherina werneri*) from the Olive River had colouration more spectacular than that of threadfins collected from other locations. The body was generally a salmon pink or red colour. The dorsal `sail' fin was yellow edged with black in some specimens. Sizes reached were large compared to some other locations. There is potential for development of this form as an aquarium fish.

Coal grunters (*Hephaestus carbo*) from Harmer Creek and the Olive River have potential for development as aquarium fish. Although aggressive towards other fish (Leggett and Merrick, 1987), it could be a viable alternative to exotic cichlid species which have similar behaviour and colouration. They have potential for artificial breeding due to their larger size than the golden spotted variety of the Lockhart and Claudie Rivers and the western flowing rivers. Techniques for successful propagation of this species were developed at Walkamin Research Station in the 1980's (Barlow, personal communication).

Snakehead gudgeons, (*Ophieleotris aporos*) were caught as far north as Bolt Head near the Olive River, but were only common in the Endeavour River. Snakehead gudgeons are beautifully coloured (close to gaudy) with bright orange and blue markings. They grow quite large and have potential for export to Asian markets as a gourmet fish in the restaurant trade. Chinese customers pay high prices for fish with red or orange colouration. Snakeheads are similar in body form to marbled goby (*Oxyeleotris marmoratus*) which fetch extremely high prices in the Thai, Malaysian and Singaporian live fish trade for restaurants. Additionally, snakehead gudgeons are extremely attractive aquarium fish, and are suitable tank mates for anything larger than their mouths.

Banded rainbow fish (*M. trifasciata*) are known for colour variations ("morphs") from different locations. The east coast has several colour forms which have potential for the ornamental fish market. Banded rainbows from the McIvor River, Pascoe River (Brown Creek) and Olive River are particularly attractive forms not well established in aquaria to date (See Plate 30). The eastern (Australian) form of McCullochs' rainbow is well established and on occasion they are imported from Singapore and sold here.

The New Guinea form found on the east coast of the Peninsula has more subdued colours but would have potential as well. Blue eyes (Gertrude's and Pacific) are attractive small aquarium fish that are also important mosquito control agents. Although their distribution is patchy, there may be colour forms or variations which may be particularly large or attractive and thus have potential as aquarium fish.

**22.5 Breeding Observations**

Observations on breeding were limited due to the necessity of sampling in the northern Peninsula being restricted to the dry season. However, it appears that most small fish species breed year round, but reach a peak of breeding success in environments favourable for juveniles. In lagoons which are seasonal, recruitment of larger breeding species from the river or other lagoons provides a nucleus for rapid expansion of fish populations. This was particularly observed with threadfin rainbows, chequered rainbows and hardyheads in the Olive River.

Jungle perch breeding appeared to be seasonal, with an upstream migration of juveniles observed in January, only weeks after the first rains started flow in the rivers. Jungle perch are believed to spawn in saline water, as their sperm die rapidly in freshwater (A. Hogan, pers. comm.). Very little is known about jungle perch breeding, so this is an addition to our knowledge.

Most larger fish species appeared to be more seasonal, breeding at certain times of the year. Particularly, breeding in species dependent upon dispersal in floods or reliant on flood prepared habitat was tied to rainfall. Species which breed in salt water had to wait for rain to start stream flow in intermittent streams before going to the estuaries to breed.

**22.6 Water Quality**

Water quality in most sites sampled appeared to be unaffected by human activity. Most rivers had remarkably pure, clear water. The rivers gradually had good water for human and agricultural use, and it would have been suitable for aquaculture of crustaceans (prawns, crayfish), crocodiles or fish. The only exception was the West Claudie River, in which high turbidity was observed downstream of all road crossings and siltation was seen well downstream from the road crossings. Concrete causeways at these crossings would limit this problem, but runoff from the road surfaces would still carry significant amounts of silt into the river.

The humic water (with low pH) may cause pipe corrosion or damage to some metal fittings over time. With widespread use of plastic or PVC pipes and fittings, this is not a big concern. The high tannin levels in some tea tree water areas may have limited the types of fish able to live there. It did seem necessary for survival of some species, which were restricted to humic water environments. Humic waters are not suitable for aquaculture due to the effects of low pH and high tannin levels on fish and crustaceans, but they are suitable for domestic and agricultural use.

### 22.7 Habitat Disturbance

As is to be expected, more habitat disturbance was evidenced further south where settlement and agricultural activity were more established and intense. Extensive clearing in the Annan, Endeavour and Lockhart basins and the Silver Plains area was noted, but disturbance to adjacent river systems appeared to be related to clearing practices and management of agricultural land. The extensive siltation and erosion observed in former rainforest streams south of Cairns was not observed in the Peninsula rivers, probably due to retention of vegetation and in some areas, restricted cattle access to river banks. Further north, habitat disturbance was minimal, restricted to localised erosion caused by roads or cattle pads. Soil type and vegetation cover also has marked effects on erosion. Some soils are particularly susceptible to erosion if cleared or if any damage to protective vegetation occurs. Topography and vegetation will also affect the erosion processes, in steeper slopes or nearly vegetated areas being highly susceptible. Information on disturbed or degraded areas has been mapped as part of the Land Resource Inventory (Project NR02). This information, a map of the Peninsula showing disturbed areas (urban, mining, cleared land) is available from CYPLUS.

Feral pigs appeared to become more abundant as one moved north, and disturbance of river habitats is a concern, particularly in the Olive River. In the Cooktown area pigs are very common. Severe habitat degradation by pigs in the Peninsula has been of concern since the 1930's, when extensive destruction of swamps and the richest country was noted (Thomson, 1935). However, pig activity around water courses is very seasonal, and observed pig activity was more a reflection of timing of sampling trips. One-off trips can only give a snap-shot of conditions at the time, and is not an adequate way to assess if habitats are being disturbed more continuously.

Habitat disturbance due to mining was not observed at any sampling locations studied by us. However, mining of tin in the Annan River had a significant effect on fish there (Hortle and Pearson, 1990), due to effects of sedimentation. Turbidity has important effects on movement and survival of fish (Cyrus and Blaber, 1992) and mining without adequate safeguards to limit entry of sediments to nearby rivers may have severe effects on the fish fauna. Reduced fish diversity was noted at sites downstream of tin mining operations in the Annan River, and this was attributed to the effects of sedimentation (Hortle and Pearson, 1990).

## 23.0 SYNOPSIS - WESTERN RIVER SYSTEMS

**Summary**

1. All western rivers have lagoons on extensive floodplains, and are intermittent with permanent waterholes in the dry season. Terraced banks or levees are common. Gallery forest is normally well developed and contributes to habitat complexity.
2. The Archer and Wenlock river systems were similar zoologically. The Holroyd, Edward and Coleman Rivers were similar to each other, but had differences in faunas suggesting that they are an area of change in fish distributions. The Palmer was most similar to the Coleman River.
3. The Holroyd, Edward and Coleman Rivers represent the northern or southern limits of a number of fish species. Temperature may be an influencing factor in fish distributions. Sharks, sawfish and stingrays appear to require large water bodies as habitat. Some fish (threadfin rainbows, *Iriatherina werneri*; and pennyfish, *Denariusa bandata*) were collected exclusively from vegetated lagoons.
4. Estuarine fisheries based on barramundi support a number of full time fishermen on the west coast. At present fisheries in freshwater are not threatened, but with increased visitation some areas may be vulnerable to overfishing.
5. Small species of fish appear to breed all year round. Larger fish species appear to require specific stimuli or environmental conditions to spawn. Recruitment of catadromous species is dependent upon flow regimes.
6. Water quality in all west coast streams was good. Humic waters on the west coast were rare, but had unique fish faunas.
7. Disturbance from tourists is currently limited to the most popular campsites and is very restricted.

### 23.1 Basin Characteristics

With the exception of the Jardine River, the major rivers flowing into the Gulf of Carpentaria in the CYPLUS study area are quite similar. All have their headwaters in the Great Dividing Range, and flow across flat areas of woodland or savanna country. All but the Wenlock are intermittent, flowing for part of the year only. All have lagoons on the floodplain, well above the level of the river basin. In some areas lagoon complexes are spread over the flood plains, with numerous lagoons, temporary swamps and marshes distributed over a wide area. In the lower reaches, the rivers typically have large holes, stretches of permanent water in the stream bed which may be several kilometres long. In some rivers, the uppermost reaches may be spring fed and perennial, but flow becomes hyporheic (subsand) once the streams reach flat country. Lateritic rock formations are present in parts of most of the western

Peninsula rivers, and may form bars or waterfalls in places. The northern rivers (Wenlock and Archer) characteristically have terraced banks leading up to the floodplain, and may have levee banks as well. The more southerly rivers (Holroyd, Edward and Coleman) tend not to have as well developed terraces or levee banks. These rivers are shorter than the Archer or Wenlock, flow through very flat savanna country for most of their length, and have cut down to bedrock in many areas.

Gallery forest along all western flowing rivers except the Edward is usually well developed, although undoubtedly is more complex and extensive on the terraced banks of the Archer and Wenlock Rivers. Gallery forest is generally limited to the river banks, so is very restricted where terracing is poorly developed or absent.

All western river beds are sandy, although there are extensive areas of bedrock in parts of the Holroyd, Edward, Coleman and Palmer Rivers. No aquatic vegetation was seen in any river beds, except the Jardine and Palmer.

Lagoons were a prominent feature of all western flowing streams, generally becoming more numerous downstream. They were present on the floodplains, sometimes many kilometres from the river bed. Lagoons usually were well vegetated, with waterlilies and a variety of submerged water weeds. Some lagoons on the lower reaches of rivers were exceptionally large, being several kilometres long and 500 m wide. Most lagoons had a fringing band of paperbark forest around the upper water level area. Freshwater mangroves (*Barringtonia racemosa*) and tea tree (*Leptospermum*) were generally also present close to lagoons.

The Jardine River was not sampled in this study as it has been surveyed several times already. It is substantially different to all other rivers on the Peninsula in that it has aquatic vegetation in the river bed. This is probably present as a result of the high rate of base flow and less severe flooding and scouring effects. The water clarity of the Jardine is always high and thus the water plants can flourish in the river channel. Lack of suitable substrate in most of the channel prohibits establishment of plants except in the leaf litter beds on the margins. Reeds (*Eleocharis* sp.), lilies (*Nymphaea* sp., *Nymphoides* sp.) and eelgrass (*Blyxa* sp.) were present along the margins of the river. No aquatic plants grew in the middle of the channel or on the outside edges of bends. The Jardine is the largest river in the Peninsula in terms of discharge, and has the highest base flow of any river in Queensland. The Jardine is surrounded by extensive areas of permanent swamps. Nearly all of the catchment area is sand country, the headwaters rising in the dunes behind Hunter Point and False Orford. The Jardine has a large floodplain area, but this does not support the lagoon systems found in other areas, probably due to the sandy soils. Vast areas of swamp instead are associated with the floodplain.

## 23.2 Fish Species Sampled

The six western flowing river systems sampled by us could be split into two groups on the basis of what fish species were present. The Archer and Wenlock Rivers had very similar fish faunas. The Holroyd, Edward, Coleman and Palmer shared a number of species not found in the Archer and Wenlock, but each had slightly different fish faunas.

All western flowing rivers (except the Jardine) on the Peninsula shared what could be called "typical" western river fish - saratoga (*S. jardinii*) , black bream (*H. fuliginosus*), sleepy cod (*O. lineolatus*) and striped sleepy cod (*O. selheimi*). The Jardine river appears not to have striped sleepy cod according to previous studies (Allen & Hoese 1980; Leggett, 1987; Midgley, 1988).

All of these species were ubiquitous in western drainages (including the Mitchell) but only have isolated populations on east coast rivers.

Table Eighteen. Fish Species found on the West Coast of Cape York Peninsula (but not on the East).

| Common Name | Scientific Name |
|---|---|
| Toothless catfish | *Anodontiglanis dahli* |
| Freshwater sole | *Brachirus selheimi* |
| Freshwater stingray | *Dasyatis* sp (*fluviorum* ?) |
| Black bream/Sooty grunter | *Hephaestus fuliginosus* |
| Black banded rainbow fish | *Melanotaenia nigrans* |
| Gilbert's grunter | *Pingalla gilberti* |
| Lorentz's grunter | *Pingalla lorentzi* |
| Silver tandan | *Neosilurus argenteus* |
| River sawfish | *Pristis pristis* |
| Leathery grunter | *Scortum hillii* |
| Barcoo Grunter/Leathery grunter | *Scortum barcoo* |
| Freshwater anchovy | *Thryssa scratchleyi* |
| Fly River garfish | *Zenarchopterus novaeguineae* |
| Buffon's garfish | *Zenarchopterus buffonis* |

## 23.3 Distributions

### *23.3.1 Extent*

The Archer, Jardine and Wenlock rivers share one species not collected in the Holroyd, Edward or Coleman, coal grunter (*Hephaestus carbo*). This fish appears to have a broken distribution, as it is present on the east coast in the Olive, Harmer, and Lockhart River basins, and in the headwaters of the Mitchell and the Gilbert rivers further south in the Gulf. The reasons for this are unclear.

The Holroyd, Edward and Coleman rivers shared two grunters not collected from the rivers to the north. Leathery grunter (*Scortum cf. hillii*), and barcoo grunter (*Scortum cf barcoo*) were all collected from the Holroyd, Edward and Coleman Rivers. Barcoo grunters were present in the Palmer River, also.

The Holroyd/Edward/Coleman area appears to be an area of change in fish distributions. It marks the most southerly distribution of threadfin rainbows (*I. werneri*) and poreless gudgeon (*O. nullipora*) on the west coast. The northern limit of distribution of Gilbert's grunter (*Pingalla gilberti*) appears to be the Coleman. The Archer River appears to be the southernmost boundary of coal grunter (*H. carbo*) and banded rainbow fish (*M. trifasciata*). Lorentz's grunter (*Pingalla lorentzi*) appear to be restricted to the Jardine and Wenlock Rivers only, on the far north of the Peninsula.

These distributions possibly could be influenced by temperature, as suggested by Allen and Hoese (1980). However, coal grunter and banded rainbows are found in cool highland creeks (Rifle Creek on the Mitchell River, and Peach Creek on the Archer, respectively) and probably have reasonable tolerance of cold conditions. Both species are regarded by Leggett and Merrick (1987) to have temperature requirements of over 23°C for breeding. The southernmost distribution of poreless gudgeons and threadfin rainbows is the Edward River. These species may have slightly lower temperature ranges than coal grunters and banded rainbows. Possibly the further distribution could be due to differences in salinity tolerances, ease of translocation of such fish by natural means, or other factors.

Other west coast species appeared to be more ubiquitous. Saratoga, large sleepy cods (*O. lineolatus* and *O. selheimi*) and black bream/sooty grunter were present all along the west coast. Of interest was the toothless catfish (*Anodontiglanis dahli*) which was collected from all the western flowing rivers except the Wenlock and Jardine. The Archer River appeared to be northernmost point in the distribution of the fish as it has not been collected from the Weipa region (Tait & Pearson, 1988; present study). Toothless catfish are also distributed in the Northern Territory and Western Australia (Allen 1989) and are known from the southern gulf rivers the Gilbert and Leichhardt (Midgley, 1985; Wager, 1993).

*23.3.2 Habitat dependence*

Sawfish (*Pristis pristis*), river sharks (*Carcharhinus leucas*) and stingrays (*Dasyatis* sp. -probably *fluviorum*) were generally only seen or reported from larger waterholes in downstream parts of the rivers. We only caught a river shark at one location (Stone's Crossing on the Wenlock River), but had reliable reports of their presence in King Junction Hole on the Palmer River and Blazeaway Hole in the Coleman. Other reports were less specific. King Junction is about 300 km from the mouth of the Mitchell, or about 250 km from the upper limit of tidal influence.

Freshwater stingrays were noted to be extremely abundant in the Wenlock River, probably because it is perennial in the lower reaches. They were seen as far upstream as the waterfall (about 200 km upstream from the river mouth). Evidence of their presence was noted at all locations downstream of this due to the circular depressions left in the sand where they bury themselves. Freshwater stingrays (up to 1 m diameter) were also observed in the Archer River at Horsetailer Hole and further downstream. Reports of freshwater stingrays in other rivers were from holes within 100 km of the sea, except King Junction on the Palmer.

River sawfish were caught only in river holes in the Archer River downstream from and including Horsetailer Hole, about 120 km from the river mouth. A sawfish was caught in the Wenlock river at Stones Crossing. No sawfish were captured or seen in lagoons. However, there were reports of sawfish being seen in the Coen river at the Bend (250 km upstream of the mouth) during the wet season. All other reports of sawfish were from large permanent holes in the downstream areas of rivers. Ironically, no sawfish had been caught from Swordfish hole on the Coleman River, although local residents assumed that the hole was named after one was caught there.

It appears that sawfish, sharks and rays all require permanent, large river holes to live in. None were found or reported from lagoons anywhere, although Malcolm Taylor (pers. comm.) has collected them in lagoons in the Mitchell system. These fish appear to require large bodies of water to support them during the dry season, when most rivers cease flowing. Although stingrays do use the shallows a lot, they were always observed in locations near deep holes. The large size of these fish precludes them from living in the shallow upstream sections of rivers. The deep, large holes found in all downstream reaches of rivers appear to be essential habitat for these fish.

A number of small fish appeared to be dependent upon the presence of aquatic vegetation and their distribution was restricted to those lagoons with abundant vegetation. Threadfin rainbows (*I. werneri*) and pennyfish (*D. bandata*) were collected exclusively from vegetated lagoons. This is an important consideration in management as disturbance from pigs, horses and cattle muddies lagoons and kills aquatic vegetation. No threadfin rainbows or pennyfish were found in turbid lagoons even when there was remnant emergent vegetation. The retention of clear, vegetated lagoons is important for continued survival of these fish in the wild. On most stations cattle are in low numbers so did not cause extensive damage. Horses and pigs, due to their wading and digging habits, disturb lagoon habitats severely, particularly late in the dry season when the fish start to breed. Most stations make some attempt to manage these pests but it is an expensive job and often impractical.

It was interesting to note that poreless gudgeons (*O. nullipora*) were found mostly in lagoons associated with vegetation or leaf litter, in contrast to their east coast counterparts which were only found in humic (tea tree) water habitats. They were occasionally collected from river holes, also. All west coast poreless gudgeons collected were the striped form. In the Jardine and Silver Plains populations, males are plain coloured and females have pale vertical stripes and are mottled (Leggett and Merrick, 1987; present study). Possibly there are different populations of this fish, some which are sexually dimorphic (sexes are different colour or shape) and others which are not.

Banded rainbow fish on the west coast were invariably most common in running water environments. They were rarely caught in oxbow lakes and lagoons, and were never abundant in these habitats. Banded rainbows from the upper reaches of the Wenlock and Archer were noted for their large size and brilliant colours. No juvenile banded rainbows were ever collected in still water habitats, suggesting that flowing water or a clean substrate is essential for breeding in the wild. In captivity they spawn amongst plants or in spawning mops (Leggett and Merrick, 1987). In the wild presumably they spawn in roots or other bankside substrate. Possibly the reason why banded rainbows were not collected from the Holroyd, Edward or Coleman Rivers was because no upstream, running water environments were sampled.

## 23.4 Species of Commercial and Recreational Importance

Barramundi, threadfin salmon and grunter are fished commercially in the estuaries of all western Peninsula rivers. Those fisheries are substantial, with well over half of the 643 tonnes of barramundi caught in the Gulf of Carpentaria in 1992 caught in the CYPLUS area. Exact numbers of full time fisherman operating in the area are not known.

In freshwater, commercial fishing by licensed fishermen is rare. Effective policing is only carried out in the Kowanyama area, where restrictions have been placed on fishing to conserve resources.

The runoff of Peninsular rivers has important effects on the lucrative Gulf prawn fishery, and any developments on these rivers should bear this in mind. It is expected that only massive developments on a scale not yet seen in this country would have an appreciable effect.

Recreational fisheries are undoubtedly the most important fisheries affecting freshwater in the Peninsula. Landholders and residents are generally conservative in their fishing habits, taking only enough for immediate consumption. Most tourists are limited by lack of effective refrigeration facilities, but there are people who take generators and freezers, and freeze quantities of fish to take home. As larger numbers of tourists venture north more pressure will be put on desirable or easily caught species such as barramundi, saratoga, black bream, archer fish and catfish. The last two groups (archer fish and catfish) appear to be able to breed rapidly. Eeltailed catfish (*N. ater*) and archer fish are able to withstand heavy fishing, as observed in the McIvor and Endeavour Rivers on the east coast. Barramundi and black bream are less susceptible to overfishing by legal methods than saratoga because of their high reproductive rates and migratory nature. Saratoga are highly vulnerable to overfishing because they are surface feeders, easily caught, and have slow reproductive rates, only producing small numbers of juveniles (50-100) per breeding (Merrick and Schmida, 1984). They are widely dispersed over the western Peninsula and at present are not uncommon in areas where tourists visitation is limited. Consideration of their vulnerability is important if large scale developments (which may impose significant fishing pressure on inland areas) are proposed. Coastal developments appear not to be detrimental to the inland fisheries, as most people fish for estuarine or ocean fish if the opportunity is there.

There are spectacularly coloured varieties of banded rainbows in the Weipa area, which may be of potential use in the ornamental fish trade as broodstock. There is a wide variation is fish colours and even shape over their distributions. Undoubtedly there are other varieties or forms of fish which may be of interest to ornamental fish fanciers.

### 23.5 Breeding Observations

As observed on the east coast, the smaller, more fecund fish (rainbows, hardyheads, blue-eyes, perchlets, mouth almighties) appeared to breed all year round. Juvenile fish are seen at all times of the year but are particularly abundant after the first storms when natural production in water bodies increases due to nutrients being flushed in.

Larger fish generally have more specific requirements. Most mouth breeders (saratoga, fork tailed catfish) and fish with floating eggs (bony bream, long tom) breed just before monsoonal rains. Fish with eggs which are deposited on the substrate (e.g. sooty grunter/black bream, eeltailed catfish) need clean flowing water for breeding success as their eggs need to be in well oxygenated water and not subject to being covered in sediment. Those species may have to wait until after stream flow commences (usually in January) to breed.

Catadromous species (those which move down to the sea to breed but live in fresh water) are dependent upon good wet seasons in order to move downstream and for juveniles to move upstream before flow stops. Barramundi and tarpon, the two most common inland penetrating species, have estuarine populations which may breed before river flow commences and hence young are available for upstream migration when river flow starts.

### 23.6 Water Quality

Water quality throughout the west coast streams was very good. Oxygen levels were as high as could be expected in the high temperatures. Very little nutrient (phosphate) was present in any of the streams sampled. Turbidity was only high at certain lagoons/holes which had high levels of horse, pig or cattle activity. The sampling on the middle Palmer River was conducted after flow in the upper reaches and through mining leases had stopped, so effects of mining were not observed. No humic waters were sampled in locations south of the Weipa area.

### 23.7 Habitat Disturbance

On the basis of single visits to most sites, there were no severely disturbed sites sampled. However, disturbance from cattle, horses and pigs is largely seasonal, and one-off visits cannot account for this. Disturbance from other sources was minimal, as most stations have not cleared much woodland and there are few extractive industries in the area. The mine at Weipa is isolated from most watercourses and effects from it are minimal. The major disturbance observed was erosion from roads, observed particularly in the southern areas near the Palmer River, where washouts and breakaways were extensive in some areas. Erosion of this nature may be largely attributable to soil types.

Major tourist campsites are present on the Coen, Archer and Wenlock Rivers, at the main road crossings. Facilities at the Archer and Wenlock crossings are minimal and there are undoubtedly effects from the presence of large numbers of people at these sites. These sites were not sampled deliberately as preliminary observations showed that few species were present at these sites, and usually the sites were atypical when compared to the rest of the system. On the Coen and Archer Rivers are a bridge and causeway, respectively, so effects from vehicles crossing are minimal. However, on the Wenlock, a clay bedding was placed on the crossing in 1993, resulting in sedimentation and high turbidity downstream of the crossing. Only two species of fish were observed in the affected area, compared to ten above the crossing.

## 24.0 MANAGEMENT CONSIDERATIONS

**Summary**

1. Under present regimes, most areas in the Peninsula are not under threat. Representative areas of most habitat types are currently in reserves or in land with similar status, and management of grazing leases is compatible with habitat conservation.

2. Threats and long term potential problems include overfishing, feral animals, water use and pollution, and exotic species.

3. Stocking of commercially important species may raise specific management issues in some areas.

4. Areas of special interest covered in this study were a) Olive River, b) Claudie and Lockhart Rivers, c) Sach waterhole, d) sand dune lakes region, e) Holroyd, Edward and Coleman Rivers.

5. Unique faunal assemblages are likely to be found in small tributaries or isolated small drainages. Studies to date have concentrated on major rivers and overlooked this important factor.

### 24.1 Conservation and Management

Under present management regimes, most of the areas surveyed on the Peninsula appear to be reasonably safe from severe degradation, except possibly from feral animals. Many of the areas of significance proposed for National Parks by Stanton (1976) have become National Parks or are covered in special purpose reserves. Some of the areas are aboriginal land. Conservation and management of freshwater fishes in the Peninsula is compatible with present land uses such as low density cattle grazing and small scale agriculture. Most landholders we met were responsible in management of fish and only took enough for their immediate requirements.

Areas of special interest are discussed in 24.4. These areas have special significance as they have either unique faunal assemblages or represent zoogeographical areas of change. At present there are no potential threats to these areas.

Management depends to a degree on the financial success and viability of grazing in the areas concerned. More management of grazing will flow on from better economics as fencing, improved stock and pastures will become more affordable. Additionally, changes in land use to increase productivity may occur. Current policy on clearing in relation to cattle production needs to be developed for specific areas of the Peninsula, as at present clearing in some areas has decreased possible yields due to wind burn and more rapid drying of surface soils. In other areas fertilisation may be necessary to increase yields. Any changes in management practices will impact on fish populations. Some changes could be beneficial, others not so. At present representative samples of most of the important habitats and species assemblages are protected in the various reserves on the Peninsula. If, and when, development occurs in other areas of special significance the development plans (mainly involving buffer strips, erosion control, and access of stock to waterbodies) should be implemented to minimise possible negative impacts. Financial incentives may need to be given to assist in this, as at times they may not be the most economically viable option.

## 24.2 Threats and Potential Problems

### *24.2.1 Overfishing*

Overfishing is a only potential problem in the distant future. At present it is not a major consideration in freshwaters as the most sought after species are estuarine or marine. Commercial fishing in freshwater is currently not viable due to the small size and temporary nature of many of the rivers. At present most tourist pressure is restricted to the main roads, and access to many stations and aboriginal lands is restricted. As the Peninsula becomes more well traveled the number of areas accessible to anglers will increase. As all species of commercial and recreational importance have a wide distribution, and significant habitats are protected in National Parks and reserves, overfishing will only be a localised problem in areas with heavy visitation. Many of the more desirable species can recolonise these environments annually when the floods come. At present, overfishing is not a major consideration and will only be localised in effect in the foreseeable future.

### *24.2.2 Feral Animals*

The effects of feral animals on aquatic environments, particularly swamps and lagoons, have been well documented (e.g. Thomson, 1935). The integral importance of lagoons in maintaining fish populations and as nursery grounds for juvenile fish is of concern due to the damage caused by feral animals. Particularly at the end of the dry season horses, pigs and cattle congregate around lagoons and may make the water turbid and/or eat much of the aquatic vegetation. Most properties make some attempt to manage horses and pigs, and cattle are stocked at comparatively low densities, so at present the damage caused is not a major concern. In the wet season the floods rejuvenate damaged lagoons and the animals disperse.

In a succession of particularly dry years, however, the lagoons may not be rejuvenated and animals disperse for a much shorter period. Already, localised extinction of the lotus (*Nelumbo nucifera*) has occurred on the lower Mitchell floodplain due to pig activity (Sinnamon, pers. comm. 1993). It was believed that this was due to the succession of dry seasons and low level of lagoons which allowed pigs access to the rhizomes of the lotus plants everywhere. It is not known if, or how severely, other less distinctive plants were affected.

Management of feral animals is an issue which should be addressed, as it bears directly on the pastoral industry and conservation values on the Peninsula. The impact of feral animals on crucial lagoon environments needs research, to determine if these systems have the capacity to rejuvenate or if long term feral animal activity degrades them. The presence of large numbers of feral animals, asides from their effect on the aquatic environment, may be of immense importance in the event of exotic disease outbreaks. Cost effective methods of control of feral animals may need to be developed.

*24.2.3 Water Use*

At present problems associated with water use (sharing, salinity etc.) have not arisen due to low levels of population. Particularly in areas with intermittent rivers, future growth may see increased use of surface water resources for agriculture, mining and domestic use. Particularly, some mining activities and leachates from mineral areas are of concern due to high levels of heavy metals or other toxins in them. Effects of discharge of waste water into waterways with minimal flow has been demonstrated in the Murray-Darling system, and it should be considered in future developments on the Peninsula.

Eutrophication (a condition where waterways become choked with water weeds due to nutrient input) is a potential cause for concern if agriculture using large amounts of fertiliser is ever developed on the Peninsula. Effects of enriched runoff would only be observed during periods of low flow. Parts of the Peninsula apparently have soils unsuitable for agricultural activity, so this is a management concern in those areas.

*24.2.4 Exotic Species*

No exotic species of fish were collected from any location on the Peninsula. Guppies (*Poecilia reticulata*) are present in drains around Weipa and may spread into Trunding Creek. Sooty grunter/black bream (*Hephaestus fuliginosus*) were successfully translocated into Wallaby Creek on the Annan River. No noxious exotic water weeds were noted by us on the Peninsula.

Exotic species do not appear to thrive in undisturbed environments. This may be true for plants as well as animals. Rubber vine (*Cryptostegia grandiflora*) is abundant in the disturbed Mitchell and Burdekin catchments but is not as abundant in less disturbed areas of the Normanby Complex. Burning practises also impact on this species. Introductions of fish appear to be similar. Introductions of tilapia (*Tilapia mariae*) in areas around Cairns has met with varying success. They have established well in drains and disturbed creeks but appear to have fared less well in clear rainforest streams. Some introductions may not have established. There was some concern about the use of tilapia as live baits and some reports of people taking them into Cape York Peninsula on fishing trips. Tilapia appear to survive best in pond/lagoon type environments. It is not known what the effects of tilapia introduction would be, except that the fishing would not get any better (except for tilapia), which breed up in enormous numbers and become stunted in a short period.

**24.3 Stocking of Commercially Important Species**

There are proposals by some fisherman's organisations to stock natural waterways with barramundi fingerlings. Considerations that should be taken into account in any stocking programme primarily concern impacts on yield and secondarily on the environment. Research designed to determine the efficacy of such a program and the effects on native fish populations, if any, would need to be conducted.

The idea of stocking itself is good, but considerations to be taken into account would be when stocking should occur, as movement of barramundi juveniles into temporary habitats (e.g. swamps, temporary lagoons, intermittent rivers) would be a waste of resources. Bony bream (*Nematalosa erebi*) are a favourite food of barramundi, and they are abundant in all western river systems, particularly lagoons, providing a vast potential food resource.

Care should be taken to ensure that if such programs are to go ahead that only fish from that area are used as breeders, to avoid possible problems later. Translocation of different sturgeon stocks between lakes in Russia caused the complete collapse of several very important fisheries. Translocation of fish can have unforeseen effects and present policy is to prohibit it without special permission. Recent research on the genetics of barramundi suggest that there is considerable mixing of genetic stocks around the coastline (Keenan, pers. comm.), and that stocks previously believed to be discrete may not be so. Continued research will enable effective, more informed management decisions to be made. Ownership of privately stocked fish in natural waters is also an issue which may need to be considered.

Aquaculture (raising of prawns, crayfish, fish or crabs) in ponds is a different scene altogether, as the problems with stocking in natural waters are minimised or negated. Possible candidates for pond culture in the Peninsula include redclaw (*Cherax quadricarinatus*) and barramundi. When technology is developed, other species such as red bream (*Lutjanus argentimaculatus*) or sleepy cods (*Oxyeleotris* spp.) could be grown for local markets or export. Red bream and sleepy cod already fetch high prices in south-east Asian markets, and there is potential for exploitation of this market. The high temperature for most of the year over much of the Peninsula would be suitable for rapid growth of tropical fish and crayfish. Barramundi cultivated further south either grow slowly or not at all for up to 6 months due to the colder temperatures.

**24.4 Areas of Special Interest**

*24.4.1 Olive River*

The Olive River is of special significance as it is one of the most biologically diverse streams in Queensland in relation to the size of its catchment. It represents the southernmost distribution of Jardinean fish fauna on the east coast. The Olive is unusual for such a small stream in that it has large numbers of large fish, with barramundi, coal grunter, saratoga, tarpon, eeltailed catfish, jungle perch, archer fish and red bream abundant in even small holes. Large numbers of potential ornamental fish are also present in the Olive (Plate 31).

The Department of Environment and Heritage has expressed an interest in acquiring the property on which all the perennial parts of the Olive lie (Bromley Holding and Carrom Valley). At present visitor numbers are restricted as entry is only obtained through Bramwell Station or Bromley, and few people seem to know about the Olive River.

Current management régimes do not pose a threat to the Olive river ecosystem, as present managers of the lands have a responsible attitude. This area does have significant conservation values and apparently much of it is not good grazing country (according to D.P.I. Pasture Management), and it may be of best use for conservation/nature park type activities. The abundance of other wildlife (particularly birds) would attract nature lovers from around the world.

*24.4.2 Claudie and Lockhart Rivers*

The Lockhart River was of significance because it represented the southernmost distribution of coal grunter (*Hephaestus carbo*) and short-finned catfish (*Neosilurus brevidorsalis*). Of particular interest is the shortfinned catfish because it is a very rare catfish in Australia, only a few specimens have been collected (see Paxton et al, 1989) from the Jardine River and McDonnell Creek (Allen and Hoese, 1980). The presence of this fish and coal grunter suggest that the Claudie and Lockhart Rivers were once very close (they shared a common outflow when sea levels were lower) and that they have a relationship with the Olive River which was not shared by the Pascoe. Also collected from the Claudie River were extra large freshwater prawns (*Macrobrachium rosenbergii*) which appeared to have a larger body size in relation to head size than normal freshwater prawns of this species. For its catchment size, the Claudie River has one of the most diverse fish faunas of any Australian river, with 19 freshwater species and 3 estuarine species collected.

The Claudie River has considerable disturbance due to the turbidity from vehicle wash at crossings which results in siltation for considerable distance downstream of crossings. Construction of concrete causeways at the creek crossings would not only improve access to Lockhart River and Portland Roads, but would help to minimise the severe disturbance caused by the substantial amount of vehicle wash occurring during the tourist season. The Claudie River is largely protected within National Park , State Forest or aboriginal lands. The Lockhart River is fully located within the Lockhart River Community lands.

*24.4.3 Sach Waterhole*

Sach Waterhole was unique as it had the only floating vegetation mats observed in the Peninsula. These mats were composed of a reed, *Lepironia auriculata*, and floated about 1m above the substrate of the waterhole. The root bed was about 1m deep in the water. These dense mats supported other vegetation such as pitcher plants (*Nepenthes mirabilis*) and mangrove fern (*Acrostichum speciosum*). They also provided the habitat for all fish species in the lake except rainbows (*Melanotaenia splendida inornata*) and large eeltailed catfish (*Neosilurus ater*). Although only eight fish species were collected from Sach Waterhole, it is a unique habitat not documented elsewhere in Australia. The only other floating vegetation mats we have heard of are those in the Northern Territory, which are composed of *Hymenachne acutigluma* (see Hill and Webb, 1982). There are also limited mats of reeds at Blue Lake, Stradbroke Island, in south east Queensland (Pusey, pers. comm.)

*24.4.4 Sand Dune Lakes*

The dune fields scattered along the east coast from Shadd Point to Cooktown are of special significance as they appear to hold a particular species assemblage, and sometimes of species far outside their normal distribution. Each sand dune region had its own particular unique faunal assemblage. The dunes at Cape Flattery have pennyfish (*Denariusa bandata*), Obbes' catfish (*Porochilus obbesi*), and poreless gudgeons (*Oxyeleotris nullipora*), all of which are normally found on the west coast or at the tip of the Peninsula in the Jardine River.

Three Quarter Mile Lake and Scrubby Creek (Plate 32) had delicate blue eyes (*Pseudomugil tenellus*), sexually dimorphic poreless gudgeons and vast numbers of Rendahl's catfish (*Porochilus rendahli*). Each sand dune lake in the Olive River dune field had its own unique, distinctive fauna (Lees and Saenger, 1989). The lakes near Shadd and Ussher Point, also, have limited fish faunas reflecting their isolation and/or special water quality characteristics. The sand dune lakes are fragile environments which have been protected by their isolation and the poor country surrounding them. However, silica mining is a potential threat (in the distant long term), and irresponsible development may also be of concern in relation to those dune lakes in areas currently in grazing leases. Although such threats are unlikely in the foreseeable future, the dune environment is a magnificent and valuable scenic and natural resource and the dune lakes are unique. Even lakes side by side may have different fish faunas and different water chemistry.

*24.4.5 Holroyd, Edward and Coleman Rivers*

The Holroyd, Edward and Coleman rivers represent an area of faunal change, between the more typical northern fauna and the fauna of the southern Peninsula. Two species of leathery grunter (*Scortum* spp.) were present in these rivers but were not present north of them. Threadfin rainbows, poreless gudgeons and Macleay's glassfish were found in the Edward River but not the Coleman River, as this area marks a zone of change in fish faunas. Also, silver tandans (*Porochilus argenteus*) were present in the Edward and were found nowhere else on the Peninsula. Delicate blue eyes were collected from the Edward River (by Hansen, 1985), and those have only been collected from the Jardine and Watson systems before, suggesting that they have a very restricted distribution. On the west coast, these rivers exhibit an area of transition between faunal regions and have unique faunal assemblages.

Plate 31. The catch from a small pool in the Olive River. Saratoga, coal grunter, banded rainbows, threadfin rainbows and sailfin glassfish are present

Plate 32. Scrubby Creek. This is the only documented habitat of delicate blue-eyes on the east coast of the Peninsula.

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**24.5 General Observations on Faunal Assemblages**

It appeared from our limited studies that unique faunal assemblages were more likely to be found in tributaries of major rivers or areas away from major rivers. The most unique environments, with species rarely encountered elsewhere on the Peninsula, were the small creeks and streams or lagoons. Scrubby Creek/Three Quarter Mile Lake, Ronnie's Rocky Creek (tributary of the Stewart River), Black Creek (Hope Vale), swamps near Weipa and the creek near Bolt Head all had interesting and unique faunal assemblages not found in main rivers they flowed into or were near to. Each of the sand dune lakes sampled by us had either differences in water chemistry or fish fauna. Lees and Saenger (1989) found a unique freshwater fish fauna in each lake sampled in the Olive River dune field. The museum records from Cape Flattery indicate the presence of relict populations of Jardine River fish.

That a number of species found nowhere else on the Peninsula were restricted to minor tributaries suggest that further investigations are essential before conclusions, based upon knowledge of the fauna in the major rivers, can be drawn about an area.

# 25.0 CONCLUSIONS

## Summary

1. Distributions of many species are much wider than previously thought. Electrophoretic tests between selected populations of east and west coast fish did not reveal differences.
2. Lagoons are crucial habitats for some species of fish which appear to require aquatic vegetation. They are also important refuges in dry seasons and breeding grounds prior to floods.
3. Flooding is of extreme importance for rejuvenation of habitats, breeding and migration of fish. They are essential for catadromous fish such as barramundi to reach the sea for spawning and for juveniles to recolonise freshwater habitats.
4. Overfishing, while not a concern at present, should be considered as a potential problem in the distant future. Some vulnerable species such as saratoga and jungle perch may require special management in some areas.
5. No exotic species appear to have established in the study area to date. Exotic species appear to require disturbed habitats to establish.

## 25.1 Species Diversity

The northern rivers of Cape York Peninsula appear to have possibly the most diverse fish fauna of any region in Australia. This area is still largely unexplored and studies and surveys on fish have generally concentrated on the major river systems. It appears from the results of this study and others that smaller tributaries and isolated drainages may harbour species in restricted distributions (e.g. *Melanotaenia nigrans* at Weipa) or that some species may have localised distributions within a river system (e.g. *Thryssa scratchleyi* in the Archer River system, *Neosilurus argenteus* in the Edward). The number of species already documented from the northern rivers of the Peninsula compares favourably with those documented from the Alligator Rivers region, probably the most intensively studied tropical monsoon region in Australia, and tropical Asian and African rivers (See Figure 16). Further studies in the Peninsula will probably document more species with restricted distributions and increase the number of species documented from in this area. The northern Peninsula appears to have the richest fauna, although studies in the huge Mitchell system will undoubtedly produce many species not previously documented. As late as 1992 specimens of *Varichthys lacustris* (Allen, 1993) were collected in the Mitchell. These were previously unknown from Australian waters.

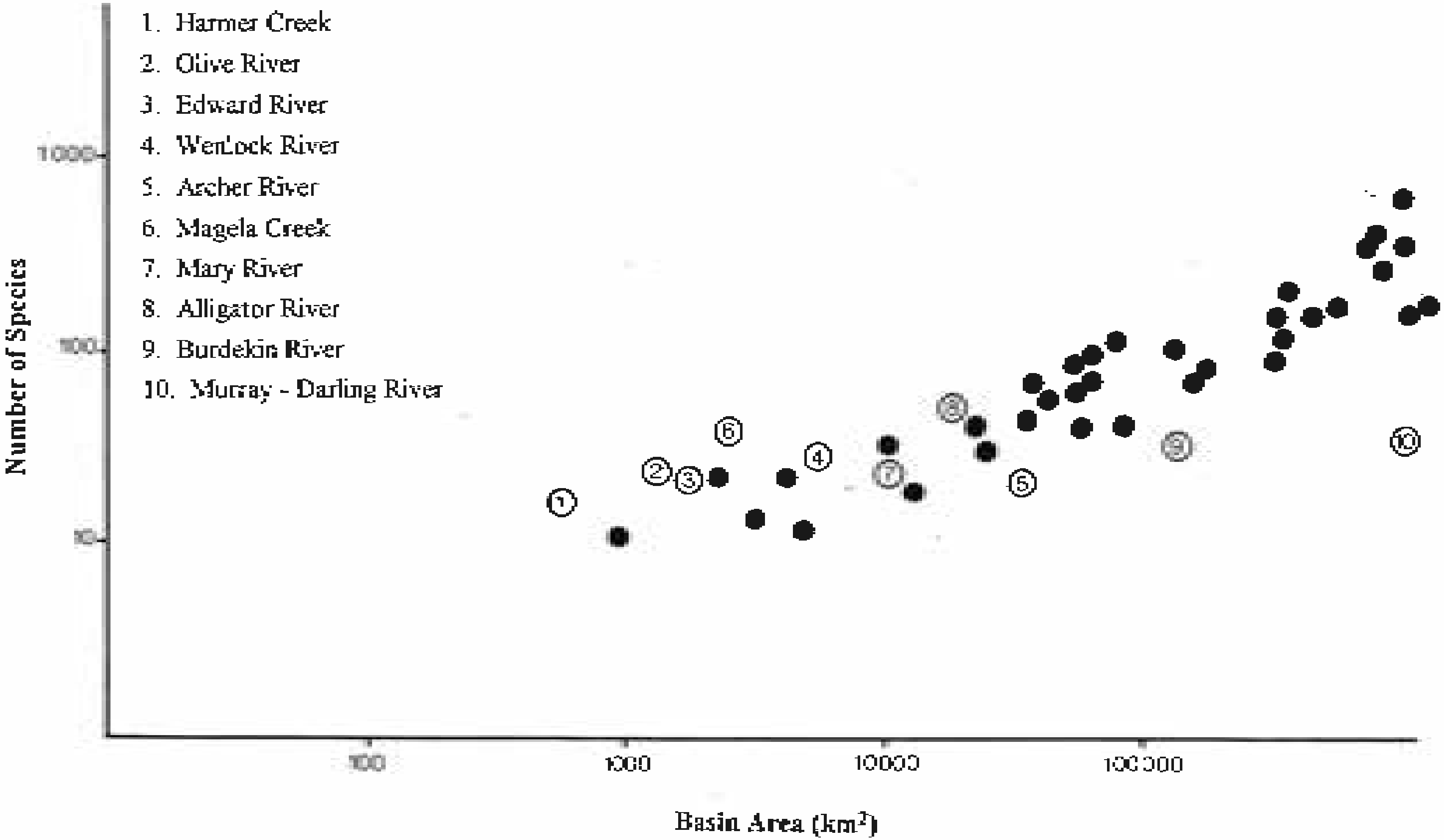


**Figure 16.** **Relationship between the number of fish species and basin area for selected rivers in Australia Filled circles represent selected tropical Asian and African Rivers. Adapted from Welcomme (1985) and MacKinnon (1987)**

**25.2 Species Distributions**

Distributions of most fish species found on Cape York Peninsula were much wider than previously thought. The most recent comprehensive documentation of fish distributions in Australia was by Allen (1989). The results of this survey has extended many of the distributions known for fish at that time. Work done previously by other collectors (notably Midgley 1985, 1988; Leggett, 1987, 1990; Hansen, 1987, 1988, 1989 and Armstrong, 1985, 1987) was discussed earlier in the relevant sections.

Of some significance was the collection of specimens of west coast fish fauna from the Harmer, Olive and Annan Rivers on the east coast. Although documented previously (Midgley, 1988) and known to locals and recreational fisherman for years, specimens from the Olive River or Harmer Creek had not been lodged with the museum. Electrophoretic comparison of general proteins was conducted on saratoga (*Scleropages jardinii*), coal grunter (*Hephaestus carbo*) and eeltailed catfish (*Neosilurus ater*) by C. Keenan at the Southern Fisheries Centre, Deception Bay. Specimens of the fish from the Harmer, Olive, Wenlock, Lockhart and Archer Rivers were collected and compared. The only protein profiles which stood out as being different to others were those of eeltailed catfish from Harmer Creek. Saratoga and coal grunter from all sites (which have more complex protein profiles than catfish) were identical. Enzyme analysis is the next step in determining if there are any minor differences between the east and west coast populations of these fish but these will take some time to be completed. Of particular interest is whether coal grunter from the east coast are different at all to the west coast ones, as they do grow larger and are differently coloured. If there are no genetic differences then the morphological differences may be due to the environment they live in. The specimens of eeltailed catfish collected from all sites are lodged at Queensland Museum. Although they did not appear to be different, the Harmer Creek population has a different protein profile which suggests it has been isolated for a much longer period than would be suggested by the geology of the region.

The extension of the distribution of the west coast fauna down to the Olive River changes the generally accepted pattern of distribution of Australian fishes which places them in drainage divisions. The eastern coast drainage division (see Lake, 1978) should probably start at Princes Charlotte Bay, which is the most northerly distribution of east coast fish such as southern purple spotted gudgeon (*Mogurnda adspersa*), eastern rainbow fish (*Melanotaenia splendida splendida*) and Agassiz's perchlet (*Ambassis agassizi*)(Refer to Kennard, 1992). North of Princess Charlotte Bay the fish fauna appears to be more fragmented but has major elements of west coast fauna, particularly striped sleepy cod (*Oxyeleotris selheimi*), chequered rainbow fish (*Melanotaenia splendida inornata*), coal grunter (*H. carbo*) and northern purple spotted gudgeon (*Mogurnda mogurnda*). Originally, the Stewart River to the north of Princess Charlotte Bay flowed west, being part of the Holroyd River (C. Paine, pers. comm.). It was diverted eastwards by uplifting land (at about where the Port Stewart Road is now) and so has western fish fauna in it.

The large number of species for which extensions of known range were recorded is briefly discussed below. See Appendix Three for mapped distributions.

Rainbow fishes: Threadfin rainbows (*Iriatherina werneri*) were abundant in heavily vegetated lagoons in all west coast rivers as far south as the Edward. On the east coast they were present in both creeks and lagoons (some not vegetated) and sand dune lakes south to the Olive River. Previous recorded distribution was the Jardine and Holroyd Rivers (Allen, 1989), Edward River (Hansen, 1987), Olive River dune field lakes (Lees and Saenger, 1989), and the Watson River (Queensland Museum).

McCulloch's Rainbow (*Melanotaenia maccullochi*) were uncommon in Harmer Creek and Shelburne Bay dune lakes, and at Scrubby Creek (Chester River) near Silver Plains. They were abundant at Blue Valley lagoon (north of the Jardine) and common Black Creek (Hope Vale - tributary of Endeavour River). Previous records are of four isolated relict populations, on the Jardine River, McIvor River and plains, streams north of the Daintree River and the coastal plains from Cairns to Cardwell (Allen, 1989). They have also been collected from the Olive River dune field (Lees and Saenger, 1989), and Cape Flattery dune lakes (Queensland Museum). McCulloch's rainbows were only collected from sand country, usually in strongly tannic water. Their distribution is probably anywhere on the east coast with suitable habitat.

Black-banded rainbow fish (*Melanotaenia nigrans*) were collected at Kupandhangan swamp near Weipa. Black banded rainbows were initially known in Queensland only from the Jardine River (Allen, 1989), Jacky Jacky Creek (Leggett, 1987) and Prince of Wales Island (Queensland Museum). More recently they have been reported from Pappan Creek (Weipa), (Tait and Pearson, pers, comm.) and Tentpole Creek (Weipa) (Armstrong, 1985). These records are all from a regional population centred around the north-east and north of Weipa between the Mission and Embley rivers.

Blue eyes: Gertrude's blue-eye (*Pseudomugil gertrudae*) were collected in the Wenlock, Harmer and Olive Rivers, Scrubby Creek, Blue Valley Lagoon, Kupandhangan swamp, and dune lakes north of Harmer Creek. Previously Queensland populations were reported from the Jardine River area and the Tully swamps (Leggett, 1987, Allen 1989), Cape Flattery (Queensland Museum) and the Embley estuary (Blaber et al 1989). The population at Blue Valley Lagoon had particularly large fins and were large for this species (SL 25 mm). The specimens collected from Kupandhangan swamp had red tips on the pectoral fins. Delicate blue-eyes (*Pseudomugil tenellus*) were collected from Scrubby Creek on the east coast of Australia. Previous records in Queensland were from the Jardine River (Allen, 1989) Watson River (Queensland Museum) and Edward River (Armstrong, 1987).

Gudgeons/Sleepy Cods: Poreless gudgeons (*Oxyeleotris nullipora*) were collected from all west coast rivers as far south as the Edward. On the east coast they were abundant in all lagoons, creeks and sand dune lakes from the tip down to Scrubby Creek (but were not found in the Claudie River). Numerous specimens were also collected from Black Creek at Hope Vale. Previously they have been collected from the Jardine area (Allen, 1989), Cape Flattery (Queensland Museum), Edward River (Hansen, 1987), Archer River (Queensland Museum), Watson River (Queensland Museum) Shelburne Bay (Queensland Museum), and the Kennedy River (Wager, 1993). Those records make its distribution continuous throughout the north Peninsula from Hope Vale to the Edward River. It was interesting that on the east coast the species was only associated with humic waters, and on the west coast it was found in both river and lagoon environments, usually associated with leaf litter or aquatic vegetation. The sexually dimorphic population reported by Leggett from the Jardine (see Leggett and Merrick, 1987) was only found by us at Scrubby Creek and Hope Vale, both on the east coast. All west coast poreless gudgeons sampled by us were mottled/striped.

Sleepy Cods (*Oxyeleotris gyrinoides, O. lineolatus, O. selheimi*) were divided into east and west coast distributions. Eastern sleepy cod/green backed gauvina (*O. gyrinoides*) were common to abundant in all east coast streams south of the Olive River, and they are probably present in the Harmer. There appears to be a gap in their distribution between Massy Creek to the McIvor River, excepting a small population at Cape Melville. In the Stewart River on the northern limit of this gap, striped sleepy cod (*Oxyeleotris selheimi*) are present and common. In the Normanby Complex, Kennard (1992) and Leggett (1990) collected sleepy cod (*O. lineolatus*). Possibly eastern sleepy cod have environmental requirements not met by the rivers in the Normanby complex. We believe other reports of sleepy cod (*O. lineolatus*) in the east coast rivers to be misidentifications, as no other large sleepy cods were seen in the other east coast rivers sampled by us. Sleepy cod (*O. lineolatus*) and striped sleepy cod (*O. selheimi*) were common to abundant in all west coast rivers sampled by us. Sleepy cod (O. *lineolatus*) records as in Wager (1993) extend up and down both coasts of the Peninsula in areas either not sampled by us (Jardine, Normanby) or areas sampled by us but where *O. gyrinoides* or *O. selheimi* were caught (Stewart, Endeavour).

Fimbriate gudgeons (*Oxyeleotris fimbriatus*) were collected from the Wenlock River in the west and the Olive River in the east. Previously they were documented only from the Jackson and Dalhunty rivers (Allen, 1989).

Snakehead gudgeons (*Ophieleotris aporos*) were reported by Allen (1989) to be present as far north as Cape Tribulation. We collected them in the Endeavour River, creeks at Bathurst Bay, and a small creek at Bolt Head. They have also been collected in the Jardine River area (Leggett, 1987), sand dune lakes of the Olive River dune field (Lees and Saenger, 1989) and the Embley estuary (Blaber et al, 1989). It appears that their distribution extends north to Cape York and down the west coast of the Peninsula to the Weipa area.

Northern purple spotted gudgeons (*M. mogurnda*) were collected all along the west coast as far south as the Coleman River, with the exception of the Holroyd and Edward River. Midgley (1985) collected them in the Holroyd. They were collected by us in all eastern rivers as far south as Bathurst Bay, and were also collected in Black Creek at Hope Vale. Southern purple spotted gudgeon (*M. adspersa*) were only collected by us in the McIvor, Endeavour and Annan rivers, and Palm Creek. These collections extend the documented distribution (in Allen, 1989) of northern purple spotted gudgeon south from the Jardine River basin to the Normanby basin. Kennard (1992) reported southern purple spotted gudgeons from the Normanby system, but Leggett 1990 collected northern purple spotted gudgeons from the area. From our collections and museum records, southern purple spotted gudgeons have only been collected from the Bathurst Bay and south.

Eeltailed catfish: Black catfish (*N. ater*) were collected in all river systems sampled by us except the Jeannie and Howick Rivers. The distribution of black catfish appears to cover the entire Peninsula area. Previous records of Allen (1989) documented it only in the Jardine and Starcke Rivers, and museum records only add the Annan River to that list. Collections by Midgley (1985, 1989) and Leggett (1990) undoubtedly include black catfish. (Midgley's and Leggett's reports did not identify eeltailed catfish to species). Kennard (1992) documented their presence in the Normanby complex. It is surprising that such a large, tasty, common and ubiquitous fish has been overlooked, although difficulties in identification of this fish have meant that many collections have not been identified.

Shortfinned catfish (*Neosilurus brevidorsalis*) were collected from the Olive, Claudie and Lockhart Rivers, an extension south of previous collections. Shortfinned catfish were only known from the Jardine and Jackson Rivers, at the northern tip of the Peninsula (Allen, 1989). They appear to be very uncommon wherever they are found.

Silver tandans (*Neosilurus argenteus*) were abundant at only one location in both the Edward and Coleman Rivers. No other collections of these fish from the Peninsula have been documented. Their known distribution is central Australian, inland draining river systems (Wager, 1993; Larson and Martin, 1991; Allen, 1989).

Obbes' catfish (*Porochilus obbesi*) were collected in the Olive River in small numbers in lagoons. Their documented distribution on the Peninsula includes the Jardine Basin (Allen, 1989) and Watson and Jacky Jacky basins (Queensland Museum) (Wager, 1993). This record extends their distribution further down the east coast.

Rendahls' catfish (*Porochilus rendahli*) was collected in vast numbers in Three Quarter Mile Lake, at Silver Plains. A few were collected in lagoons near the Endeavour River, Wenlock River, Archer River, Holroyd River and Palmer River. Few collections elsewhere in the Peninsula have been documented, apart from the Jardine River (Allen, 1989), and the Normanby Complex (Kennard, 1992).

Toothless catfish (*Anodontiglanis dahli*) were collected in all rivers south of and including the Archer on the west coast. These records extend the distribution as documented by Allen (1989), although Midgley collected them in the Holroyd and Coleman basins in 1988.

Fork-tailed catfish (Ariidae). These were collected in abundance by us in all west coast rivers. Lesser salmon catfish (*Arius graeffei*) and shovel-nosed catfish (*Arius midgleyi*) were abundant and common at all sites on floodplains. Triangular shield catfish (*Arius leptaspis*) was uncommon and only found in the Wenlock and Archer Rivers. Berney's catfish (*Arius berneyi*) was only collected from the Coleman and Holroyd rivers. Due to difficulties in identification, we have not received confirmation of identifications from the museum to date. The distribution of all species match those of Allen, 1989, except that the distribution of shovel nosed and triangular shield catfish are extended north to the Wenlock River.

Swamp eels (*Ophisternon bengalense*) were collected from all river basins sampled on the west coast, except the Palmer. They were also collected from the sand dune lakes near Cape York down to the Olive River. It was unusual that no specimens at all were collected in 1992 or early 1993. They were only collected after July 1993, in every river system sampled. Possibly 1993 was a good year for recruitment, or in 1992 they were scarce, as the same techniques were used throughout the study period and suitable habitat was sampled. This species of swamp eel has only been collected from Goulburn Island in the Northern Territory previously (Paxton et al 1989). These records represent the first records of this species from Queensland and mainland Australia.

Glassfish/Perchlets: a total of six species of glassfish were collected during the course of this study. Macleay's glassfish (*Ambassis macleayi*) was common to abundant throughout its west coast distribution, and was collected from the Olive River, which is an extension of its known distribution to the east coast.

Mueller's glassfish (*Ambassis mulleri*) was collected from Three Quarter Mile Lake, the Howick River, Black Creek at Hope Vale and the Wenlock, Archer, Edward and Palmer Rivers. All of these are outside the known distribution of Mueller's glassfish which was believed to be restricted to the southern Gulf of Carpentaria and inland drainages in Queensland (Allen, 1989; Wager, 1993).

Sailfin glassfish (*Ambassis agrammus*) were also believed to have a restricted distribution in northern Cape York Peninsula. We found them in all river basins studied north of and including the Edward River on the west coast, and north of and including the Endeavour River on the east coast. Their distribution overlapped that of Mueller's glassfish and Agassiz's glassfish (*Ambassis agassizi*). In Queensland, sailfin glassfish had only been collected from the Endeavour River until recently (Wager, 1993). They were the most abundant and widely distributed glassfish collected in this survey.

Agassiz's glassfish were believed to be distributed from South Australia to Cairns, (Allen, 1989). Our collections have extended their distribution north to the Annan River and an isolated population in the Stewart River. Additionally, Kennard (1992) collected them in the Normanby Complex at Lakefield National Park. The Princess

Charlotte Bay population represents a considerable gap in the distribution of Agassiz's glassfish, as they co-existed with sailfin glassfish in the Stewart River and are present in the coastal rivers from the Howick south to the Endeavour.

In the Edward, Coleman and Holroyd rivers all species of Ambassids collected (but not all individuals) had red pelvic fins and often reddish dorsal, anal and caudal (tail) fins. These colour forms would make attractive aquarium fish.

Pennyfish (*Denariusa bandata*) were collected in all vegetated habitats on the west coast of the Peninsula, except the one sampled on the Palmer River. We have seen specimens from the Mitchell River floodplain at Kowanyama, which suggests that they extend a very long way through the Gulf. They have been collected as far west as the Nicholson River at the southernmost point in the Gulf of Carpentaria (Midgley, 1988). On the east coast we collected none. However, pennyfish are found at Cape Flattery (Queensland Museum) and in the Normanby Basin (Kennard, 1992) on the east coast.

Gobies: Bug-eyed goby (*Redigobius bikolanus*) were collected in the Annan, McIvor, Starcke, Claudie and Pascoe Rivers. It was believed to have been only as far north as the Normanby complex (Wager, 1993), and these additional records represent a significant extension of its distribution to the north. Spot-fin gobies (*Redigobius chrysosoma*) were only collected in the Claudie River. This was the only location on the Peninsula where they have been collected to our knowledge.

Freshwater soles: Saltpan sole (*Brachirus salinarum*) was only collected by us in one location on the Wenlock River and on the Jardine River. It is occasionally also caught by anglers at Moreton telegraph crossing. This species has been recorded from the Archer and Mitchell River systems also (Allen, 1989). It appeared to be uncommon and restricted to certain areas of river bed.

### 25.3 Importance of Lagoons

Lagoons appeared to be of particular importance as the only habitat for some species of fish. Only a few species (e.g. saltpan soles and jungle perch) were restricted to rivers and these were collected infrequently. Rendahl's catfish, Obbe's catfish, threadfin rainbows and pennyfish were never collected in any habitat other than heavily vegetated lagoons (with the exception of threadfin rainbows in the Olive River). Lagoons are absolutely essential for survival of these species.

Lagoons are also crucial as refuges during dry periods, particularly in the upper and middle reaches of intermittent streams, where waterholes are few and far between. For example, in 1991 there was no surface water in the bed of the Archer River between Fox Hole and Horsetailer Hole, a distance of some 70 km. The numerous lagoons on the floodplains above the river provided fish with refuges during the dry period. Lagoons also appear to be the places where fish breed up over the dry season, or those species which breed only once or twice breed prior to the floods and juvenile fish are ready to migrate as soon as the lagoons are flooded and connected to the river. Generally, lagoons sampled early in the year had few fish but numbers appeared to increase over time, as lagoons sampled later had larger numbers of fish. In November and December vast numbers of juvenile bony bream (*Nematalosa erebi*), rainbows (*Melanotaenia* spp.), threadfin rainbows, hardyheads (*Craterocephalus stercusmuscarum*), glassfish (*Ambassis* spp.), pennyfish (*Denariusa bandata*) and spangled perch (*Leiopotherapon unicolor*) were frequently caught. In large intermittent rivers, all species present in rivers were found in lagoons, with the exceptions of the sharks, rays and sawfish and banded rainbow fish. Banded rainbows appeared to prefer flowing water and were generally found in perennial waters or holes in the upstream reaches of intermittent rivers.

Lagoons are therefore a vital habitat for fish and are essential nurseries for wet season stocking of rivers. They also harbour the complete diversity of aquatic plants in a river basin. All rivers on the Peninsula have either no or very little aquatic vegetation (with the exception of the Jardine and Palmer). The lagoons are therefore the only habitat for many aquatic plants requiring permanent water. Eriocaulon (*Eriocaulon setaceum*) is a rare aquatic plant (Armstrong, 1985) found in all lagoons all over the Peninsula, as far south as the Edward River on the west and the Stewart River on the east coast. It was almost completely restricted to lagoon habitats.

With current management practices and husbandry, and lack of capital for improvements, lagoons are not under serious threat. However, overstocking of cattle or uncontrolled breeding of feral pigs and brumbies could eventually result in destruction or severe damage to lagoons and nurseries and refuges. Some fish can survive in muddy water but may not be able to breed in it and others cannot tolerate it. It is a management concern for the future.

## 25.4 Flooding

Floods are of vital importance for rejuvenation of habitats, colonisation of habitats, breeding and migrations for some species. Floods assist in removal of sediment built up over the stormy season, and flush and scour out stagnant water bodies. Trees and snags are moved around, holes scoured out or filled in, and generally the river bed is cleaned out and rejuvenated. Lagoons are also flushed out with rainwater fed flood flow. Many lagoons become more saline progressively over the dry season and the periodic flushing by floods helps to wash out excess buildup of salts.

Floods also provide routes for colonisation of new habitats. After a succession of dry years many normally permanent lagoons or waterholes could dry out or become stagnant during the dry season. Fish species moving in floodwaters can recolonise these habitats. There is a great risk inherent in this strategy but buildup of numbers of fish over the dry season in lagoons, and continued breeding throughout the wet season, must account for the heavy losses through stranding and colonisation of temporary habitats. Of particular interest in this respect were the eeltailed catfish. Hundreds of thousands of juvenile eel tailed catfish (*Neosilurus ater*, *Neosilurus hyrtlii*, *Anodontiglanis dahli*) were found in drying river beds in May through to July. All of those fish undoubtedly would have perished. Enough must survive in permanent waterholes (often lagoons) for them to breed up the following year and repeat the cycle.

Floods are also essential for breeding and migration of some fish. Black bream/sooty grunter (*Hephaestus fuliginosus*) have been observed by Peninsula residents moving upstream to breed in flooded creeks and rivers, and in perennial streams may even breed before the floods start, during the stormy season. Spangled perch (*Leiopotherapon unicolor*), rainbows (*Melanotaenia splendida inornata*) and sleepy cod (*Oxyeleotris lineolatus, O. selheimi*) are often seen way upstream of any permanent water soon after creeks start to flow.

Catadromous fish (those which need to breed in brackish or salt water) are completely reliant on flooding to go out to the estuaries and for colonisation. In 1991 large numbers of large barramundi (*Lates calcarifer*) perished in Lakefield National Park when an early short lived flood left many of them stranded high and dry when they tried to move out of lagoons to rivers. Tarpon/oxeye herring (*Megalops cyprinoides*) and jungle perch (*Kuhlia rupestris*) are other species with a known requirement for salt water for successful breeding. Recruitment of juvenile catadromous fish requires that water levels stay elevated long enough for juvenile fish to swim upstream and colonise lagoons and waterhole habitats not accessible when flood waters recede. In intermittent streams, in some years it is likely that no colonisation of lagoons occurs because flood peaks are too short to allow migration of juvenile fish upstream while lagoons and rivers are linked. Floods may not be vital for survival of these species as usually they have populations living permanently in the estuaries, but the length and height of floods may strongly influence recruitment of fish into lagoons.

After the initial flush, which may be quite turbid, those fish needing clear water and current to breed (e.g. black bream) are able to breed successfully. In intermittent streams, floods are the only time when breeding will be successful.

As discussed above, flooding is crucial as it allows for migration, colonisation and breeding of fish, and rejuvenates environments. Any flood controls (e.g. dams, mitigation works) will have significant effects on fish ecology. Declines in fish catches on the Murray Darling system are directly attributable to prevention of upstream breeding migration by dams, and habitat alteration of rivers (Lake, 1967). Such effects should be considered if rivers on the Peninsula are to be impounded for agriculture or hydro power purposes.

### 25.5 Overfishing

At present, there is little risk of overfishing as areas of the Peninsula are protected in National Parks where non-aboriginal people are not permitted to fish (except Lakefield) or are subject to fish management regulations designed to prevent over exploitation of the resource. Certain species are highly vulnerable to overfishing (e.g. saratoga, jungle perch), but at present are not under severe threat as large areas of their habitat are inaccessible to all but the most dedicated `catch and release' sports fisherman or `catch and eat' landholders. Over exploitation is only a risk where large numbers of people come to limited areas to fish. Seven to nine thousand camping permits are issued annually at Lakefield National Park. Most fishing is directed at barramundi (Russell and Hales, 1993), which are a highly fecund estuary breeding fish and which seems to have held up well against modest fishing pressure in areas like Weipa and Lakefield.

### 25.6 Exotic Species

No exotic species of fish were collected anywhere on the Peninsula. However, guppies are present in some drains in the Weipa area and could get out and colonise Trunding Creek in town. Generally, however, exotic species only successfully colonise disturbed environments. No severe habitat disturbance was observed near watercourses in the

Weipa area, and in many of the Peninsula watercourses disturbance is periodic. The main area of concern regarding potential introduction of exotic species is the Mitchell system. Vast areas of this system have been severely disturbed by mining, clearing, agriculture, over-grazing, pollution and rubber vine. Irrigation water from the Barron River passes through irrigated crops to the Walsh River. Guppies (*Poecilia reticulata*) and eastern rainbows (*Melanotaenia splendida splendida*) are abundant in the irrigation channels and it is only a matter of time before they reach the Walsh River. Whether they successfully colonise and the effects on the fish fauna remain to be seen. No baseline data exists for much of this catchment which lies outside the CYPLUS area but which has significant effects on people living in it.

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Graham McColm at the Lands Department in Brisbane drew up data models to allow data submission in a format suitable for the entry of data collected by this project to be entered into a relational database as part of the CYPLUS GIS. He also supplied necessary information to allow the construction of a data dictionary.

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### 26.2 Personal Communications

Barlow. Chris Barlow is Officer in Charge of Fisheries at Walkamin Research Station. He has conducted research on the freshwater fishes in the Mitchell system including the Palmer, and the Annan River.

Bews. Bronwyn Bews, caretaker of Moreton Telegraph Station, on the Wenlock River at Moreton

Cotter. Gary Cotter, works as a land valuer on the Peninsula for the Department of Lands. Is a keen (some would say fanatical) recreational fisherman, and features in numerous fishing articles in magazines such as Modern Fishing.

Fielder. Professor Don Fielder is a zoologist at the University of Queensland whose specialist field of study is crustaceans, particularly freshwater prawns and crayfish.

Hoese. Doug Hoese is an ichthyologist at the Australian museum, Sydney, and is recognised as the authority on Eleotrids in Australia.

Hogan. Alf Hogan is a biologist at Walkamin Research Station who has stocked rivers and impoundments in northern Queensland with native fish. He is a keen recreational angler and has conducted extensive research on the biology and breeding of black bream (*H. fuliginosus*).

Johnson. J. Jeff Johnson is the assistant curator of Fishes at the Queensland Museum, Brisbane.

Keenan. Clive Keenan is a Fisheries Biologist working at the Southern Fisheries Centre, Deception Bay. His main area of research is genetics of fish, using electrophoretic techniques.

Kennard. Mark Kennard is completing a Master of Science at Griffith University, studying ecology of floodplain lagoon in the Normanby complex.

Liddle. David Liddle works for Telecom in the Peninsula and collects and breeds ornamental native fish. He is experienced in fish identification.

MacKinnon. Mal MacKinnon worked at Walkamin Research Station and conducted research into breeding and ecology of native freshwater fishes, particularly barramundi, in impoundments.

Mrs. T. Heinemann. Manages Bramwell Station, a grazing property covering all of the upper catchment of the Olive River.

Price. John Price owns Strathgordon, which borders the Edward and Coleman Rivers. He has extensive knowledge of the natural environment in that area.

Taylor. Malcolm Taylor is a professional fish collector who has been collecting in the Peninsula for many years and has a wide experience with fish in the area.

# APPENDIX ONE

Species lists from collections prior to 1992
Where possible, specific names have been applied where descriptions of specimens were adequate. eg Midgley's mottled *Neosilurus* are here called *Neosilurus ater* and yellow finned *Neosilurus* are *N. hyrtlii*. Where specific names have been given these are retained, even if not used by us (eg Leggett's *Neosilurus glencoensis*).

## Cape York Watershed

Sources: Timms, B. V. 1986 Reconnaissance limnology of some coastal sand dune lakes of Cape York Peninsula, Queensland *Australian Journal of Marine and Freshwater Research* 37: 167-176
: *Hansen, B. 1988 A jaunt to the Jardine *Fishes of Sahul* 5(2): 211-215

### Lake Bronto

| | |
|---|---|
| Northern purple spotted gudgeon | *Mogurnda mogurnda* (Richardson) |
| Swamp eel | *Ophisternon gutturale* Richardson |

### Lake Wicheura

| | |
|---|---|
| Northern purple spotted gudgeon | *Mogurnda mogurnda* (Richardson) |
| *Poreless gudgeon | *Oxyeleotris nullipora* Roberts, 1978 |

### Blue Lagoon-Ussher Point

| | |
|---|---|
| Spotted blue-eye/Gertrude's blue-eye | *Pseudomugil gertrudae* Weber |

### Ussher Point lakes (2)

| | |
|---|---|
| Agassiz's glassfish | *Ambassis agassizi* Steindachner |

### Starcke lakes

| | |
|---|---|
| Spotted blue-eye/Gertrude's blue-eye | *Pseudomugil gertrudae* Weber |

### Cape Bedford lakes

| | |
|---|---|
| Rainbow fish | *Melanotaenia splendida* (Peters) |

# Olive River Catchment

## Olive River dunefield lakes.

Source :Lees, B. G. and Saenger, P. 1989 The wetlands of the OliveRiver dunefield, Eastern Cape York, Australia. *Tropical Ecology* 30 (2): 183-192 (Pooled results from four lakes)

| **Common Name** | **Scientific Name** |
|---|---|
| Glassfish/Perchlet | *Ambassis* sp. |
| South pacific eel | *Anguilla obscura* Günther, 1872 |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Threadfin rainbow fish | *Iriatherina werneri* Meinkin |
| Rainbow fish | *Melanotaenia* sp |
| McCulloch's rainbow fish | *Melanotaenia maccullochi* Ogilby |
| Australian rainbow fish | *Melanotaenia splendida splendida* (Peters) |
| Northern purple spotted gudgeon | *Mogurnda mogurnda* (Richardson) |
| Snakehead gudgeon | *Ophieleotris aporos* (Bleeker, 1854) |
| Spotted blue-eye/Gertrude's blue-eye | *Pseudomugil gertrudae* Weber |

## Olive River at Bromley Crossing

Source: Midgley, S. H. 1988 Some river systems of Cape York Peninsula. An Account of a Biological Resource Study of Freshwaters Conducted during July, August and September 1988. Unpublished report.

| **Common Name** | **Scientific Name** |
|---|---|
| Long-finned eel | *Anguilla reinhardtii* Steindachner |
| Coal grunter | *Hephaestus carbo* (Ogilby & McCulloch) |
| Barramundi | *Lates calcarifer* (Bloch) |
| Chequered rainbow fish | *Melanotaenia* sp. |
| Eeltailed catfish | *Neosilurus* sp. |
| Gulf saratoga | *Scleropages jardinii* (Kent) |
| Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |

# Cape Flattery sand dune lakes

Source: Queensland Museum accession records

| Common Name | Scientific Name |
|---|---|
| Penny fish | *Denariusa bandata* Whitley, 1948 |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| McCulloch's rainbow fish | *Melanotaenia maccullochi* |
| Chequered rainbow fish | *Melanotaenia splendida inornata*(Peters) |
| Northern purple spotted gudgeon | *Mogurnda mogurnda* (Richardson) |
| Black Catfish/Jewfish/Eel-tailed Catfish | *Neosilurus ater* (Perugia, 1894) |
| Poreless gudgeon | *Oxyeleotris nullipora* Roberts, 1978 |
| Obbes' catfish | *Porochilus obbesi* Weber, 1913 |
| Spotted blue-eye/Gertrude's blue-eye | *Pseudomugil gertrudae* Weber |

# Pascoe River

Sources: †Leggett, R. 1990 Freshwater fish of Iron Range and adjoining areas. *Queensland Naturalist* 30 (1-2): 12-13

*Pusey, B. Personal communication

#Midgley, S. H. 1985 Some river systems of North Queensland between Lat. 22°S and Lat.12°S. Unpublished Report.

| Common Name | Scientific Name |
|---|---|
| †Glassfish/Perchlet | *Ambassis* sp. |
| *Long-finned eel | *Anguilla reinhardtii* Steindachner, 1867 |
| *Shovel-nosed catfish | *Arius midgleyi* Kailola & Pierce, 1988 |
| #*†Roman nose goby | *Awaous crassilabrus* (Günther) |
| *†Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| #*†Mouth almighty | *Glossamia aprion* (Richardson) |
| #*†Sooty Grunter/Black Bream | *Hephaestus fuliginosus* (Macleay) |
| #*†Jungle perch/Golden bream | *Kuhlia rupestris* (Lacépède) |
| #*†Spangled Perch | *Leiopotherapon unicolor* (Günther) |
| #Rainbowfish | *Melanotaenia* sp. |
| †Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| *Australian rainbow fish | *Melanotaenia splendida splendida* (Peters) |
| #†Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| *Northern purple spotted gudgeon | *Mogurnda mogurnda* (Richardson) |
| *Sea mullet/Bully mullet | *Mugil cephalus* Linnaeus |
| #*Black Catfish/Jewfish/Eel-tailed Catfish | *Neosilurus ater* (Perugia, 1894) |
| †Eeltailed catfish | *Neosilurus* sp. |
| *Sleepy cod | *Oxyeleotris lineolatus* (Steindachner) |
| *Speckled goby | *Redigobius bikolanus* (Herre, 1927) |
| *Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |

# West Claudie River

Sources: Leggett, R. 1990 Freshwater fish of Iron Range and adjoining areas. *Queensland Naturalist* 30 (1-2): 12-13

: Hansen, B. . 1989 Collecting on the Claudies. *Fishes of Sahul* 5 (3): 225-228

| Common Name | Scientific Name |
|---|---|
| Eel | *Anguilla* sp. |
| Roman nose goby | *Awaous crassilabrus* (Günther) |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Coal grunter | *Hephaestus carbo* (Ogilby & McCulloch) |
| Jungle perch/Golden bream | *Kuhlia rupestris* (Lacépède) |
| Barramundi | *Lates calcarifer* (Bloch) |
| Spangled Perch | *Leiopotherapon unicolor* (Günther) |
| Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| Northern purple spotted gudgeon | *Mogurnda mogurnda* (Richardson) |
| Poreless gudgeon | *Oxyeleotris nullipora* Roberts |

## Stewart River

Source: Pusey, personal communication

| Common Name | Scientific Name |
|---|---|
| Sailfin glassfish/Perchlet | *Ambassis agrammus* Günther |
| Long finned eel | *Anguilla reinhardtii* Steindachner |
| Roman nose goby | *Awaous crassilabrus* (Günther) |
| Milkfish/Giant herring | *Chanos chanos* Forsskål |
| Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| Threadfin silver-biddy | *Gerres filamentosus* Cuvier |
| Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| Jungle perch | *Kuhlia rupestris* (Lacépède) |
| Spangled perch | *Leiopotherapon unicolor* (Günther) |
| Rainbow fish | *Melanotaenia splendida* (Peters) |
| Northern purple spotted gudgeon | *Mogurnda mogurnda* (Richardson) |
| Yellow finned tandan/Eel-tailed Catfish | *Neosilurus hyrtlii* Steindachner |
| Sleepy cod | *Oxyeleotris lineolatus* (Steindachner) |

## Endeavour River

Source: Midgley, S. H. 1988 Some river systems of Cape York Peninsula. An Account of a Biological Resource Study of Freshwaters Conducted during July, August and September 1988. Unpublished report.

| Common Name | Scientific Name |
|---|---|
| Jungle perch/Golden bream | *Kuhlia rupestris* (Lacépède) |
| Spangled Perch | *Leiopotherapon unicolor* (Günther) |
| Common Rainbow fish | *Melanotaenia splendida* (Peters) |

# Annan River

Sources: *Barlow, C.; Rodgers, L. and Marnock, T. 1987 Fish of the Annan River. Annan River Weir, Fisheries considerations Unpublished Report

:Hortle, K. G. and Pearson, R. G. 1990 Fauna of the Annan River system, Far north Queensland, with reference to the impact of tin mining. I. Fishes. *Australian Journal of Marine and Freshwater Research* 41: 677-694

| Common Name | Scientific Name |
| --- | --- |
| †*Sailfin glassfish/Perchlet | *Ambassis agrammus* Günther, 1867 |
| †*Barred Grunter | *Amniataba percoides* (Günther) |
| †*Long-finned eel | *Anguilla reinhardtii*(Steindachner) |
| †*Roman nose goby | *Awaous crassilabrus* (Günther) |
| †*Bigeye trevally/Turrum/Great trevally | *Caranx sexfasciatus* Quoy & Gaimard |
| *Milkfish/Giant herring | *Chanos chanos* (Forsskål) |
| †*Fly-specked Hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| †*Ebony gudgeon | *Eleotris melanosoma* Bleeker |
| †*Mouth Almighty | *Glossamia aprion* (Richardson) |
| †*Goby | *Glossogobius* sp. |
| †*Celebes goby | *Glossogobius celebius* (Valenciennes) |
| †*Flathead goby | *Glossogobius giurus* |
| †*Sooty grunter/Black bream | *Hephaestus fuliginosus* (Macleay) |
| †*Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| †*Jungle perch/Golden bream | *Kuhlia rupestris* (Lacépède) |
| *Barramundi | *Lates calcarifer* (Bloch) |
| †*Spangled Perch | *Leiopotherapon unicolor* (Günther) |
| †*Mangrove jack/Red bream | *Lutjanus argentimaculatus* (Forsskål) |
| *Ox-eye Herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| †*Common Rainbow fish | *Melanotaenia splendida* (Peters) |
| †*Purple-spotted Gudgeon | *Mogurnda adspersa* (Castelnau) |
| †*Black Catfish/Eel-tailed Catfish | *Neosilurus ater* (Perugia) |
| †*Hyrtl's Tandan/Eel-tailed Catfish | *Neosilurus hyrtlii* (Steindachner) |
| †*Bony Bream | *Nematalosa erebi* (Günther) |
| *Mud cod | *Ophiocara* sp. |
| *Speckled Goby | *Redigobius bikolanus* (Herre) |
| *Seven-spot Archerfish | *Toxotes chatareus* (Hamilton) |

N.B. Some marine vagrants not included

# Species from the Jardine River and Environs

Sources: Allen, G.R. and Hoese, D.F. 1980 A collection of fishes from the Jardine River, Cape York Peninsula, Australia. *Journal of the Royal Society of Western Australia* **63** (2):53-61

:Byron, G. and Blake, D. 1993 Distribution and abundance of freshwater fish on Northern Cape York Peninsula. In: *Cape York Peninsula Scientific Expedition Wet Season 1992 Report Volume 2.* The Royal Geographical Society of Queensland Inc. pp.233-238

:Leggett, R. 1987 Freshwater fish of the Cape York Area. *Queensland Naturalist* **28** (1-4):13-18.

| **Common Name** | **Scientific Name** |
|---|---|
| Elongate glassfish | *Ambassis elongatus* (Castelnau) |
| Macleay's glass fish/Perchlet | *Ambassis macleayi* (Castelnau) |
| Barred grunter | *Amniataba percoides* (Günther) |
| South pacific eel | *Anguilla obscura* Günther |
| Long-finned eel | *Anguilla reinhardtii* Steindachner |
| Lesser salmon catfish/Forktail | *Arius graeffei* (Kner & Steindachner) |
| Triangular shield catfish/Forktail | *Arius leptaspis* (Bleeker) |
| Freshwater sole | *Brachirus selheimi* (Macleay) |
| Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| Penny fish | *Denariusa bandata* Whitley |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Square blotch goby | *Glossogobius* species |
| Coal grunter | *Hephaestus carbo* (Ogilby & McCulloch) |
| Sooty Grunter/Black Bream | *Hephaestus fuliginosus* (Macleay) |
| Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| Threadfin rainbowfish | *Iriatherina werneri* (Meinkin) |
| Barramundi | *Lates calcarifer* (Bloch) |
| Spangled Perch | *Leiopotherapon unicolor* (Günther) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| McCulloch's rainbowfish | *Melanotaenia maccullochi* Ogilby |
| Black banded rainbowfish | *Melanotaenia nigrans (Richardson)* |
| Chequered rainbowfish | *Melanotaenia splendida inornata*(Peters) |
| Banded rainbowfish | *Melanotaenia trifasciata* (Rendahl) |
| ??Purple-spotted gudgeon | *Mogurnda adspersa* (Castelnau) |
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson) |

| | |
|---|---|
| Bony bream | *Nematalosa erebi* (Günther) |
| Black Catfish/Jewfish/Eel-tailed Catfish | *Neosilurus ater* (Perugia) |
| Shortfinned catfish/Eeltail | *Neosilurus brevidorsalis* (Günther) |
| Yellow finned tandan/Eel-tailed Catfish | *Neosilurus hyrtlii* Steindachner |
| Snakehead gudgeon | *Ophieleotris aporos* (Bleeker) |
| Swamp eel | *Ophisternon bengalense* McClelland |
| Fimbriate gudgeon | *Oxyeleotris fimbriatus* Weber |
| Sleepy cod | *Oxyeleotris lineolatus* (Steindachner) |
| Poreless gudgeon | *Oxyeleotris nullipora* Roberts |
| Lorentz's grunter | *Pingalla lorentzi* (Weber) |
| Spotted blue-eye/Gertrude's blue-eye | *Pseudomugil gertrudae* Weber |
| Delicate blue-eye | *Pseudomugil tenellus* Taylor |
| Obbes' catfish | *Porochilus obbesi* Weber |
| Rendahl's Catfish | *Porochilus rendahli* (Whitley) |
| Gulf saratoga | *Scleropages jardinii* (Kent) |
| Freshwater long tom | *Strongylura krefftii* (Günther) |
| Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |

42 species documented

# Wenlock River Area

## Wenlock River-Portland Roads Road Crossing

Sources: Leggett, R. 1990 Freshwater fish of Iron Range and adjoining areas. *Queensland Naturalist* 30 (1-2): 12-13

| Common Name | Scientific Name |
|---|---|
| Barred grunter | *Amniataba percoides* (Günther) |
| Spangled Perch | *Leiopotherapon unicolor* (Günther) |
| Coal grunter | *Hephaestus carbo* (Ogilby & McCulloch) |
| Sooty Grunter/Black Bream | *Hephaestus fuliginosus* (Macleay) |
| Eeltailed catfish | *Neosilurus* sp. |
| Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| Northern purple spotted gudgeon | *Mogurnda mogurnda* (Richardson) |
| Sleepy cod | *Oxyeleotris lineolatus* (Steindachner) |

## Wenlock River

Source: Armstrong, N. 1985 A wilderness of rivers *Fishes of Sahul* 2(4): 85-90

| Common Name | Scientific Name |
|---|---|
| Snub nosed garfish | *Arramphus sclerolepis* Günther |
| Coal grunter | *Hephaestus carbo* (Ogilby & McCulloch) |
| Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| Northern purple spotted gudgeon | *Mogurnda mogurnda* (Richardson) |

## Wenlock River

Source: Tait, J. T. P. and Pearson, R. G. 1988 Personal communication. Survey of freshwater fishes in the Weipa region. Report for environmental impact statement of Weipa airforce base. (unpublished report)

| Common Name | Scientific Name |
|---|---|
| Elongate glassfish/ Perchlet | *Ambassis elongatus* (Castelnau) |
| Barred grunter | *Amniataba percoides* (Günther) |
| Berney's catfish/Forktail | *Arius berneyi* (Whitley) |
| Lesser salmon catfish/Forktail | *Arius graeffei* (Kner & Steindachner) |
| Triangular shield catfish/Forktail | *Arius leptaspis* (Bleeker) |
| Snub nosed garfish | *Arramphus sclerolepis* Günther |
| River shark | *Carcharhinus ? fitzroyensis* (Whitley) |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Coal grunter | *Hephaestus carbo* (Ogilby & McCulloch) |
| Sooty grunter/Black bream | *Hephaestus fuliginosus* (Macleay) |
| Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| Barramundi | *Lates calcarifer* (Bloch) |
| Spangled perch | *Leiopotherapon unicolor* (Günther) |
| Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| Yellow finned tandan/Eel-tailed catfish | *Neosilurus hyrtlii* Steindachner |
| Bony bream | *Nematalosa erebi* (Günther) |
| Sleepy cod | *Oxyeleotris lineolatus* (Steindachner) |
| Spotted scat | *Scatophagus argus* (Linnaeus) |
| Freshwater long tom | *Strongylura krefftii* (Günther) |
| Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |

**Wenlock River-near major crossings**

Sources:†Leggett, R. 1990 Freshwater fishes of Iron Range and adjoining areas. *Queensland Naturalist* 30 (1-2):12-13

#Midgley, S. H. 1985 Some river systems of North Queensland between Lat. 22°S and Lat.12° S. Unpublished Report.

*Armstrong, N. 1985 A wilderness of rivers. *Fishes of Sahul* 2(4): 85-90

| Common Name | Scientific Name |
|---|---|
| #Macleay's glass fish/Perchlet | *Ambassis macleayi* (Castelnau) |
| #Glassfish/Perchlet | *Ambassis sp.* |
| #†Barred grunter | *Amniataba percoides* (Günther) |
| #Triangular shield catfish/Forktail | *Arius leptaspis* (Bleeker) |
| *Snub nosed garfish | *Arramphus sclerolepis* Günther |
| #*Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| #Stingray | *Dasyatis fluviorum* |
| #Penny fish | *Denariusa bandata* Whitley |
| #Mouth almighty | *Glossamia aprion* (Richardson) |
| #Flathead gudgeon | *Glossogobius* sp. |
| #†*Coal grunter | *Hephaestus carbo* (Ogilby & McCulloch) |
| #†Sooty grunter/Black bream | *Hephaestus fuliginosus* (Macleay) |
| #Barramundi | *Lates calcarifer* (Bloch) |
| #†Spangled perch | *Leiopotherapon unicolor* (Günther) |
| †*Chequered rainbow fish (Peters) | *Melanotaenia splendida inornata* |
| †*Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| #Rainbow fish | *Melanotaenia* sp. |
| †Northern purple spotted gudgeon | *Mogurnda mogurnda* (Richardson) |
| #Yellow finned tandan/Eel-tailed catfish | *Neosilurus hyrtlii* Steindachner |
| †Eeltailed catfish | *Neosilurus* sp2 |
| #†Sleepy cod | *Oxyeleotris lineolatus* (Steindachner) |
| #Lorentz's grunter | *Pingalla lorentzi* (Weber) |
| #River sawfish | *Pristis pristis* Linnaeus |
| #Gulf saratoga | *Scleropages jardinii* (Kent) |
| #Freshwater long tom | *Strongylura krefftii* (Günther) |
| #Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |

## Marmoss Creek (Weipa area)

Source: Tait, J. T. P. and Pearson, R. G. 1988 Personal communication. Survey of freshwater fishes in the Weipa region. Report for environmental impact statement of Weipa airforce base. (unpublished report)

| Common Name | Scientific Name |
|---|---|
| Elongate glassfish/ Perchlet | *Ambassis elongatus* (Castelnau) |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Spangled perch | *Leiopotherapon unicolor* (Günther) |
| Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| Yellow finned tandan/Eel-tailed catfish | *Neosilurus glencoensis* (Rendahl) |
| Yellow finned tandan/Eel-tailed catfish | *Neosilurus hyrtlii* Steindachner |
| Sleepy cod | *Oxyeleotris* species B |

## Arthur Creek (Weipa area)

Source: Tait, J. T. P. and Pearson, R. G. 1988 Personal communication. Survey of freshwater fishes in the Weipa region. Report for environmental impact statement of Weipa airforce base. (unpublished report)

| Common Name | Scientific Name |
|---|---|
| Elongate glassfish/ Perchlet | *Ambassis elongatus* (Castelnau) |
| Triangular shield catfish/Forktail | *Arius leptaspis* (Bleeker) |
| Coal grunter | *Hephaestus carbo* (Ogilby & McCulloch) |
| Spangled perch | *Leiopotherapon unicolor* (Günther) |
| Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| Sleepy cod | *Oxyeleotris* species B |
| Gulf saratoga | *Scleropages jardinii* (Saville-Kent) |
| Freshwater long tom | *Strongylura krefftii* (Günther) |
| Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |

## Cox Creek (Weipa area)

Source: Tait, J. T. P. and Pearson, R. G. 1988 Personal communication. Survey of freshwater fishes in the Weipa region. Report for environmental impact statement of Weipa airforce base. (unpublished report)

| Common Name | Scientific Name |
|---|---|
| Elongate glassfish/ Perchlet | *Ambassis elongatus* (Castelnau) |
| Barred grunter | *Amniataba percoides* (Günther) |
| Spangled perch | *Leiopotherapon unicolor* (Günther) |
| Coal grunter | *Hephaestus carbo* (Ogilby & McCulloch) |
| Chequered rainbow fish | *Melanotaenia splendida inornata*(Peters) |
| Yellow finned tandan/Eel-tailed catfish | *Neosilurus glencoensis* (Rendahl) |
| Gulf saratoga | *Scleropages jardinii* (Saville-Kent) |

## Pappan Creek (Weipa area)

Source: Tait, J. T. P. and Pearson, R. G. 1988 Personal communication. Survey of freshwater fishes in the Weipa region. Report for environmental impact statement of Weipa airforce base. (unpublished report)

| Common Name | Scientific Name |
|---|---|
| Black banded rainbow fish | *Melanotaenia nigrans* (Richardson) |
| Chequered rainbow fish | *Melanotaenia splendida inornata*(Peters) |
| Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| Yellow finned tandan/Eel-tailed catfish | *Neosilurus glencoensis* (Rendahl) |
| Spotted blue-eye/Gertrude's blue-eye | *Pseudomugil gertrudae* Weber |

## † Tent Pole Creek (Weipa area)
## * Lagoon near Weipa

Source: Armstrong, N. 1985 A wilderness of rivers *Fishes of Sahul* 2(4): 85-90

| Common Name | Scientific Name |
|---|---|
| *Glass perch/Perchlet | *Ambassis* sp. |
| *†Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| *†Black banded rainbow fish | *Melanotaenia nigrans* (Richardson, |
| *†Chequered rainbow fish | *Melanotaenia splendida inornata*(Peters) |
| *†Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| †Northern purple spotted gudgeon | *Mogurnda mogurnda* (Richardson) |
| *†Spotted blue-eye/Gertrude's blue-eye | *Pseudomugil gertrudae* Weber |

## Uningan Creek

Source: Voss, D. 1988 Freshwater fish. *In*: *Uningan Guide. A handbook to the Uningan Bicentennial Nature and Recreation Reserve*. Weipa Bicentennial Community Committee: Weipa

| Common Name | Scientific Name |
| --- | --- |
| Glassfish/Perchlet | *Ambassis* sp. |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| Spangled perch | *Leiopotherapon unicolor* (Günther) |
| Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| Northern purple spotted gudgeon | *Mogurnda mogurnda* (Richardson) |
| Yellow finned tandan/Eel-tailed catfish | *Neosilurus glencoensis* (Rendahl) |
| Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |

## Estuarine Species Recorded from the Embley Estuary which may Enter Freshwater

(Source: Blaber, Brewer and Salini, 1989)

| Common Name | Scientific Name |
|---|---|
| Lesser salmon catfish/Forktail | *Arius graeffei* (Kner & Steindachner) |
| Triangular shield catfish/Forktail | *Arius leptaspis* (Bleeker) |
| Snub-nosed garfish | *Arramphus sclerolepis* Günther |
| *Crimson-tipped gudgeon | *Butis butis* (Hamilton) |
| *River shark | *Carcharhinus leucas* (Valenciennes) |
| *Bigeye trevally/Turrum/Great trevally | *Caranx sexfasciatus* Quoy & Gaimard |
| *Milkfish/Giant herring | *Chanos chanos* Forsskål |
| *Threadfin silver-biddy | *Gerres filamentosus* Cuvier |
| Mangrove goby | *Glossogobius biocellatus* (Valenciennes) |
| Celebes goby | *Glossogobius celebius* (Valenciennes) |
| Barramundi | *Lates calcarifer* (Bloch) |
| *Mangrove jack/Red bream | *Lutjanus argentimaculatus* (Forsskål) |
| *Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Mono/ Silver moonfish | *Monodactylus argenteus* Linnaeus |
| Bony bream | *Nematalosa erebi* (Günther) |
| Snakehead gudgeon | *Ophieleotris aporos* (Bleeker) |
| Spotted blue-eye/Gertrude's blue-eye | *Pseudomugil gertrudae* Weber |
| *Spotted scat | *Scatophagus argus* (Linnaeus) |
| *Butterfish | *Selenotoca multifasciata* (Richardson) |
| Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |
| Buffon's river garfish | *Zenarchopterus buffonis* (Valenciennes) |
| Spoon-fin garfish | *Zenarchopterus dispar* (Valenciennes) |

* essentially marine

# Archer River Catchment

## Archer River near Tea Tree Lagoon

Source: Midgley, S. H. 1988 Some river systems of Cape York Peninsula. An Account of a Biological Resource Study of Freshwaters Conducted during July, August and September 1988. Unpublished report.

*species collected by us at Tea Tree Lagoon 7 Sep 1993

| Common Name | Scientific Name |
|---|---|
| #Glassfish/Perchlet | *Ambassis* sp. |
| *Sailfin glassfish/Perchlet | *Ambassis agrammus* Günther |
| *Macleay's glassfish/Perchlet | *Ambassis macleayi* (Castelnau) |
| *#Barred grunter | *Amniataba percoides* (Günther) |
| #Berney's catfish/Forktail | *Arius berneyi* (Whitley) |
| *#Lesser salmon catfish/Forktail | *Arius graeffei* (Kner & Steindachner) |
| *#Triangular shield catfish/Forktail | *Arius leptaspis* (Bleeker) |
| #Shovel-nosed catfish | *Arius midgleyi* Kailola & Pierce, 1988 |
| *#Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| *Penny fish | *Denariusa bandata* Whitley, 1948 |
| *#Mouth almighty | *Glossamia aprion* (Richardson) |
| #Flathead goby | *Glossogobius giurus* |
| *Square-blotched goby | *Glossogobius* species C Allen |
| *Coal grunter | *Hephaestus carbo* (Ogilby & McCulloch) |
| #Sooty grunter/Black bream | *Hephaestus fuliginosus* (Macleay) |
| *Barramundi | *Lates calcarifer* (Bloch) |
| *Ox-eye Herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| #Rainbow fish | *Melanotaenia* sp. (two species) |
| *Chequered rainbow fish | *Melanotaenia splendida inornata* |
| (Peters) | |
| *#Bony bream | *Nematalosa erebi* (Günther) |
| *#Sleepy cod | *Oxyeleotris lineolatus* (Steindachner) |
| *Striped sleepy cod | *Oxyeleotris selheimi* (Macleay) |
| *#Gulf saratoga | *Scleropages jardinii* (Saville-Kent) |
| *#Freshwater long tom | *Strongylura krefftii* (Günther) |
| *#Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |

## Archer River - near Fox hole

Source: #Midgley, S. H. 1985 Some river systems of North Queensland between Lat. 22°S and Lat.12° S. Unpublished Report.

†Leggett, R. 1990 Freshwater fishes of Iron Range and adjoining areas. *Queensland Naturalist* 30 (1-2):12-13 (Collection at crossing)

* species collected by us at Fox Hole 31 Aug 1993

| Common Name | Scientific Name |
|---|---|
| #Glassfish/Perchlet | *Ambassis* sp. |
| *†Macleay's glassfish/Perchlet | *Ambassis macleayi* (Castelnau) |
| *†#Barred grunter | *Amniataba percoides* (Günther) |
| *Toothless catfish | *Anodontiglanis dahli* Rendahl |
| *Lesser salmon catfish/Forktail | *Arius graeffei* (Kner & Steindachner) |
| #Triangular shield catfish/Forktail | *Arius leptaspis* (Bleeker) |
| *†Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| *#Mouth almighty | *Glossamia aprion* (Richardson) |
| †#Coal grunter | *Hephaestus carbo* (Ogilby & McCulloch) |
| *#Sooty grunter/Black bream | *Hephaestus fuliginosus* (Macleay) |
| #Barramundi | *Lates calcarifer* (Bloch) |
| *†#Spangled perch | *Leiopotherapon unicolor* (Günther) |
| *Ox-eye Herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| #Rainbow fish | *Melanotaenia* sp. |
| †Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| *†Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| †Northern Purple spotted gudgeon | *Mogurnda mogurnda* (Richardson) |
| *†#Bony bream | *Nematalosa erebi* (Günther) |
| *#Black Catfish/Jewfish/Eel-tailed Catfish | *Neosilurus ater* (Perugia) |
| †Yellow finned tandan/Eel-tailed catfish | *Neosilurus glencoensis* (Rendahl) |
| *#Yellow finned tandan/Eel-tailed catfish | *Neosilurus hyrtlii* Steindachner |
| *Swamp eel | *Ophisternon bengalense* McClelland |
| †Sleepy cod | *Oxyeleotris* sp 1. |
| *Sleepy cod | *Oxyeleotris lineolatus* (Steindachner) |
| *Striped sleepy cod | *Oxyeleotris selheimi* (Macleay) |
| #Gulf saratoga | *Scleropages jardinii* (Saville-Kent) |
| *#Freshwater long tom | *Strongylura krefftii* (Günther) |
| *#Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |

## Coen River - near Rokeby

Source: #Midgley, S. H. 1985 Some river systems of North Queensland between Lat. 22°S and Lat.12° S. Unpublished Report.

§Midgley, S. H. 1988 Some river systems of Cape York Peninsula. An Account of a Biological Resource Study of Freshwaters Conducted during July, August and September 1988. Unpublished report. (Extra species recorded)

*Species recorded by us in Coen River at Rokeby, 1-2 June 1993

| Common Name | Scientific Name |
|---|---|
| *Macleay's glassfish/Perchlet | *Ambassis macleayi* (Castelnau) |
| *Mueller's glassfish/Perchlet | *Ambassis mulleri* Klunzinger |
| *#Barred grunter | *Amniataba percoides* (Günther) |
| *§Lesser salmon catfish/Forktail | *Arius graeffei* (Kner & Steindachner) |
| *§Triangular shield catfish/Forktail | *Arius leptaspis* (Bleeker) |
| *Shovel-nosed catfish | *Arius midgleyi* Kailola & Pierce, 1988 |
| *Mouth almighty | *Glossamia aprion* (Richardson) |
| *#Coal grunter | *Hephaestus carbo* (Ogilby & McCulloch) |
| *#Sooty grunter/Black bream | *Hephaestus fuliginosus* (Macleay) |
| *#Spangled Perch | *Leiopotherapon unicolor* (Günther) |
| *Ox-eye Herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| #Rainbow fish | *Melanotaenia* sp. |
| *Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| *Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| *#Bony bream | *Nematalosa erebi* (Günther) |
| *#Black Catfish/Jewfish/Eel-tailed Catfish | *Neosilurus ater* (Perugia, 1894) |
| *#Yellow finned tandan/Eel-tailed catfish | *Neosilurus hyrtlii* Steindachner |
| *Sleepy cod | *Oxyeleotris lineolatus* (Steindachner) |
| *Striped sleepy cod | *Oxyeleotris selheimi* (Macleay) |
| #Gulf saratoga | *Scleropages jardinii* (Saville-Kent) |
| *#Freshwater long tom | *Strongylura krefftii* (Günther) |
| *Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |

## Archer River and Tributaries- Specimens Deposited in Queensland Museum Prior to Dec 1992

| Common Name | Scientific Name |
|---|---|
| Sailfin glassfish/Perchlet | *Ambassis agrammus* Günther |
| Elongate glassfish/ Perchlet | *Ambassis* cf *elongatus* (Castelnau) |
| Macleay's glassfish/Perchlet | *Ambassis macleayi* (Castelnau) |
| Barred grunter | *Amniataba percoides* (Günther) |
| Toothless catfish/Jewfish | *Anodontiglanis dahli* Rendahl |
| Triangular shield catfish/Forktail | *Arius leptaspis* (Bleeker) |
| River shark | *Carcharhinus leucas* (Valenciennes) |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Coal grunter | *Hephaestus carbo* (Ogilby & McCulloch) |
| Sooty grunter/Black bream | *Hephaestus fuliginosus* (Macleay) |
| Spangled perch | *Leiopotherapon unicolor* (Günther) |
| Black-banded rainbowfish | *Melanotaenia nigrans* (Richardson) |
| Chequered rainbowfish | *Melanotaenia splendida inornata*(Peters) |
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson) |
| Bony bream | *Nematalosa erebi* (Günther) |
| Black catfish/Eel-tailed catfish | *Neosilurus ater* (Perugia) |
| Yellow finned tandan/Eel-tailed catfish | *Neosilurus hyrtlii* Steindachner |
| Sleepy cod | *Oxyeleotris lineolatus* (Steindachner) |
| Gulf saratoga | *Scleropages jardinii* (Kent) |
| Freshwater long tom | *Strongylura kreffiii* (Günther) |
| Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |

## Holroyd River

Source: * Midgley, S. H. 1985 Some river systems of North Queensland between Lat. 22°S and Lat.12° S. Unpublished Report.

# Midgley, S. H. 1988 Some river systems of Cape York Peninsula. An Account of a Biological Resource Study of Freshwaters Conducted during July, August and September 1988. Unpublished report.

| **Common Name** | **Scientific Name** |
|---|---|
| Glassfish/Perchlet | *Ambassis* sp. |
| Barred grunter | *Amniataba percoides* (Günther) |
| Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Spangled perch | *Leiopotherapon unicolor* (Günther) |
| Rainbowfish | *Melanotaenia* sp. |
| Northern Purple spotted gudgeon | *Mogurnda mogurnda* (Richardson) |
| Bony bream | *Nematalosa erebi* (Günther) |
| Black Catfish/Jewfish/Eel-tailed Catfish | *Neosilurus ater* (Perugia, 1894) |
| Yellow finned tandan/Eel-tailed catfish | *Neosilurus hyrtlii* Steindachner |
| Sleepy cod | *Oxyeleotris lineolatus* (Steindachner) |

# Edward River

Source: *Hansen, B. 1987 Werneri from the wild. *Fishes of Sahul* 4 (2): 164-168
#Midgley, S. H. 1985 Some river systems of North Queensland between Lat. 22°S and Lat.12° S. Unpublished Report.

| Common Name | Scientific Name |
|---|---|
| #*Macleay's glass fish/Perchlet | *Ambassis macleayi* (Castelnau, 1878) |
| #*Barred grunter | *Amniataba percoides* (Günther) |
| #Triangular shield catfish/Forktail | *Arius leptaspis* (Bleeker) |
| #Shovel-nosed catfish | *Arius midgleyi* Kailola & Pierce, 1988 |
| *Salmon catfish/Forktail | *Arius* sp. |
| #*Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| *Penny fish | *Denariusa bandata* Whitley, 1948 |
| #*Mouth almighty | *Glossamia aprion* (Richardson) |
| #Flathead goby | *Glossogobius giurus* |
| #*Sooty Grunter/Black Bream | *Hephaestus fuliginosus* (Macleay) |
| *Threadfin rainbow fish | *Iriatherina werneri* Meinkin |
| *Barramundi | *Lates calcarifer* (Bloch) |
| #*Spangled Perch | *Leiopotherapon unicolor* (Günther) |
| *Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| # Rainbow fish | *Melanotaenia* sp. |
| #Bony bream | *Nematalosa erebi* (Günther) |
| *Black Catfish/Jewfish/Eel-tailed Catfish | *Neosilurus ater* (Perugia, 1894) |
| #Yellow finned tandan/Eel-tailed catfish | *Neosilurus hyrtlii* Steindachner |
| #*Sleepy cod | *Oxyeleotris lineolatus* (Steindachner) |
| *Poreless gudgeon | *Oxyeleotris nullipora* Roberts, 1978 |
| *Delicate blue-eye | *Pseudomugil tenellus* Taylor, 1964 |
| #*Gulf saratoga | *Scleropages jardinii* (Saville-Kent) |
| #Barcoo grunter | *Scortum barcoo* (McCulloch & Waite) |
| *Silver perch | (was probably *Scortum hillii*) |
| *Freshwater long tom | *Strongylura kreffiii* (Günther) |
| *Swamp eel | *Synbranchium* sp (was probably *Ophisternon bengalense*) |
| *Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |

## Coleman River

Source: # Midgley, S. H. 1988 Some river systems of Cape York Peninsula. An Account of a Biological Resource Study of Freshwaters Conducted during July, August and September 1988. Unpublished report.

* denotes species collected by us at the same site

| Common Name | Scientific Name |
|---|---|
| *#Macleay's glass fish/Perchlet | *Ambassis macleayi* (Castelnau, 1878) |
| *#Barred grunter | *Amniataba percoides* (Günther) |
| #Toothless catfish/Eeltail | *Anodontiglanis dahli* Rendahl |
| #Shovel-nosed catfish | *Arius midgleyi* Kailola & Pierce, 1988 |
| #Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| #Penny fish | *Denariusa bandata* Whitley, 1948 |
| *#Mouth almighty | *Glossamia aprion* (Richardson) |
| *Spangled Perch | *Leiopotherapon unicolor* (Günther) |
| *Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| #Rainbow fish | *Melanotaenia* sp. |
| *Northern purple spotted gudgeon | *Mogurnda mogurnda* (Richardson) |
| *#Bony bream | *Nematalosa erebi* (Günther) |
| *Black Catfish/Jewfish/Eel-tailed Catfish | *Neosilurus ater* (Perugia, 1894) |
| *Sleepy cod | *Oxyeleotris lineolatus* (Steindachner) |
| *Striped sleepy cod | *Oxyeleotris selheimi* (Macleay) |
| *Barcoo grunter | *Scortum barcoo* (McCulloch & Waite) |
| *Leathery grunter | *Scortum hillii* |
| #Freshwater long tom | *Strongylura krefftii* (Günther) |
| *Swamp eel | *Ophisternon bengalense* |
| *#Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |

# Palmer River

## Palmer River-King Junction Hole

Source: #Midgley, S. H. 1988 Some river systems of Cape York Peninsula. An Account of a Biological Resource Study of Freshwaters Conducted during July, August and September 1988. Unpublished report.

*denotes species collected by us at this site

| Common Name | Scientific Name |
|---|---|
| #Glassfish/Perchlet | *Ambassis* sp. |
| *Macleay's glassfish/Perchlet | *Ambassis macleayi* (Castelnau) |
| *#Barred grunter | *Amniataba percoides* (Günther) |
| *#Lesser salmon catfish/Forktail | *Arius graeffei* (Kner & Steindachner) |
| *#Shovel-nosed catfish/Forktail | *Arius midgleyi* Kailola & Pierce |
| *Snub nosed garfish | *Arramphus sclerolepis* Günther |
| *#Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| *#Mouth almighty | *Glossamia aprion* (Richardson) |
| *#Goby | *Glossogobius* sp. |
| *#Sooty grunter/Black bream | *Hephaestus fuliginosus* (Macleay) |
| *#Barramundi | *Lates calcarifer* (Bloch) |
| *#Spangled perch | *Leiopotherapon unicolor* (Günther) |
| #Rainbow fish | *Melanotaenia* sp. |
| *Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| *Ox-eye Herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| *#Bony bream | *Nematalosa erebi* (Günther) |
| *Black Catfish/Eel-tailed Catfish | *Neosilurus ater* (Perugia) |
| #Hyrtl's Tandan/Eel-tailed Catfish | *Neosilurus hyrtlii* (Steindachner) |
| *#Sleepy cod | *Oxyeleotris lineolatus* (Steindachner) |
| *Striped sleepy cod | *Oxyeleotris selheimi* (Macleay) |
| *Freshwater long tom | *Strongylura krefftii* (Günther) |
| *#Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |

## Palmer River near Maytown

Sources:# Macleay, W. 1882 The fishes of the Palmer River. *Proceedings of the Linnean Society of new South Wales* 7: 69-71

* denotes species collected by us at Maytown.

| Common Name | Scientific Name |
|---|---|
| *#Barred grunter | *Amniataba percoides* (Günther) |
| *Lesser salmon catfish/Forktail | *Arius graeffei* (Kner & Steindachner) |
| #Freshwater sole | *Brachirus selheimi* (Macleay, 1882) |
| *Mouth almighty | *Glossamia aprion* (Richardson) |
| *Sooty grunter/Black bream | *Hephaestus fuliginosus* (Macleay) |
| *#Spangled Perch | *Leiopotherapon unicolor* (Günther) |
| *#Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| *#Bony bream | *Nematalosa erebi* (Günther) |
| *Black Catfish/Eel-tailed Catfish | *Neosilurus ater* (Perugia) |
| #Yellow finned tandan/Eel-tailed catfish | *Neosilurus hyrtlii* Steindachner |
| *Sleepy cod | *Oxyeleotris lineolatus* (Steindachner) |
| *#Striped sleepy cod | *Oxyeleotris selheimi* (Macleay, 1882) |
| *Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |

# Species of Freshwater Fish Collected in Alligator Rivers Region

Source: Bishop, K.A., Allen, S.A., Pollard, D.A. and M. G. Cook 1990 *Ecological studies of the freshwater fishes of the Alligator Rivers Region, Northern Territory. Volume II : Synecology.* Australian Government Publishing Service, Canberra.

| **Common Name** | **Scientific Name** |
|---|---|
| Sailfin glassfish/Perchlet | *Ambassis agrammus* Günther |
| Yellow finned glassfish/Perchlet | *Ambassis elongatus* |
| Macleay's glass fish/Perchlet | *Ambassis macleayi* (Castelnau) |
| Barred grunter | *Amniataba percoides* (Günther) |
| Toothless catfish/Eeltail | *Anodontiglanis dahli* Rendahl |
| Fork tailed catfish | *Arius proximus* |
| Lesser salmon catfish/Forktail | *Arius graeffei* (Kner & Steindachner) |
| Triangular shield catfish/Forktail | *Arius leptaspis* (Bleeker) |
| Tailed sole | *Aseraggodes klunzingeri* (Weber) |
| Freshwater sole | *Brachirus selheimi* (Macleay) |
| River shark | *Carcharhinus leucas* (Valenciennes) |
| Marjorie's hardyhead | *Craterocephalus marjoriae* |
| Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| Tongue sole | *Cynoglossus heterolepis* |
| Freshwater stingray | *Dasyatis sp (fluviorum?)* |
| Penny fish | *Denariusa bandata* Whitley |
| Golden goby | *Glossogobius aureus* Akihito & Meguro |
| Flat-headed goby | *Glossogobius giurus* |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Sooty Grunter/Black Bream | *Hephaestus fuliginosus* (Macleay) |
| Black spotted bream | *Hilsa kelee* |
| Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| Barramundi | *Lates calcarifer* (Bloch) |
| Spangled Perch | *Leiopotherapon unicolor* (Günther) |
| Ord river mullet | *Liza alata* |
| Green backed mullet | *Liza dussemieri* |

| | |
|---|---|
| Mullet | *Liza macrolepis* |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Black banded rainbowfish | *Melanotaenia nigrans* (Richardson) |
| Chequered rainbowfish | *Melanotaenia splendida inornata*(Peters) |
| Red tailed rainbow fish & | *Melanotaenia splendida australis* (Allen Cross) |
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson) |
| Bony bream | *Nematalosa come* |
| Bony bream | *Nematalosa erebi* (Günther) |
| Black Catfish/Jewfish/Eel-tailed Catfish | *Neosilurus ater* (Perugia) |
| Yellow finned tandan/Eel-tailed Catfish | *Neosilurus hyrtlii* Steindachner |
| Swamp eel | *Ophisternon gutturale* |
| Black banded gauvina | *Oxyeleotris* (cf *herwerdenii*) |
| Sleepy cod | *Oxyeleotris lineolatus* (Steindachner) |
| Black-blotched anal fin grunter | *Pingalla midgleyi* |
| Small-eyed sleeper | *Prionobutis microps* (Weber) |
| River sawfish | *Pristis pristis* Linnaeus |
| Delicate blue-eye | *Pseudomugil tenellus* Taylor |
| Obbes' catfish | *Porochilus obbesi* Weber |
| Rendahl's Catfish | *Porochilus rendahli* (Whitley) |
| Spotted scat | *Scatophagus argus* (Linnaeus) |
| Gulf saratoga | *Scleropages jardinii* (Kent) |
| Freshwater long tom | *Strongylura krefftii* (Günther) |
| Primitive archerfish/Riflefish | *Toxotes lorentzi* (Weber) |
| Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |
| Banded archerfish/Riflefish | *Toxotes jaculatrix* (Pallas) |
| Garfish | *Zenarchopterus caudovittatus* |

52 species

# APPENDIX TWO

**Species lists from Cape York Peninsula Fish Surveys 1992-1994**

Species lists are compiled from the results of surveys of selected Cape York Peninsula rivers from 1992-1993. The lists are generally merged from the different sites sampled on a river, except in cases where differences in fish fauna between sites were different enough to warrant their separation. All discrete drainages within a basin were also listed separately.

Nomenclature follows that of Allen (1989) with the exception of *Porochilus argenteus*, which is called *Neosilurus argenteus* in accordance with the Zoological Catalogue of Australia. Fish species not dealt with in Allen 1989 were identified from the sources listed below.

| Species | Source of Identification |
|---|---|
| *Caranx sexfasciatus* | Grant, 1982 |
| *Butis butis* | Allen, 1991 |
| *Eleotris melanosoma* | Allen, 1991 |
| *Eleotris fusca* | Allen, 1991 |
| *Elops machnata* | Allen, 1991 |
| *Gerres filamentosus* | Allen, 1991 |
| *Glossogobius spp. 1 & 2* | Identified by D. Hoese, 1993 |
| *Ophisternon bengalense* | Paxton *et al.*, 1989 |
| *Oxyeleotris gyrinoides* | Allen, 1991 |
| *Oxyeleotris selheimi* | Identified by D. Hoese, 1993 |
| *Thryssa scratchleyi* | Allen, 1991 |
| *Zenarchopterus novaeguineae* | Allen, 1991; Collette, 1974; Munro, 1967 |
| *Zenarchopterus buffonis* | Allen, 1991; Collette, 1974; Munro, 1967 |
| Family Chandidae *(Ambassis, Denariusa)* | Allen and Burgess, 1990 |
| Family Melanotaeniidae *(Melanotaenia, Iriatherina, Pseudomugil)* | Allen, 1989; Allen and Cross, 1982 |

# Cape York Watershed

## Harmer Creek

4 sites sampled

| Common Name | Scientific Name |
|---|---|
| Barred grunter | *Amniataba percoides* (Günther) |
| South pacific eel | *Anguilla obscura* Günther |
| Long-finned eel | *Anguilla reinhardtii* Steindachner |
| Coal grunter | *Hephaestus carbo* (Ogilby & McCulloch) |
| Threadfin silver-biddy | *Gerres filamentosus* Cuvier |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Concave goby | *Glossogobius concavifrons* (Ramsay & Ogilby) |
| Square blotch goby | *Glossogobius* species 2 Hoese |
| Coal grunter | *Hephaestus carbo* (Ogilby & McCulloch) |
| Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| Jungle perch/Golden bream | *Kuhlia rupestris* (Lacépède) |
| Barramundi | *Lates calcarifer* (Bloch) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| McCulloch's rainbow fish | *Melanotaenia maccullochi* Ogilby |
| Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson) |
| Belut (One-gilled eel) | *Monopterus albus* (Zuiew) |
| Black catfish/Jewfish/Eel-tailed Catfish | *Neosilurus ater* (Perugia) |
| Aru gudgeon | *Oxyeleotris aruensis* (Weber) |
| Poreless gudgeon | *Oxyeleotris nullipora* Roberts |
| Spotted blue-eye/Gertrude's blue-eye | *Pseudomugil gertrudae* Weber |
| Gulf saratoga | *Scleropages jardinii* (Kent) |

23 species

## Shellburne Perched Lake

| Common Name | Scientific Name |
|---|---|
| Sailfin glassfish/Perchlet | *Ambassis agrammus* Günther |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Threadfin rainbow fish | *Iriatherina werneri* Meinkin |
| McCulloch's rainbow fish | *Melanotaenia maccullochi* Ogilby |
| Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| Yellow finned tandan/Eel-tailed catfish | *Neosilurus ater* (Perugia) |
| Gulf Saratoga | *Scleropages jardinii* (Kent) |

7 species

## Lake Wicheura

| Common Name | Scientific Name |
|---|---|
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson) |
| Swamp eel | *Ophisternon bengalense* McClelland |
| Poreless gudgeon | *Oxyeleotris nullipora* Roberts |

3 species

## Lake Bronto

| Common Name | Scientific Name |
|---|---|
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson) |
| Swamp eel | *Ophisternon bengalense* McClelland |
| Poreless gudgeon | *Oxyeleotris nullipora* Roberts |

3 species

## Sach Waterhole

| Common Name | Scientific Name |
|---|---|
| Long-finned eel | *Anguilla reinhardtii* Steindachner |
| Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson) |
| Black catfish/Jewfish/Eel-tailed Catfish | *Neosilurus ater* (Perugia) |
| Swamp eel | *Ophisternon bengalense* McClelland |
| Poreless gudgeon | *Oxyeleotris nullipora* Roberts |
| Obbes' Catfish | *Porochilus obbesi* Weber |
| Spotted blue-eye/Gertrude's blue-eye | *Pseudomugil gertrudae* Weber |

8 species

## Blue Lagoon-Ussher Point

No fish found.
pH 3·28 , alkalinity 0

Previously collected- Gertrude's blue-eye (*Pseudomugil gertrudae*)
Source: Timms, 1986

# Olive River and associated Tributaries and Lagoons

12 sites sampled

| Common Name | Scientific Name |
|---|---|
| South pacific eel | *Anguilla obscura* Günther |
| Long-finned eel | *Anguilla reinhardtii* Steindachner |
| Sailfin glassfish/Perchlet | *Ambassis agrammus* Günther |
| Macleay's glass fish/Perchlet | *Ambassis macleayi* (Castelnau) |
| Shovel-nosed catfish | *Arius midgleyi* Kailola & Pierce |
| Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| Threadfin silver-biddy | *Gerres filamentosus* Cuvier |
| Golden goby | *Glossogobius aureus* Akihito & Meguro |
| Concave goby | *Glossogobius concavifrons* (Ramsay & |
| Dwarf goby | *Glossogobius* species 2 Hoese |
| Square blotch goby | *Glossogobius* species 1 Hoese |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Coal grunter | *Hephaestus carbo* (Ogilby & McCulloch) |
| Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| Threadfin rainbow fish | *Iriatherina werneri* (Meinkin) |
| Jungle perch/Golden bream | *Kuhlia rupestris* (Lacépède) |
| Barramundi | *Lates calcarifer* (Bloch) |
| Spangled Perch | *Leiopotherapon unicolor* (Günther) |
| Mangrove jack/Red bream | *Lutjanus argentimaculatus* (Forsskål) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson) |
| Belut (One-gilled eel) | *Monopterus albus* (Zuiew) |
| Black Catfish/Jewfish/Eel-tailed Catfish | *Neosilurus ater* (Perugia) |
| Shortfinned catfish/Eeltail | *Neosilurus brevidorsalis* (Günther) |
| Yellow finned tandan/Eel-tailed Catfish | *Neosilurus hyrtlii* Steindachner |
| Swamp eel | *Ophisternon bengalense* McClelland |
| Aru gudgeon | *Oxyeleotris aruensis* (Weber) |
| Fimbriate gudgeon | *Oxyeleotris fimbriatus* Weber |
| Greenback gauvina/Eastern sleepy cod | *Oxyeleotris gyrinoides* (Bleeker) |
| Poreless gudgeon | *Oxyeleotris nullipora* Roberts |
| Spotted blue-eye/Gertrude's blue-eye | *Pseudomugil gertrudae* Weber |
| Obbes' catfish | *Porochilus obbesi* Weber |
| Gulf saratoga | *Scleropages jardinii* (Kent) |
| Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |

36 species

## Temple Bay Creek

| Common Name | Scientific Name |
|---|---|
| Long-finned eel | *Anguilla reinhardtii* Steindachner |
| Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| Snakehead gudgeon | *Ophieleotris aporos* (Bleeker) |
| Poreless gudgeon | *Oxyeleotris nullipora* Roberts |
| Spotted blue-eye/Gertrude's blue-eye | *Pseudomugil gertrudae* Weber |

7 species

# Pascoe River

10 sites sampled

| Common Name | Scientific Name |
|---|---|
| Sailfin glassfish/Perchlet | *Ambassis agrammus* Günther |
| Long finned eel | *Anguilla reinhardtii* Steindachner |
| South pacific eel | *Anguilla obscura* Günther |
| Roman nose goby | *Awaous crassilabrus* (Günther) |
| Crimson-tipped gudgeon | *Butis butis* (Hamilton) |
| Bigeye trevally/Turrum/Great trevally | *Caranx sexfasciatus* Quoy & Gaimard |
| Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| Ebony gudgeon | *Eleotris melanosoma* Bleeker |
| Threadfin silver-biddy | *Gerres filamentosus* Cuvier |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Square-blotched goby | *Glossogobius* species 1 Hoese |
| Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| Jungle perch | *Kuhlia rupestris* (Lacépède) |
| Barramundi | *Lates calcarifer* (Bloch) |
| Spangled perch | *Leiopotherapon unicolor* (Günther) |
| Mangrove jack/Red bream | *Lutjanus argentimaculatus* (Forsskål) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson) |
| Black catfish/Jewfish/Eel-tailed catfish | *Neosilurus ater* (Perugia) |
| Aru gudgeon | *Oxyeleotris aruensis* (Weber) |
| Greenback gauvina/Eastern sleepy cod | *Oxyeleotris gyrinoides* (Bleeker) |
| Poreless gudgeon | *Oxyeleotris nullipora* Roberts |
| Speckled goby | *Redigobius bikolanus* (Herre) |
| Spotted scat | *Scatophagus argus* (Linnaeus) |
| Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |
| Banded archerfish/Riflefish | *Toxotes jaculatrix* (Pallas) |

28 species

Additional species collected from Pascoe River or tributaries:

| | |
|---|---|
| Sooty Grunter/Black Bream<br>(Source: Midgley, 1985) | *Hephaestus fuliginosus* (Macleay) |

# Lockhart River Division
## Lockhart River

| Common Name | Scientific Name |
|---|---|
| Sailfin glassfish/Perchlet | *Ambassis agrammus* Günther |
| South pacific eel | *Anguilla obscura* Günther |
| Long finned eel | *Anguilla reinhardtii* Steindachner |
| Roman nose goby | *Awaous crassilabrus* (Günther) |
| Threadfin silver-biddy | *Gerres filamentosus* Cuvier |
| Celebes goby | *Glossogobius celebius* (Valenciennes) |
| Coal grunter | *Hephaestus carbo* (Ogilby & McCulloch) |
| Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| Jungle perch | *Kuhlia rupestris* (Lacépède) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Australian rainbow fish | *Melanotaenia splendida splendida* (Allen & Cross) |
| Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson) |
| Black catfish/Jewfish/Eel-tailed catfish | *Neosilurus ater* (Perugia) |
| Shortfinned catfish/Eeltail | *Neosilurus brevidorsalis* (Günther) |
| Yellow finned tandan/Eel-tailed Catfish | *Neosilurus hyrtlii* Steindachner |
| Aru gudgeon | *Oxyeleotris aruensis* (Weber) |
| Poreless gudgeon | *Oxyeleotris nullipora* Roberts |

18 species

## Three Quarter Mile Lake/Scrubby Creek

| Common Name | Scientific Name |
|---|---|
| Sailfin glassfish/Perchlet | *Ambassis agrammus* Günther |
| Mueller's glassfish/Perchlet | *Ambassis mulleri* Klunzinger |
| Long finned eel | *Anguilla reinhardtii* Steindachner |
| Empire Gudgeon | *Hypseleotris compressa* (Krefft) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| McCulloch's rainbow fish | *Melanotaenia maccullochi* Ogilby |
| Australian rainbow fish | *Melanotaenia splendida splendida* (Allen & Cross) |
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson) |
| Black catfish/Jewfish/Eel-tailed catfish | *Neosilurus ater* (Perugia) |
| Yellow finned tandan/Eel-tailed catfish | *Neosilurus hyrtlii* Steindachner |
| Poreless gudgeon | *Oxyeleotris nullipora* Roberts |
| Rendahl's Catfish | *Porochilus rendahli* (Whitley) |
| Spotted blue-eye/Gertrude's blue-eye | *Pseudomugil gertrudae* Weber |
| Delicate blue-eye | *Pseudomugil tenellus* Taylor |

14 species

## Claudie River

2 sites sampled

| **Common Name** | **Scientific Name** |
|---|---|
| Sailfin glassfish/Perchlet | *Ambassis agrammus* Günther |
| South pacific eel | *Anguilla obscura* Günther |
| Long finned eel | *Anguilla reinhardtii* Steindachner |
| Roman nose goby | *Awaous crassilabrus* (Günther) |
| Ebony gudgeon | *Eleotris melanosoma* Bleeker |
| Threadfin silver-biddy | *Gerres filamentosus* Cuvier |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Coal grunter | *Hephaestus carbo* (Ogilby & McCulloch) |
| Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| Jungle perch | *Kuhlia rupestris* (Lacépède) |
| Australian rainbow fish | *Melanotaenia splendida splendida* (Allen & Cross) |
| Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson) |
| Black catfish/Jewfish/Eel-tailed catfish | *Neosilurus ater* (Perugia) |
| Shortfinned catfish/Eeltail | *Neosilurus brevidorsalis* (Günther) |
| Yellow finned tandan/Eel-tailed Catfish | *Neosilurus hyrtlii* Steindachner, 1866 |
| Snakehead Gudgeon | *Ophieleotris aporos* (Bleeker) |
| Aru gudgeon | *Oxyeleotris aruensis* (Weber) |
| Greenback gauvina/Eastern sleepy cod | *Oxyeleotris gyrinoides* (Bleeker) |
| Speckled goby | *Redigobius bikolanus* (Herre) |
| Spot fin goby | *Redigobius chrysosoma* (Bleeker) |

22 species

# Stewart River Drainage Division

## Stewart River
5 sites sampled

| Common Name | Scientific Name |
|---|---|
| Agassiz's glassfish | *Ambassis agassizi* Steindachner |
| Sailfin glassfish/Perchlet | *Ambassis agrammus* Günther |
| Long finned eel | *Anguilla reinhardtii* Steindachner |
| Roman nose goby | *Awaous crassilabrus* (Günther) |
| Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| Ebony gudgeon | *Eleotris melanosoma* Bleeker |
| Threadfin silver-biddy | *Gerres filamentosus* Cuvier |
| Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| Jungle perch | *Kuhlia rupestris* (Lacépède) |
| Spangled perch | *Leiopotherapon unicolor* (Günther) |
| Mangrove jack/Red bream | *Lutjanus argentimaculatus* (Forsskål) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson) |
| Bony bream | *Nematalosa erebi* (Günther) |
| Black catfish/Jewfish/Eel-tailed catfish | *Neosilurus ater* (Perugia) |
| Yellow finned tandan/Eel-tailed Catfish | *Neosilurus hyrtlii* Steindachner, 1866 |
| Striped sleepy cod | *Oxyeleotris selheimi* (Macleay) |
| Spotted scat | *Scatophagus argus* (Linnaeus) |
| Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |

20 species

Reported but not captured:

| | |
|---|---|
| Barramundi | *Lates calcarifer* (Bloch) |

## Massy Creek

| Common Name | Scientific Name |
|---|---|
| Sailfin glassfish/Perchlet | *Ambassis agrammus* Günther |
| Long finned eel | *Anguilla reinhardtii* Steindachner |
| Roman nose goby | *Awaous crassilabrus* (Günther) |
| Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| Brown gudgeon | *Eleotris fusca* (Bloch & Schneider) |
| Threadfin silver-biddy | *Gerres filamentosus* Cuvier |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| Jungle perch | *Kuhlia rupestris* (Lacépède) |
| Barramundi | *Lates calcarifer* (Bloch) |
| Spangled perch | *Leiopotherapon unicolor* (Günther) |
| Mangrove jack/Red bream | *Lutjanus argentimaculatus* (Forsskål) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Australian rainbow fish | *Melanotaenia splendida splendida* (Allen & Cross) |
| Silver grunter/Silver trumpeter | *Mesopristes argenteus* (Cuvier) |
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson) |
| Black catfish/Jewfish/Eel-tailed catfish | *Neosilurus ater* (Perugia) |
| Yellow finned tandan/Eel-tailed catfish | *Neosilurus hyrtlii* Steindachner |
| Greenback gauvina/Eastern sleepy cod | *Oxyeleotris gyrinoides* (Bleeker) |
| Striped sleepy cod | *Oxyeleotris selheimi* (Macleay) |
| Spotted scat | *Scatophagus argus* (Linnaeus) |

21 species

## Rocky River

| Common Name | Scientific Name |
|---|---|
| Long finned eel | *Anguilla reinhardtii* Steindachner |
| Roman nose goby | *Awaous crassilabrus* (Günther) |
| Brown gudgeon | *Eleotris fusca* (Bloch & Schneider) |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| Jungle perch | *Kuhlia rupestris* (Lacépède) |
| Spangled perch | *Leiopotherapon unicolor* (Günther) |
| Mangrove jack/Red bream | *Lutjanus argentimaculatus* (Forsskål) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Australian rainbow fish | *Melanotaenia splendida splendida* (Allen & Cross) |
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson) |
| Black catfish/Jewfish/Eel-tailed catfish | *Neosilurus ater* (Perugia) |
| Yellow finned tandan/Eel-tailed catfish | *Neosilurus hyrtlii* Steindachner, 1866 |
| Greenback gauvina/Eastern sleepy cod | *Oxyeleotris gyrinoides* (Bleeker) |
| Pacific Blue-eye | *Pseudomugil signifer* (Kner) |

15 species

## Rivers and Lagoons in Lakefield National Park

Source: M. Kennard, 1992. A progress report to the Queensland N.P.W.S.

| Common Name | Scientific Name |
|---|---|
| Agassiz's glassfish | *Ambassis agassizi* Steindachner |
| Barred grunter | *Amniataba percoides* (Günther) |
| South pacific eel | *Anguilla obscura* Günther |
| Long-finned eel | *Anguilla reinhardtii*(Steindachner) |
| Shovel-nosed catfish/Forktail | *Arius midgleyi* Kailola & Pierce |
| Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| Penny fish | *Denariusa bandata* Whitley |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Golden goby | *Glossogobius aureus* Akihito & Meguro |
| Barramundi | *Lates calcarifer* (Bloch) |
| Spangled perch | *Leiopotherapon unicolor* (Günther) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Common rainbow fish | *Melanotaenia splendida* (Peters) |
| Purple-spotted gudgeon | *Mogurnda adspersa* (Castelnau) |
| Bony bream | *Nematalosa erebi* (Günther) |
| Black catfish/Jewfish/Eel-tailed catfish | *Neosilurus ater* (Perugia) |
| Yellow finned tandan/Eel-tailed catfish | *Neosilurus hyrtlii* Steindachner |
| Eel-tailed catfish | *Neosilurus sp.* |
| Sleepy cod | *Oxyeleotris lineolatus* (Steindachner) |
| Rendahl's Catfish | *Porochilus rendahli* (Whitley) |
| Speckled goby | *Redigobius bikolanus* (Herre) |
| Freshwater long tom | *Strongylura krefftii* (Günther) |
| Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |

23 species

# Starcke Drainage Division
## Starcke River

| Common Name | Scientific Name |
|---|---|
| Glassfish/Perchlet | *Ambassis interruptus* Bleeker |
| Flag-tailed glassfish/Perchlet | *Ambassis miops* Günther |
| Long finned eel | *Anguilla reinhardtii* Steindachner |
| Bigeye trevally/Turrum/Great trevally | *Caranx sexfasciatus* Quoy & Gaimard |
| Milkfish/Giant herring | *Chanos chanos* Forsskål |
| Ebony gudgeon | *Eleotris melanosoma* Bleeker |
| Torres Strait herring | *Elops machnata* Regan |
| Threadfin silver-biddy | *Gerres filamentosus* Cuvier |
| Celebes goby | *Glossogobius celebius* (Valenciennes) |
| Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| Jungle perch | *Kuhlia rupestris* (Lacépède) |
| Barramundi | *Lates calcarifer* (Bloch) |
| Spangled perch | *Leiopotherapon unicolor* (Günther) |
| Sea mullet/Bully mullet | *Mugil cephalus* Linnaeus |
| Mangrove jack/Red bream | *Lutjanus argentimaculatus* (Forsskål) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Australian rainbow fish | *Melanotaenia splendida splendida* (Peters) |
| Silver grunter/Silver trumpeter | *Mesopristes argenteus* (Cuvier) |
| Black catfish/Eeltail/Jewfish | *Neosilurus ater* (Perugia) |
| Speckled goby | *Redigobius bikolanus* (Herre) |
| Spotted scat | *Scatophagus argus* (Linnaeus) |
| Butterfish | *Selenotoca multifasciata* (Richardson) |

22 species

## Jeannie River

| Common Name | Scientific Name |
|---|---|
| Sailfin glassfish/Perchlet | *Ambassis agrammus* (Günther) |
| Long finned eel | *Anguilla reinhardtii* Steindachner |
| Jungle perch | *Kuhlia rupestris* (Lacépède) |
| Spangled perch | *Leiopotherapon unicolor* (Günther) |
| Australian rainbow fish | *Melanotaenia splendida splendida* (Peters) |
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson) |

6 species

## Howick River
2 sites sampled

| Common Name | Scientific Name |
|---|---|
| Sailfin glassfish/Perchlet | *Ambassis agrammus* (Günther) |
| Flag-tailed glassfish/Perchlet | *Ambassis miops* Günther |
| Mueller's glassfish/Perchlet | *Ambassis mulleri* Klunzinger |
| Long finned eel | *Anguilla reinhardtii* Steindachner |
| Milkfish/Giant herring | *Chanos chanos* Forsskål |
| Ebony gudgeon | *Eleotris melanosoma* Bleeker |
| Torres Strait herring | *Elops machnata* Regan |
| Threadfin silver-biddy | *Gerres filamentosus* Cuvier |
| Celebes goby | *Glossogobius celebius* (Valenciennes) |
| Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| Jungle perch | *Kuhlia rupestris* (Lacépède) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Australian rainbow fish | *Melanotaenia splendida splendida* (Peters) |
| Spotted scat | *Scatophagus argus* (Linnaeus) |
| Banded archerfish/Riflefish | *Toxotes jaculatrix* (Pallas) |

15 species

## Alex Creek
(Bathurst Bay)

| Common Name | Scientific Name |
|---|---|
| Roman nose goby | *Awaous crassilabrus* (Günther) |
| Brown gudgeon | *Eleotris fusca* (Bloch & Schneider) |
| Ebony gudgeon | *Eleotris melanosoma* Bleeker |
| Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| Jungle perch | *Kuhlia rupestris* (Lacépède) |
| Snakehead Gudgeon | *Ophieleotris aporos* (Bleeker) |
| Greenback gauvina/Eastern sleepy cod | *Oxyeleotris gyrinoides* (Bleeker) |
| Pacific blue-eye | *Pseudomugil signifer* (Kner) |

8 species

## Muck Creek
(Bathurst Bay)

| Common Name | Scientific Name |
|---|---|
| Sailfin glassfish/Perchlet | *Ambassis agrammus* (Günther) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Australian rainbow fish | *Melanotaenia splendida splendida* (Peters) |
| Black catfish/Eeltail/Jewfish | *Neosilurus ater* (Perugia) |

(incomplete)

## Muck Creek Lagoon
(Bathurst Bay)

No fish species collected.
pH 2.81, alkalinity0

## Palm Creek
(Bathurst Bay)

| Common Name | Scientific Name |
|---|---|
| South pacific eel | *Anguilla obscura* Günther |
| Long finned eel | *Anguilla reinhardtii* Steindachner |
| Brown gudgeon | *Eleotris fusca* (Bloch & Schneider) |
| Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| Jungle perch | *Kuhlia rupestris* (Lacépède) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Australian rainbow fish | *Melanotaenia splendida splendida* (Peters) |
| Purple spotted gudgeon | *Mogurnda adspersa* (Castelnau) |
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson) |
| Snakehead Gudgeon | *Ophieleotris aporos* (Bleeker) |
| 10 species | |

## McIvor River

2 sites sampled

| Common Name | Scientific Name |
|---|---|
| Sailfin glassfish/Perchlet | *Ambassis agrammus* (Günther) |
| Flag-tailed glassfish/Perchlet | *Ambassis miops* Günther |
| Long finned eel | *Anguilla reinhardtii* Steindachner |
| Roman nose goby | *Awaous crassilabrus* (Günther) |
| Brown gudgeon | *Eleotris fusca* (Bloch & Schneider) |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| Jungle perch | *Kuhlia rupestris* (Lacépède) |
| Barramundi | *Lates calcarifer* (Bloch) |
| Mangrove jack/Red bream | *Lutjanus argentimaculatus* (Forsskål) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Australian rainbow fish | *Melanotaenia splendida splendida* (Peters) |
| Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| Purple spotted gudgeon | *Mogurnda adspersa* (Castelnau) |
| Black catfish/Eeltail/Jewfish | *Neosilurus ater* (Perugia) |
| Yellow finned tandan/Eel-tailed catfish | *Neosilurus hyrtlii* Steindachner |
| Greenback gauvina/Eastern sleepy cod | *Oxyeleotris gyrinoides* (Bleeker) |
| Pacific blue-eye | *Pseudomugil signifer* (Kner) |
| Speckled goby | *Redigobius bikolanus* (Herre) |

19 species

# Annan River Drainage Basin

## Annan River

### Weir

| Common Name | Scientific Name |
|---|---|
| Agassiz's glassfish/Perchlet | *Ambassis agassizi* Steindachner |
| Barred grunter | *Amniataba percoides* (Günther) |
| Long-finned eel | *Anguilla reinhardtii* Steindachner |
| Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Jungle perch | *Kuhlia rupestris* (Lacépède) |
| Common rainbow fish | *Melanotaenia splendida splendida*(Peters) |
| Black catfish/Jewfish/Eel-tailed catfish | *Neosilurus ater* (Perugia) |
| Bony bream | *Nematalosa erebi* (Günther) |
| Striped sleepy cod | *Oxyeleotris selheimi* (Macleay) |
| Speckled goby | *Redigobius bikolanus* (Herre) |

### Wallaby Creek

| Common Name | Scientific Name |
|---|---|
| Barred Grunter | *Amniataba percoides* (Günther) |
| Long-finned Eel | *Anguilla reinhardtii* (Steindachner |
| Roman Nose Goby | *Awaous crassilabrus* (Gunther) |
| Fly-specked Hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| Mouth Almighty | *Glossamia aprion* (Richardson) |
| *Sooty Grunter/Black Bream | *Hephaestus fuliginosus* (Macleay) |
| Common Rainbow fish | *Melanotaenia splendida splendida*(Peters) |
| Purple-spotted Gudgeon | *Mogurnda adspersa* (Castelnau) |
| Bony Bream | *Nematalosa erebi* (Günther) |

*introduced

14 species

## Endeavour River

### 4 Mile Dam, Cooktown

| Common Name | Scientific Name |
|---|---|
| Spangled perch | *Leiopotherapon unicolor* (Günther) |
| Common rainbow fish | *Melanotaenia splendida splendida*(Peters) |
| Black catfish/Jewfish/Eel-tailed Catfish | *Neosilurus ater* (Perugia) |

### Isabella Creek

| Common Name | Scientific Name |
|---|---|
| Australian rainbow fish | *Melanotaenia splendida splendida* (Peters) |
| Purple spotted gudgeon | *Mogurnda adspersa* (Castelnau) |
| Eeltail/Jewfish | *Neosilurus ater* (Perugia) |

### Endeavour River
2 sites sampled

| Common Name | Scientific Name |
|---|---|
| Sailfin glassfish/Perchlet | *Ambassis agrammus* Günther |
| Long finned eel | *Anguilla reinhardtii* Steindachner |
| Roman Nose Goby | *Awaous crassilabrus* (Gunther) |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Jungle perch | *Kuhlia rupestris* (Lacépède) |
| Spangled perch | *Leiopotherapon unicolor* (Günther) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Australian rainbow fish | *Melanotaenia splendida splendida* (Peters) |
| Purple spotted gudgeon | *Mogurnda adspersa* (Castelnau) |
| Bony bream | *Nematalosa erebi* (Günther) |
| Black Catfish/Eel-tailed Catfish | *Neosilurus ater* (Perugia) |
| Hyrtl's Tandan/Eel-tailed Catfish | *Neosilurus hyrtlii* Steindachner |
| Snakehead Gudgeon | *Ophieleotris aporos* (Bleeker) |
| Greenback gauvina/Eastern sleepy cod | *Oxyeleotris gyrinoides* (Bleeker) |
| Rendahl's Catfish | *Porochilus rendahli* (Whitley) |

15 species

## Black Creek at Hope Vale

| Common Name | Scientific Name |
|---|---|
| Mueller's glassfish/Perchlet | *Ambassis mulleri* Klunzinger |
| Long finned eel | *Anguilla reinhardtii* Steindachner |
| Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| McCulloch's rainbow fish | *Melanotaenia maccullochi* Ogilby |
| Australian rainbow fish | *Melanotaenia splendida splendida* (Peters) |
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson) |
| Black Catfish/Eel-tailed Catfish | *Neosilurus ater* (Perugia) |
| Snakehead Gudgeon | *Ophieleotris aporos* (Bleeker) |
| Poreless gudgeon | *Oxyeleotris nullipora* Roberts |

9 species

17 species in system

# Jardine River Catchment

## Blue Valley Lagoon

| | |
|---|---|
| Sailfin glassfish/Perchlet | *Ambassis agrammus* Günther |
| South pacific eel | *Anguilla obscura* Günther |
| Long-finned eel | *Anguilla reinhardtii* Steindachner |
| Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| Threadfin rainbow fish | *Iriatherina werneri* (Meinkin) |
| McCulloch's rainbow fish | *Melanotaenia maccullochi* Ogilby |
| Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson) |
| Poreless gudgeon | *Oxyeleotris nullipora* Roberts |
| Spotted blue-eye/Gertrude's blue-eye | *Pseudomugil gertrudae* Weber |

11 species collected

Reported by locals:

| | |
|---|---|
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |

## Jardine River pump station

| | |
|---|---|
| Macleay's glass fish/Perchlet | *Ambassis macleayi* (Castelnau) |
| South pacific eel | *Anguilla obscura* Günther |
| Long-finned eel | *Anguilla reinhardtii* Steindachner |
| Freshwater sole | *Brachirus selheimi* (Macleay) |
| Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Coal grunter | *Hephaestus carbo* (Ogilby & McCulloch) |
| Barramundi | *Lates calcarifer* (Bloch) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| Bony bream | *Nematalosa erebi* (Günther) |
| Black Catfish/Jewfish/Eel-tailed Catfish | *Neosilurus ater* (Perugia) |
| Poreless gudgeon | *Oxyeleotris nullipora* Roberts |
| Lorentz's grunter | *Pingalla lorentzi* (Weber) |
| Gulf saratoga | *Scleropages jardinii* (Kent) |
| Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |

17 species collected

# Wenlock River, associated Lagoons, and Tributaries

17 sites sampled

| **Common Name** | **Scientific Name** |
|---|---|
| Sailfin glassfish/Perchlet | *Ambassis agrammus* Günther |
| Long-spined glassfish/Perchlet | *Ambassis interruptus* Bleeker |
| Macleay's glass fish/Perchlet | *Ambassis macleayi* (Castelnau) |
| Mueller's glassfish/Perchlet | *Ambassis mulleri* Klunzinger |
| Barred grunter | *Amniataba percoides* (Günther) |
| Lesser salmon catfish/Forktail | *Arius graeffei* (Kner & Steindachner) |
| Triangular shield catfish/Forktail | *Arius leptaspis* (Bleeker) |
| Shovel-nosed catfish/Forktail | *Arius midgleyi* Kailola & Pierce |
| Freshwater sole | *Brachirus selheimi* (Macleay) |
| River shark | *Carcharhinus leucas* (Valenciennes) |
| Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| Stingray | *Dasyatis sp.* |
| Penny fish | *Denariusa bandata* Whitley |
| Threadfin silver-biddy | *Gerres filamentosus* Cuvier |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Square blotch goby | *Glossogobius* species 1 Hoese |
| Concave goby | *Glossogobius concavifrons* (Ramsay & Ogilby) |
| Coal grunter | *Hephaestus carbo* (Ogilby & McCulloch) |
| Sooty grunter/Black bream | *Hephaestus fuliginosus* (Macleay) |
| Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| Threadfin rainbow fish | *Iriatherina werneri* (Meinkin) |
| Barramundi | *Lates calcarifer* (Bloch) |
| Spangled perch | *Leiopotherapon unicolor* (Günther) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson) |
| Black catfish/Jewfish/Eel-tailed catfish | *Neosilurus ater* (Perugia) |
| Yellow finned tandan/Eel-tailed catfish | *Neosilurus hyrtlii* Steindachner |
| Bony bream | *Nematalosa erebi* (Günther) |
| Swamp eel | *Ophisternon gutturale* Richardson |
| Aru gudgeon | *Oxyeleotris aruensis* (Weber) |
| Fimbriate gudgeon | *Oxyeleotris fimbriatus* Weber |
| Sleepy cod | *Oxyeleotris lineolatus* (Steindachner) |
| Poreless gudgeon | *Oxyeleotris nullipora* Roberts |
| Striped sleepy cod | *Oxyeleotris selheimi* (Macleay) |
| Lorentz's grunter | *Pingalla lorentzi* (Weber) |
| Rendahl's Catfish | *Porochilus rendahli* (Whitley |
| River sawfish | *Pristis pristis* Linnaeus |
| Spotted blue-eye/Gertrude's blue-eye | *Pseudomugil gertrudae* Weber |
| Gulf saratoga | *Scleropages jardinii* (Kent) |
| Freshwater long tom | *Strongylura kreffiii* (Günther) |
| Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |
| Buffon's river garfish | *Zenarchopterus* cf *buffonis* (Valenciennes) |
| Fly River garfish | *Zenarchopterus novaeguineae* (Weber) |

45 species collected

Not collected by us but present in river:

| | |
|---|---|
| Elongate glassfish/ Perchlet | *Ambassis elongatus* (Castelnau) |
| Snub nosed garfish | *Arramphus sclerolepis* Günther |
| Snakehead gudgeon | *Ophieleotris aporos* (Blecker) |

Sources: Tait and Pearson, pers. comm.; Armstrong, 1985; Blaber, Brewer and Salini, 1989

45 species collected from system
48 species documented

# Weipa Area Lagoons

## Willum Swamp

| Common Name | Scientific Name |
|---|---|
| Swamp eel | *Ophisternon bengalense* McClelland |

## Botchet Swamp

| Common Name | Scientific Name |
|---|---|
| Sailfin glassfish/Perchlet | *Ambassis agrammus* Günther |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| Swamp eel | *Ophisternon bengalense* McClelland |

## Andoom Swamp

| Common Name | Scientific Name |
|---|---|
| Barramundi | *Lates calcarifer* (Bloch) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| Swamp eel | *Ophisternon bengalense* McClelland |

All species sampled from waterhole below swamp. No fish observed in swamp.

## Kupandhanang Swamp

| Common Name | Scientific Name |
|---|---|
| Sailfin glassfish/Perchlet | *Ambassis agrammus* Günther |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Empire gudgeon | *Hypseleotris compressa* (Krefft) |
| Black-banded rainbow fish | *Melanotaenia nigrans* (Richardson) |
| Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson) |
| Black catfish/Eel-tailed catfish | *Neosilurus ater* (Perugia) |
| Poreless gudgeon | *Oxyeleotris nullipora* Roberts |
| Spotted blue-eye/Gertrude's blue-eye | *Pseudomugil gertrudae* Weber |

10 species sampled.

# Archer River, associated Lagoons, and Tributaries

23 sites sampled

| Common Name | Scientific Name |
|---|---|
| Sailfin glassfish/Perchlet | *Ambassis agrammus* Günther |
| Macleay's glassfish/Perchlet | *Ambassis macleayi* (Castelnau) |
| Mueller's glassfish/Perchlet | *Ambassis mulleri* Klunzinger |
| Toothless catfish/Jewfish | *Anodontiglanis dahli* Rendahl |
| Barred grunter | *Amniataba percoides* (Günther) |
| Lesser salmon catfish/Forktail | *Arius graeffei* (Kner & Steindachner) |
| Triangular shield catfish/Forktail | *Arius leptaspis* (Bleeker) |
| Shovel-nosed catfish/Forktail | *Arius midgleyi* Kailola & Pierce |
| Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| Stingray | *Dasyatis sp.* |
| Penny fish | *Denariusa bandata* Whitley |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Dwarf goby | *Glossogobius* species A Allen |
| Square-blotched goby | *Glossogobius* species C Allen |
| Coal grunter | *Hephaestus carbo* (Ogilby & McCulloch) |
| Sooty grunter/Black bream | *Hephaestus fuliginosus* (Macleay) |
| Threadfin rainbow fish | *Iriatherina werneri* (Meinkin) |
| Barramundi | *Lates calcarifer* (Bloch) |
| Spangled perch | *Leiopotherapon unicolor* (Günther) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl) |
| Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson) |
| Bony bream | *Nematalosa erebi* (Günther) |
| Black catfish/Eel-tailed catfish | *Neosilurus ater* (Perugia) |
| Yellow finned tandan/Eel-tailed catfish | *Neosilurus hyrtlii* Steindachner |
| Swamp eel | *Ophisternon bengalense* McClelland |
| Sleepy cod | *Oxyeleotris lineolatus* (Steindachner) |
| Poreless gudgeon | *Oxyeleotris nullipora* Roberts |
| Striped sleepy cod | *Oxyeleotris selheimi* (Macleay) |
| Rendahl's Catfish | *Porochilus rendahli* (Whitley) |
| River sawfish | *Pristis pristis* Linnaeus |
| Gulf saratoga | *Scleropages jardinii* (Kent) |
| Freshwater long tom | *Strongylura krefftii* (Günther) |
| Freshwater anchovy | *Thryssa scratchleyi* (Ramsay & Ogilby) |
| Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |

36 species

Reported but not seen:

| | |
|---|---|
| Snub nosed garfish | *Arramphus sclerolepis* Günther |

## Holroyd River and Associated Lagoons

8 sites sampled

| Common Name | Scientific Name |
|---|---|
| Sailfin glassfish/Perchlet | *Ambassis agrammus* Günther |
| Macleay's glassfish/Perchlet | *Ambassis macleayi* (Castelnau) |
| Barred grunter | *Amniataba percoides* Günther |
| Toothless catfish/Eeltail | *Anodontiglanis dahli* Rendahl |
| Berney's catfish/Forktail | *Arius berneyi* (Whitley) |
| Lesser salmon catfish/Forktail | *Arius graeffei* (Kner & Steindachner) |
| Shovel-nosed catfish/Forktail | *Arius midgleyi* Kailola & Pierce |
| Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| Pennyfish | *Denariusa bandata* Whitley |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Golden goby | *Glossogobius aureus* Akihito & Meguro |
| Square-blotch goby | *Glossogobius species C* Allen |
| Sooty grunter/Black bream | *Hephaestus fuliginosus* (Macleay) |
| Threadfin rainbow fish | *Iriatherina werneri* (Meinkin) |
| Barramundi | *Lates calcarifer* (Bloch) |
| Spangled perch | *Leiopotherapon unicolor* (Günther) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Australian rainbow fish/ | |
| Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| Bony bream | *Nematalosa erebi* (Günther) |
| Black catfish/Eeltail/Jewfish | *Neosilurus ater* (Perugia) |
| Yellow finned tandan/Eeltail | *Neosilurus hyrtlii* Steindachner |
| Swamp eel | *Ophisternon bengalense* McClelland |
| Sleepy cod | *Oxyeleotris lineolatus* (Steindachner) |
| Poreless gudgeon | *Oxyeleotris nullipora* Roberts |
| Striped sleepy cod | *Oxyeleotris selheimi* (Macleay) |
| Rendahl's Catfish | *Porochilus rendahli* (Whitley) |
| Gulf saratoga | *Scleropages jardinii* (Kent) |
| Barcoo grunter/Leathery grunter | *Scortum cf barcoo* (McCulloch & Waite) |
| Leathery grunter | *Scortum cf hillii* (Castelnau) |
| Long Tom | *Strongylura krefftii* (Günther) |
| Archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |

32 species sampled

Reported but not seen:

| | |
|---|---|
| Freshwater stingray | *Dasyatis sp (fluviorum?)* |
| River sawfish | *Pristis pristis* Linnaeus |

34 species

Additional species:

| | |
|---|---|
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson) |

(Source: Midgley, 1985)

# Edward River and Associated Lagoons

5 sites sampled

| Common Name | Scientific Name |
|---|---|
| Sailfin glassfish/Perchlet | *Ambassis agrammus* Günther |
| Macleay's glassfish/Perchlet | *Ambassis macleayi* (Castelnau) |
| Mueller's glassfish | *Ambassis mulleri* Klunzinger |
| Barred grunter | *Amniataba percoides* Günther |
| Toothless catfish/Eeltail | *Anodontiglanis dahli* Rendahl |
| Lesser salmon catfish/Forktail | *Arius graeffei* (Kner & Steindachner) |
| Shovel-nosed catfish/Forktail | *Arius midgleyi* Kailola & Pierce |
| Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| Pennyfish | *Denariusa bandata* Whitley |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Golden goby | *Glossogobius aureus* Akihito & Meguro |
| Square-blotch goby | *Glossogobius species C* Allen |
| Sooty grunter/Black bream | *Hephaestus fuliginosus* (Macleay) |
| Spangled perch | *Leiopotherapon unicolor* (Günther) |
| Threadfin rainbow fish | *Iriatherina werneri* (Meinkin) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Australian rainbow fish/ Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| Bony bream | *Nematalosa erebi* (Günther) |
| Silver tandan/ Eeltail | *Neosilurus argenteus* (Zietz) |
| Black catfish/Eeltail/Jewfish | *Neosilurus ater* (Perugia) |
| Yellow finned tandan/Eeltail | *Neosilurus hyrtlii* Steindachner |
| Swamp eel | *Ophisternon bengalense* McClelland |
| Sleepy cod | *Oxyeleotris lineolatus* (Steindachner) |
| Poreless gudgeon | *Oxyeleotris nullipora* Roberts |
| Striped sleepy cod | *Oxyeleotris selheimi* (Macleay) |
| Rendahl's Catfish | *Porochilus rendahli* (Whitley) |
| Gulf saratoga | *Scleropages jardinii* (Kent) |
| Barcoo grunter/Leathery grunter | *Scortum cf barcoo* (McCulloch & Waite) |
| Leathery grunter | *Scortum cf hillii* (Castelnau) |
| Long Tom | *Strongylura krefftii* (Günther) |
| Archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |

31 species sampled

Reported but not seen:

| | |
|---|---|
| River shark | *Carcharhinus leucas* (Valenciennes) |
| Freshwater stingray | *Dasyatis sp (fluviorum?)* |
| River sawfish | *Pristis pristis* Linnaeus |

34 species

Additional species collected from catchment:

| | |
|---|---|
| Triangular shield catfish/Forktail | *Arius leptaspis* (Bleeker) |
| Flathead goby | *Glossogobius giurus* (Hamilton) |
| Delicate blue-eye | *Pseudomugil tenellus* Taylor |

(Sources: Midgley, 1985; Hansen, 1987)

# Coleman River and Associated Lagoons

9 sites sampled

| Common Name | Scientific Name |
|---|---|
| Macleay's glassfish/Perchlet | *Ambassis macleayi* (Castelnau) |
| Toothless catfish/Jewfish | *Anodontiglanis dahli* Rendahl |
| Barred grunter | *Amniataba percoides* (Günther) |
| Berney's catfish/Forktail | *Arius berneyi* (Whitley) |
| Lesser salmon catfish/Forktail | *Arius graeffei* (Kner & Steindachner) |
| Shovel-nosed catfish/Forktail | *Arius midgleyi* Kailola & Pierce |
| Great trevally/Turrum | *Caranx sexfasciatus* Quoy & Gaimard |
| Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Golden goby | *Glossogobius aureus* Akihito & Meguro |
| Square-blotch goby | *Glossogobius species C* Allen |
| Sooty grunter/Black bream | *Hephaestus fuliginosus* (Macleay) |
| Barramundi | *Lates calcarifer* (Bloch) |
| Spangled perch | *Leiopotherapon unicolor* (Günther) |
| Oxeye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Australian rainbow fish/ Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| Bony bream | *Nematalosa erebi* (Günther) |
| Silver tandan/ Eeltail | *Neosilurus argenteus* (Zietz) |
| Black catfish/Eeltail/Jewfish | *Neosilurus ater* (Perugia) |
| Yellow finned tandan/Eeltail | *Neosilurus hyrtlii* Steindachner, 1866 |
| Swamp eel | *Ophisternon bengalense* McClelland |
| Sleepy cod | *Oxyeleotris lineolatus* (Steindachner) |
| Striped sleepy cod | *Oxyeleotris selheimi* (Macleay) |
| Gilbert's grunter | *Pingalla gilberti* Whitley |
| Rendahl's Catfish | *Porochilus rendahli* (Whitley) |
| Gulf saratoga | *Scleropages jardinii* (Kent) |
| Barcoo grunter/Leathery grunter | *Scortum cf barcoo* (McCulloch & Waite) |
| Leathery grunter | *Scortum cf hillii* (Castelnau) |
| Long Tom | *Strongylura krefftii* (Günther) |
| Archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |

30 species

Reported but not seen:

| Common Name | Scientific Name |
|---|---|
| River shark | *Carcharhinus leucas* (Valenciennes) |
| Freshwater stingray | *Dasyatis sp (fluviorum?)* |
| River sawfish | *Pristis pristis* Linnaeus |

33 species

## Palmer River and Associated Lagoons

9 sites sampled

| Common Name | Scientific Name |
|---|---|
| Macleay's glassfish/Perchlet | *Ambassis macleayi* (Castelnau) |
| Mueller's glassfish/Perchlet | *Ambassis mulleri* Klunzinger |
| Toothless catfish/Jewfish | *Anodontiglanis dahli* Rendahl |
| Barred grunter | *Amniataba percoides* (Günther) |
| Lesser salmon catfish/Forktail | *Arius graeffei* (Kner & Steindachner) |
| Shovel-nosed catfish/Forktail | *Arius midgleyi* Kailola & Pierce |
| Snub nosed garfish | *Arramphus sclerolepis* Günther |
| Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther) |
| Mouth almighty | *Glossamia aprion* (Richardson) |
| Square-blotched goby | *Glossogobius* species 1 Hoese |
| Sooty grunter/Black bream | *Hephaestus fuliginosus* (Macleay) |
| Barramundi | *Lates calcarifer* (Bloch) |
| Spangled perch | *Leiopotherapon unicolor* (Günther) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| Chequered rainbow fish | *Melanotaenia splendida inornata* (Peters) |
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson) |
| Bony bream | *Nematalosa erebi* (Günther) |
| Black catfish/Eel-tailed catfish | *Neosilurus ater* (Perugia) |
| Yellow finned tandan/Eel-tailed catfish | *Neosilurus hyrtlii* Steindachner |
| Sleepy cod | *Oxyeleotris lineolatus* (Steindachner) |
| Striped sleepy cod | *Oxyeleotris selheimi* (Macleay) |
| Rendahl's Catfish | *Porochilus rendahli* (Whitley) |
| Freshwater long tom | *Strongylura krefftii* (Günther) |
| Seven-spot archerfish/Riflefish | *Toxotes chatareus* (Hamilton) |

24 species

Reported by locals:

| | |
|---|---|
| River shark | *Carcharhinus leucas* (Valenciennes) |
| Stingray | *Dasyatis sp.* |
| River sawfish | *Pristis pristis* Linnaeus |
| Gulf saratoga | *Scleropages jardinii* (Kent) |
| Barcoo grunter/Leathery grunter | *Scortum barcoo* (McCulloch & Waite) |
| Freshwater anchovy | *Thryssa scratchleyi* (Ramsay & Ogilby) |

30 species

Reported from Rifle Creek:

| | |
|---|---|
| Coal grunter | *Hephaestus carbo* (Ogilby & McCulloch) |

Additional species collected from Mitchell River or Tributaries
(Sources: Midgley, 1985, 1988; Leggett, 1990)

| | |
|---|---|
| Berney's catfish/Forktail | *Arius berneyi* (Whitley) |
| Triangular shield catfish/Forktail | *Arius leptaspis* (Bleeker) |
| Freshwater sole | *Brachirus selheimi* (Macleay) |
| Freshwater stingray | *Dasyatis fluviorum* |
| Silver biddy | *Gerres* sp. |
| Flathead goby | *Glossogobius giurus* (Hamilton) |
| Gilbert's grunter | *Pingalla gilberti* Whitley |

# List of species sampled from Cape York Peninsula 1992-1993

138 sites sampled

| Common Name | Scientific Name |
|---|---|
| Agassiz's glassfish | *Ambassis agassizi* Steindachner, 1866 |
| Sailfin glassfish/Perchlet | *Ambassis agrammus* Günther, 1867 |
| *Glassfish/Perchlet | *Ambassis interruptus* Bleeker, 1852 |
| Macleay's glass fish/Perchlet | *Ambassis macleayi* (Castelnau, 1878) |
| Flag-tailed glassfish/Perchlet | *Ambassis miops* Günther, 1872 |
| Mueller's glassfish/Perchlet | *Ambassis mulleri* Klunzinger, 1880 |
| Barred grunter | *Amniataba percoides* (Günther, 1864) |
| South pacific eel | *Anguilla obscura* Günther, 1872 |
| Long-finned eel | *Anguilla reinhardtii* Steindachner, 1867 |
| Toothless catfish/Eeltail | *Anodontiglanis dahli* Rendahl, 1922 |
| Berney's catfish/Forktail | *Arius berneyi* (Whitley, 1941) |
| Lesser salmon catfish/Forktail | *Arius graeffei* Kner & Steindachner, 1866 |
| Triangular shield catfish/Forktail | *Arius leptaspis* (Bleeker, 1862) |
| Shovel-nosed catfish | *Arius midgleyi* Kailola & Pierce, 1988 |
| Snub nosed garfish | *Arramphus sclerolepis* Günther, 1866 |
| Roman nose goby | *Awaous crassilabrus* (Günther, 1861) |
| Freshwater sole | *Brachirus selheimi* (Macleay, 1882) |
| *Crimson-tipped gudgeon | *Butis butis* (Hamilton, 1822) |
| *River shark | *Carcharhinus leucas* (Valenciennes, 1839) |
| *Bigeye trevally/Turrum/Great trevally | *Caranx sexfasciatus* Quoy & Gaimard, 1825 |
| *Milkfish/Giant herring | *Chanos chanos* (Forsskål, 1775) |
| Fly-specked hardyhead | *Craterocephalus stercusmuscarum* (Günther, 1867) |
| Freshwater stingray | *Dasyatis sp (fluviorum?)* |
| Penny fish | *Denariusa bandata* Whitley, 1948 |
| *Brown gudgeon | *Eleotris fusca* (Bloch & Schneider, 1801) |
| *Ebony gudgeon | *Eleotris melanosoma* Bleeker, 1852 |
| *Ten pounder/Giant herring | *Elops machnata* Forsskål, 1775 |
| *Threadfin silver-biddy | *Gerres filamentosus* Cuvier, 1829 |
| Golden goby | *Glossogobius aureus* Akihito & Meguro, 1975 |
| Celebes goby | *Glossogobius celebius* (Valenciennes, 1837) |
| Concave goby | *Glossogobius concavifrons* (Ramsay & Ogilby, 1887) |
| Square blotch goby | *Glossogobius* species 1 Hoese |
| Dwarf goby | *Glossogobius* species 2 Hoese |
| Square-blotch goby | *Glossogobius species C* Allen, 1989 |
| Mouth almighty | *Glossamia aprion* (Richardson, 1842) |
| Coal grunter | *Hephaestus carbo*(Ogilby & McCulloch, 1916) |
| Sooty Grunter/Black Bream | *Hephaestus fuliginosus* (Macleay, 1883) |
| Empire gudgeon | *Hypseleotris compressa* (Krefft, 1864) |
| Threadfin rainbow fish | *Iriatherina werneri* Meinkin, 1974 |
| Jungle perch/Golden bream | *Kuhlia rupestris* (Lacépède) |
| Barramundi | *Lates calcarifer* (Bloch) |
| Spangled Perch | *Leiopotherapon unicolor* (Günther, 1859) |

| | |
|---|---|
| *Mangrove jack/Red bream | *Lutjanus argentimaculatus* (Forsskål) |
| Ox-eye herring/Tarpon | *Megalops cyprinoides* (Broussonet) |
| McCulloch's rainbow fish | *Melanotaenia maccullochi* Ogilby, 1915 |
| Black banded rainbow fish | *Melanotaenia nigrans* (Richardson, 1843) |
| Chequered rainbow fish | *Melanotaenia splendida inornata* (Castelnau, 1875) |
| Australian rainbow fish | *Melanotaenia splendida splendida* (Peters, 1867) |
| Banded rainbow fish | *Melanotaenia trifasciata* (Rendahl, 1922) |
| *Silver grunter/Silver trumpeter | *Mesopristes argenteus* (Cuvier, 1829) |
| Purple-spotted gudgeon | *Mogurnda adspersa* (Castelnau, 1878) |
| Purple spotted gudgeon/Northern trout gudgeon | *Mogurnda mogurnda* (Richardson, 1844) |
| Belut (One-gilled eel) | *Monopterus albus* (Zuiew) |
| *Sea mullet/Bully mullet | *Mugil cephalus* Linnaeus |
| Bony bream | *Nematalosa erebi* (Günther) |
| Silver tandan/ Eeltail | *Neosilurus argenteus* (Zietz, 1896) |
| Black Catfish/Jewfish/Eel-tailed Catfish | *Neosilurus ater* (Perugia, 1894) |
| Shortfinned catfish/Eeltail | *Neosilurus brevidorsalis* (Günther, 1867) |
| Yellow finned tandan/Eel-tailed Catfish | *Neosilurus hyrtlii* Steindachner, 1867 |
| Rendahl's Catfish | *Porochilus rendahli* (Whitley, 1928) |
| Snakehead gudgeon | *Ophieleotris aporos* (Bleeker, 1854) |
| Swamp eel | *Ophisternon bengalense* McClelland |
| Aru gudgeon | *Oxyeleotris aruensis* (Weber, 1911) |
| Fimbriate gudgeon | *Oxyeleotris fimbriatus* Weber, 1908 |
| Greenback gauvina/Eastern sleepy cod | *Oxyeleotris gyrinoides* (Bleeker, 1853) |
| Sleepy cod | *Oxyeleotris lineolatus* (Steindachner, 1867) |
| Poreless gudgeon | *Oxyeleotris nullipora* Roberts, 1978 |
| Striped sleepy cod | *Oxyeleotris selheimi* (Macleay, 1882) |
| Gilbert's grunter | *Pingalla gilberti* Whitley, 1955 |
| Lorentz's grunter | *Pingalla lorentzi* (Weber, 1910) |
| River sawfish | *Pristis pristis* (Linnaeus, 1758) |
| Spotted blue-eye/Gertrude's blue-eye | *Pseudomugil gertrudae* Weber, 1911 |
| Pacific Blue-eye | *Pseudomugil signifer* Kner, 1867 |
| Delicate blue-eye | *Pseudomugil tenellus* Taylor, 1964 |
| Obbes' catfish | *Porochilus obbesi* Weber, 1913 |
| Speckled goby | *Redigobius bikolanus* (Herre, 1927) |
| *Spot fin goby | *Redigobius chrysosoma* (Bleeker, 1875) |
| *Spotted scat | *Scatophagus argus* (Linnaeus, 1766) |
| Gulf saratoga | *Scleropages jardinii* (Saville-Kent, 1892) |
| Barcoo grunter/Leathery grunter | *Scortum cf barcoo* (McCulloch & Waite, 1917) |
| Leathery grunter | *Scortum cf hillii* (Castelnau, 1878) |
| *Butterfish | *Selenotoca multifasciata* (Richardson, 1846) |
| Freshwater long tom | *Strongylura krefftii* Günther, 1866 |
| Freshwater anchovy | *Thryssa scratchleyi* Ramsay & Ogilby, 1866 |
| Seven-spot archerfish/Riflefish | *Toxotes chatoreus* (Hamilton-Buchanan, 1822) |
| Banded archerfish/Riflefish | *Toxotes jaculatrix* (Pallas, 1767) |
| Buffon's river garfish | *Zenarchopterus* cf *buffonis* (Valenciennes, 1847) |
| Fly River garfish | *Zenarchopterus novaeguineae* (Weber, 1913) |

88 Species sampled

* essentially marine-15 species
73 species spend most or all of their life in freshwater
One species (*Ambassis elongatus*) not collected. No specimens of *Dasyatis* sp, *Pristis pristis* or *Carcharhinus leucas* deposited in Queensland museum.

# APPENDIX THREE.

**Mapped distributions of selected species from Cape York Peninsula.**
These distributions were mapped from point data collected during CYPLUS field trips in 1992-1994. The following maps were provided by the Environmental Resources Information Network (ERIN) who hold some of the data collected during the CYPLUS fish survey. The distribution maps only reflect the results of our collections and hence there are huge gaps in the far Northern Peninsula (Jardine River region), Lakefield area (Normanby-Kennedy complex) and wet tropics. These maps are not intended as a definitive guide to species distributions. Data from previous studies and this one is available from ERIN (See Chapter 4).

Freshwater penetration was mapped downstream from the most upstream point of capture of selected catadromous (or suspected catadromous) fish species. Point data in some cases may overlap and obscure where two species were located in the same site. These cases are noted in the explanatory notes after each map. Also, because specimens reported by locals but not collected by us were not entered in the database, information from these sources did not go into the maps. Hence, even though sawfish have been reported from the Palmer River, they are not marked on the map because positive identification (to species) was not able to be confirmed. Freshwater stingrays, although found in the Archer River, were not collected and hence were not entered into the ERIN database (they are, however, in the CYPLUS GIS held by The Department of Lands, Queensland).

As some areas were unable to be sampled (eg. lower reaches of the Archer, Holroyd, Edward, Coleman and Mitchell Rivers) apparent absence of species from these areas reflects a lack of sampling rather than absence.

**Fish Sampling Site Locations** (p 347)
Locations sampled between July 1992 and June 1994 are plotted on this map. A number of locations are so close as to appear as one marker. This is particularly true in the case of a number of lagoons on the Wenlock and Olive River systems, which were extremely close together. A total of 138 sites are mapped.

**Blue-eyes (*Pseudomugil* spp.) species Distributions** (p 348).
Of the three species of blue-eyes (*Pseudomugil* spp.) collected on the Peninsula our records of Gertrude's blue-eye (*P. gertrudae*) are the most numerous, probably in part due to the distance from the sea of most sampling locations. As can be seen, they appeared to be restricted to the northern half of the Peninsula. The record of delicate blue-eyes (*P. tenellus*) from Scrubby creek obscures the Gertrude's blue-eyes which were collected there also.

Gertrude's blue eyes are also found further south in humic water environments in the south near Cape Flattery and south of Cairns. Although they have been found in estuaries (Blaber et al., 1989), saltwater is not essential as they are present in freshwater lakes with no access to the sea (eg. Sach waterhole).

Pacific blue-eyes (*P. signifer*).were only collected from locations south of Starcke, and Rocky Creek at Silver Plains. Sites near the sea at the Claudie, Lockhart, Pascoe and Olive Rivers, and Harmer Creek were sampled and no Pacific blue eyes were caught, which suggests that they may not be present this far north. However, most of our sampling was conducted in the dry months. Pacific blue eyes were not collected in the McIvor River in March but were present in January, suggesting that seasonal differences may influence apparent distribution of this species. Hansen (1989) had heard of Pacific blue eyes in the Lockhart River area from local residents, suggesting that their apparent absence from our collections may not be due solely to seasonal differences.

There are numerous other collections of Gertrude's blue-eyes and delicate blue-eyes from the Jardine River catchment and Dalhunty River area (see Appendix One for references). Additionally, delicate blue-eyes have been recorded from the Edward River.

**Saratoga (*Scleropages jardinii*) distribution map** (p. 349).
Saratoga were encountered in all west flowing streams sampled, except the Palmer River. Locals said that saratoga were present in the Mitchell further downstream, especially in lagoons. They were also present on the east coast in sand dune lakes at Shelburne, and in the Olive river area. The have not been reported south of the Olive River catchment. As can be seen from the map (when compared to the map of sites sampled), saratoga were virtually ubiquitous over the western river systems sampled, both upstream and downstream.

**Coal Grunter (*Hephaestus carbo*) distribution map (p. 350).**
Coal grunters were most abundant in the headwaters of the streams within their range, but in most rivers were less common throughout the middle and lower reaches. They appear not to be found, or are extremely uncommon, in the tidal reaches of rivers. The three points on the map near the upper Archer River are small feeder tributaries not in the coverage of major rivers. The map suggests a definite latitudinal boundary at about 14° South. However, they are present further south in the headwaters of the Mitchell river at Rifle and Spear Creeks and the McLeod River, which are south of the CYPLUS area in the map.

**Striped Sleepy Cod (*Oxyeleotris selheimi*) distribution map (p. 351).**
Striped sleepy cod were common to abundant all along the west coast in rivers and lagoons which we sampled. They seemed to be slightly more abundant in lagoons, and in the Edward River basin were only found in lagoons. They were also present in two east coast systems, the Stewart and the Annan Rivers. As discussed in Chapter 17, the Stewart is believed to have been a relatively recent stream capture from the Holroyd River. The other population, in the Annan River, possibly originated from that river also having been westward flowing at one stage, although it is believed to have been linked with the Normanby System in the past (Kozicka, 1987). However, it is possible that striped sleepy cod were introduced there.

**Sleepy Cod (*Oxyeleotris lineolatus*) distribution map (p. 352).**
Sleepy cod were far more common than striped sleepy cod, mainly because they were found in both lagoon and river habitats. They were found in virtually all west coast river habitats surveyed. The two records in the Normanby complex are unconfirmed, as specimens were not collected by us. These were recorded in conjunction with a Griffith University study of lagoon ecology conducted by M. Kennard. From the results of our study, sleepy cod are the most widespread and abundant of all the Eleotrids on the west coast.

**Threadfin rainbow fish (*Iriatherina werneri*) distribution map (p. 353).**
Threadfin rainbows were previously only documented from west coast rivers (Jardine, Edward, Holroyd). This study has increased the known distribution to the east coast as far south as Glennie Creek on the Olive River and their presence in lagoons on the Archer and Wenlock rivers. The widespread distribution pattern seen in the map

reflects the distribution of lagoon sampling sites. The closeness of records on the Olive River is due to the presence of this species in the river as well as lagoons, which is unique to the Olive and Jardine Rivers.

**Poreless Gudgeons (*Oxyeleotris nullipora*) distribution map** (p. 354).
Poreless gudgeons were previously little recorded species only known from the tip of Cape York Peninsula. As can be seen from the map, they are widely distributed throughout the peninsula, being present in almost all major river systems north of 15°S. Although they were most often collected from lagoons, they are also present in the rivers, and it is surprising that many previous surveys have overlooked their presence. Probably their small size and cryptic nature have meant that they are infrequently collected.

**Aru Gudgeon (*Oxyeleotris aruensis*) distribution map** (p. 355).
Similar to poreless gudgeons, Aru gudgeons were also previously poorly documented from the Peninsula, being known from the Jardine area only. Although their distribution appears to be primarily east coast, they were also present in the upper Wenlock River at one location. They appear to have a restricted distribution, being most abundant in the Olive, Pascoe and Lockhart systems.

**Swamp Eel (*Ophisternon bengalense*) distribution map** (p. 356).
The distribution of swamp eels as mapped is probably partly a reflection of the timing of sampling, as sites in the south west of the peninsula were sampled in late 1993, when swamp eels were abundant. None were caught in 1992 and early 1993, when the northern areas were most intensively surveyed. All the records from the Archer River north were collected from August 1993. The distribution pattern may be more continuous than appears from this map, but could only be fully ascertained by repeat sampling at sites sampled when swamp eels were not caught. The previous known distribution of this species of swamp eel did not include Queensland, and it appears that they are much more widely distributed than realised on the basis of previous collections.

**Eeltailed catfish / Jewfish (*Neosilurus ater*) distribution map** (p. 357).
According to Wager (1993) and Allen (1989) the Queensland distribution of *N. ater* was known from east coast division drainages and the Jardine River. As the map indicates, its distribution is widespread over the entire region. Jewfish were present in all river systems sampled and virtually all sites within a river system. They were particularly abundant in lagoons. The distribution of this fish appears to cover the entire peninsula. However, it is possible that there are different populations. The Harmer Creek population is genetically distinct from the Olive, Wenlock and Archer River populations. Further studies may reveal other discrete stocks. However, these cannot be differentiated by physical characteristics.

**Yellow finned eeltail / Hyrtl's tandan (*Neosilurus hyrtlii*) distribution map** (p. 358).
Hyrtl's tandans, while not as common as jewfish, were found over a similar distribution. They were much more abundant in upstream habitats in flowing rivers, which is partly reflected in the map. However, they were present in small numbers throughout river systems, but did not appear to live close to the sea. Hyrtl's tandans were previously well documented from the Gulf drainage division, but this study has increased their documented distribution to most east Peninsula river systems.

**Rendahl's tandan (*Porochilus rendahli*) distribution map** (p. 359).
The few records of Rendahl's tandan are probably due to its apparent requirement for lake or lagoon habitats. We never collected it in rivers or river bed holes. However, it is widespread over the Peninsula . More records would probably be forthcoming if more suitable habitats were sampled. However, this species was rarely abundant and it could take repeated sampling to fully document its distribution. The scattered points on this map suggest it to be very widespread.

**Common Rainbowfish (*Melanotaenia splendida*) distribution map** (p. 360).
Common rainbows were virtually ubiquitous on the Peninsula, and were collected from nearly all sampling locations. As can be seen on the map, eastern rainbows (*Melanotaenia splendida splendida*) were only collected from the south-eastern corner of the peninsula, south of the Nesbit River. Previously, it was believed that their distribution extended far up the east coast to Cape York (Allen, 1989).

Chequered rainbows (*Melanotaenia splendida inornata*) were present in all western flowing rivers and extended down the east coast as far as the Lockhart River.

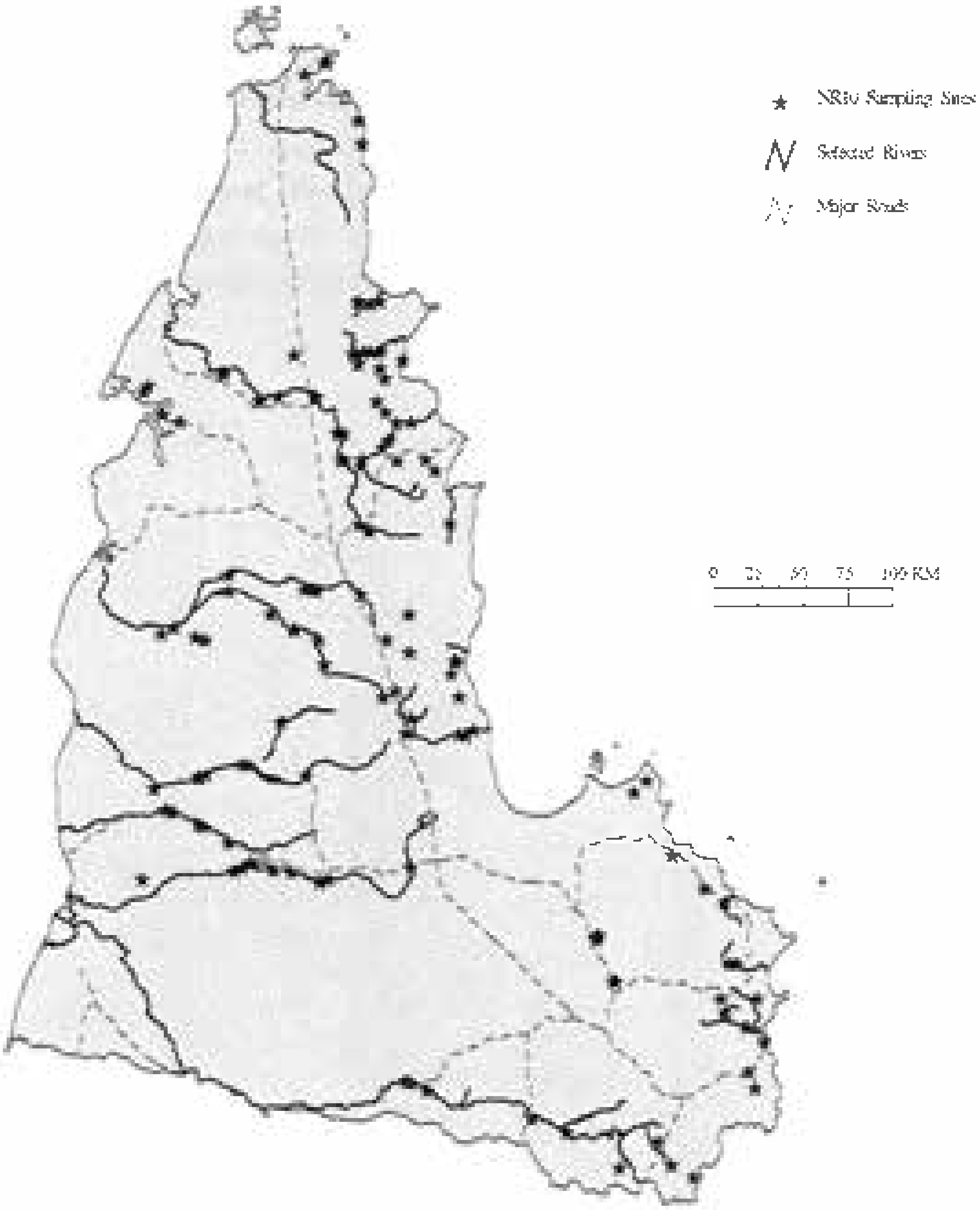
**Rainbowfishes (*Melanotaenia* species) distribution map** (p. 361).
McCulloch's rainbows (*Melanotaenia maccullochi*) were restricted to the east coast environments which had humic water. Banded rainbows (*Melanotaenia trifasciata*) were documented in, and appeared to be restricted to, upstream sites in the western flowing rivers when compared to the distribution of *Melanotaenia splendida*. These sites generally have flowing, clear water which may be essential for successful long term survival of this species. Common rainbows were far more widely distributed, particularly in the southern Peninsula. The main concentration of banded rainbows is in the north-east. They were apparently absent from rivers in the gulf Savannah country, which may be a reflection of the lack of sites with flowing water sampled than actual absence.

**Purple spotted gudgeons (*Mogurnda* spp.) distribution map** (p. 362)
Northern purple spotted gudgeons (*Mogurnda mogurnda*) are widely distributed over the Peninsula and were found from the Mitchell and Annan River systems north. It is of interest that on the west coast they appear to be restricted to the upper reaches of the main rivers (refer to the sites sampled map for full extent of sampling). On the Archer and Wenlock Rivers this is particularly noticeable. Northern purple spotted gudgeons were continuously distributed all along the eastern coast as far south as the Endeavour River. Southern purple spotted gudgeons (*Mogurnda adspersa*) were restricted in distribution to the South-eastern region of the Peninsula, being documented only from Lakefield and South. The were sympatric populations at Bathurst Bay, in a creek with humic water. Northern purple spotted gudgeons from the Endeavour River were only collected from a strongly humic creek, which suggests that these environments may have a function in survival of this species in southerly areas of its distribution where it co-exists with *M. adspersa*. Populations of *Mogurnda adspersa* appear to be very restricted in the CYPLUS study area, which represents the northern end of their East coast distribution. Previously, it was assumed that they had a continuous East coast distribution up to Cape York (Allen, 1989).

**Barramundi (*Lates calcarifer*) freshwater penetration map** (p. 363).
It must be emphasised that this map only shows the distribution of barramundi up rivers to where they were caught by us. There are a number of records of them being caught further upstream in some cases (eg Fox Hole on the Archer). From the distributions on the map it is apparent that they can move upstream considerable distances. They only appear to move as far upstream as permanent water. Rivers with short flow periods (eg. Edward) may not have many barramundi far upstream as there is not enough time for them to move up before the flow stops. In other, such as the Palmer or Wenlock, flow persists for a longer period and the fish can move further upstream. Barramundi are undoubtedly in all streams on the peninsula, and this map is also an indication of their catchability.

# Fish Sampling Site Locations

Selected rivers in CYPLUS Study Area




Projection: Albers equal area
Standard Parallels: 18 and 36 degrees South
Central Meridian: 132 degrees East
Spheroid: Australian National Spheroid

Reduction Ratio....1:4000000

Produced at ERIN : June 14, 1994

**Sources....**

* Site distribution data from NRAP project NR10 "Fish Fauna Survey"
* Rivers extracted from AUSLIG's Topo250K GEODATA
* Coastline from NRIC, provisional southern boundary from Qld. Dept. of Lands

**Caveats....**

* Users are requested to acknowledge QDPI Fisheries, CYPLUS and ERIN when using information contained on this map
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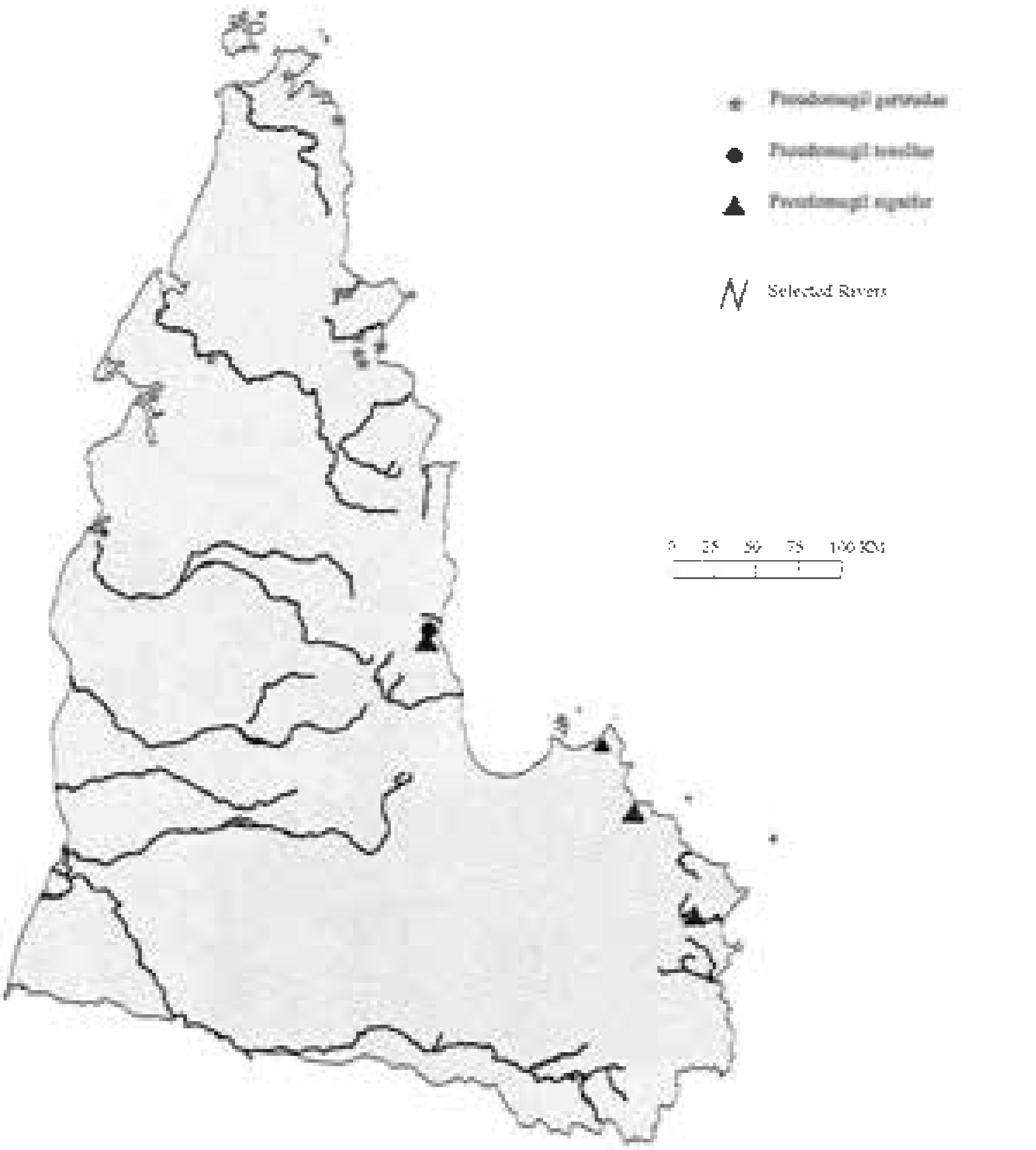
# Pseudomugil Species Distribution

## Selected rivers in CYPLUS Study Area




Projection: Albers equal area
Standard Parallels: 18 and 36 degrees South
Central Meridian: 132 degrees East
Spheroid: Australian National Spheroid

Reduction Ratio...1:4000000

Produced at ERIN : June 13, 1994

**Sources....**

* Species distribution data from NRAP project NR10 "Fish Fauna Survey"
* Rivers extracted from AUSLIG's Topo250K GEODATA
* Coastline from NRIC, provisional southern boundary from Qld. Dept. of Lands

**Caveats....**

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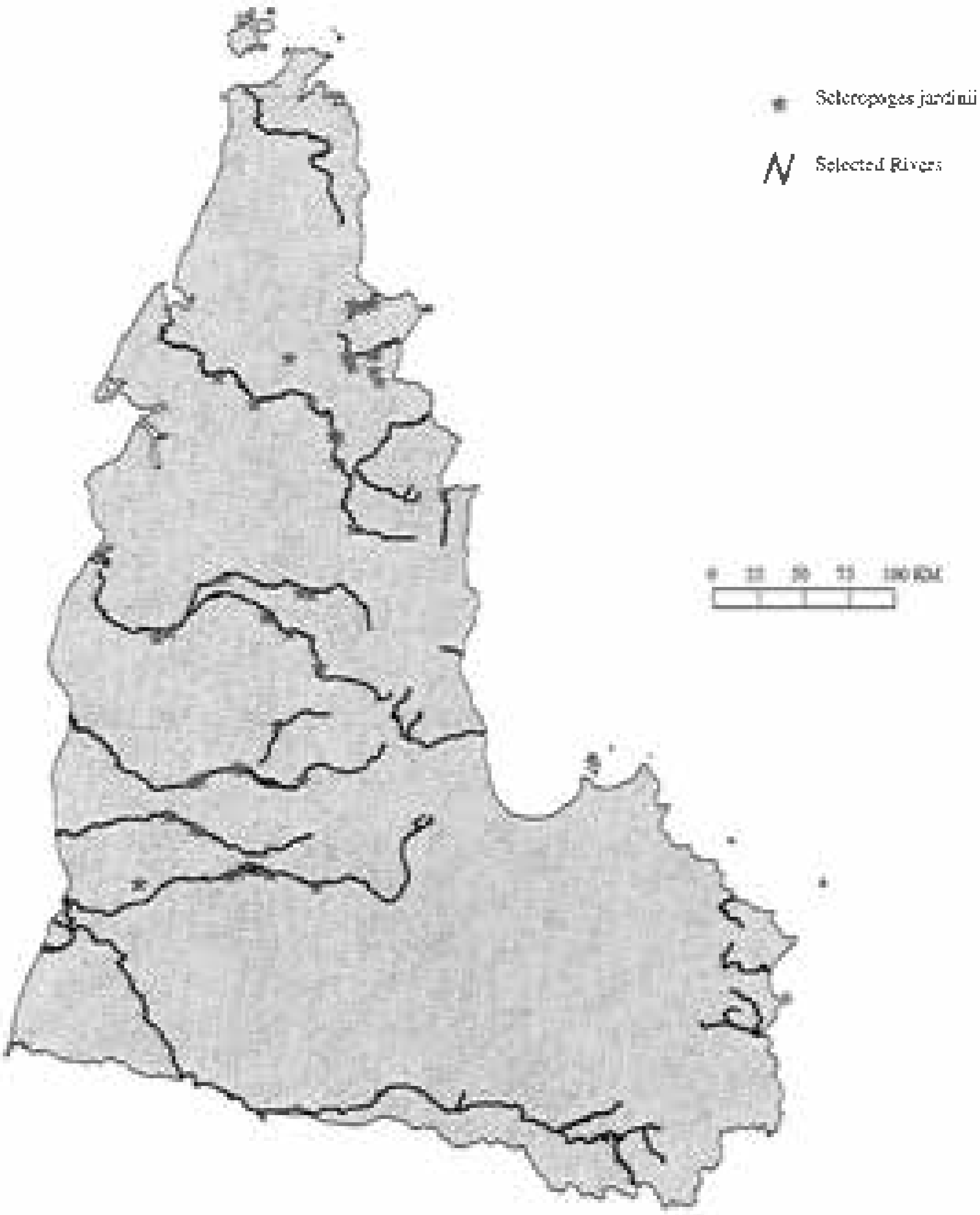
* Only selected major rivers are used in this analysis, the species may also occur in other river systems

# Scleropages jardinii Distribution

## Selected rivers in CYPLUS Study Area




Projection: Albers equal area
Standard Parallels: 18 and 36 degrees South
Central Meridian: 132 degrees East
Spheroid: Australian National Spheroid

Reduction Ratio....1:4000000

Produced at ERIN : April 19, 1994

**Sources....**

* Species distribution data from NRAP project NR10 "Fish Fauna Survey"
* Rivers extracted from AUSLIG's Topo250K GEODATA
* Coastline from NRIC, provisional southern boundary from Qld. Dept. of Lands

**Caveats....**

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# Hephaestus carbo Distribution

## Selected rivers in CYPLUS Study Area


Projection: Albers equal area
Standard Parallels: 18 and 36 degrees South
Central Meridian: 132 degrees East
Spheroid: Australian National Spheroid

Reduction Ratio....1:4000000

Produced at ERIN : April 19, 1994

**Sources....**

* Species distribution data from NRAP project NR10 "Fish Fauna Survey"
* Rivers extracted from AUSLIG's Topo250K GEODATA
* Coastline from NRIC, provisional southern boundary from Qld. Dept. of Lands

**Caveats....**

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* Only selected major rivers are used in this analysis, the species may also occur in other river systems.

# *Oxyeleotris selheimi* Distribution

## Selected rivers in CYPLUS Study Area


Projection: Albers equal area
Standard Parallels: 18 and 36 degrees South
Central Meridian: 132 degrees East
Spheroid: Australian National Spheroid

Reduction Ratio...1:4000000

Produced at ERIN : April 19, 1994

**Sources....**

- Species distribution data from NRAP project NR10 "Fish Fauna Survey"
- Rivers extracted from AUSLIG's Topo250K GEODATA
- Coastline from NRIC, provisional southern boundary from Qld Dept. of Lands

**Caveats....**

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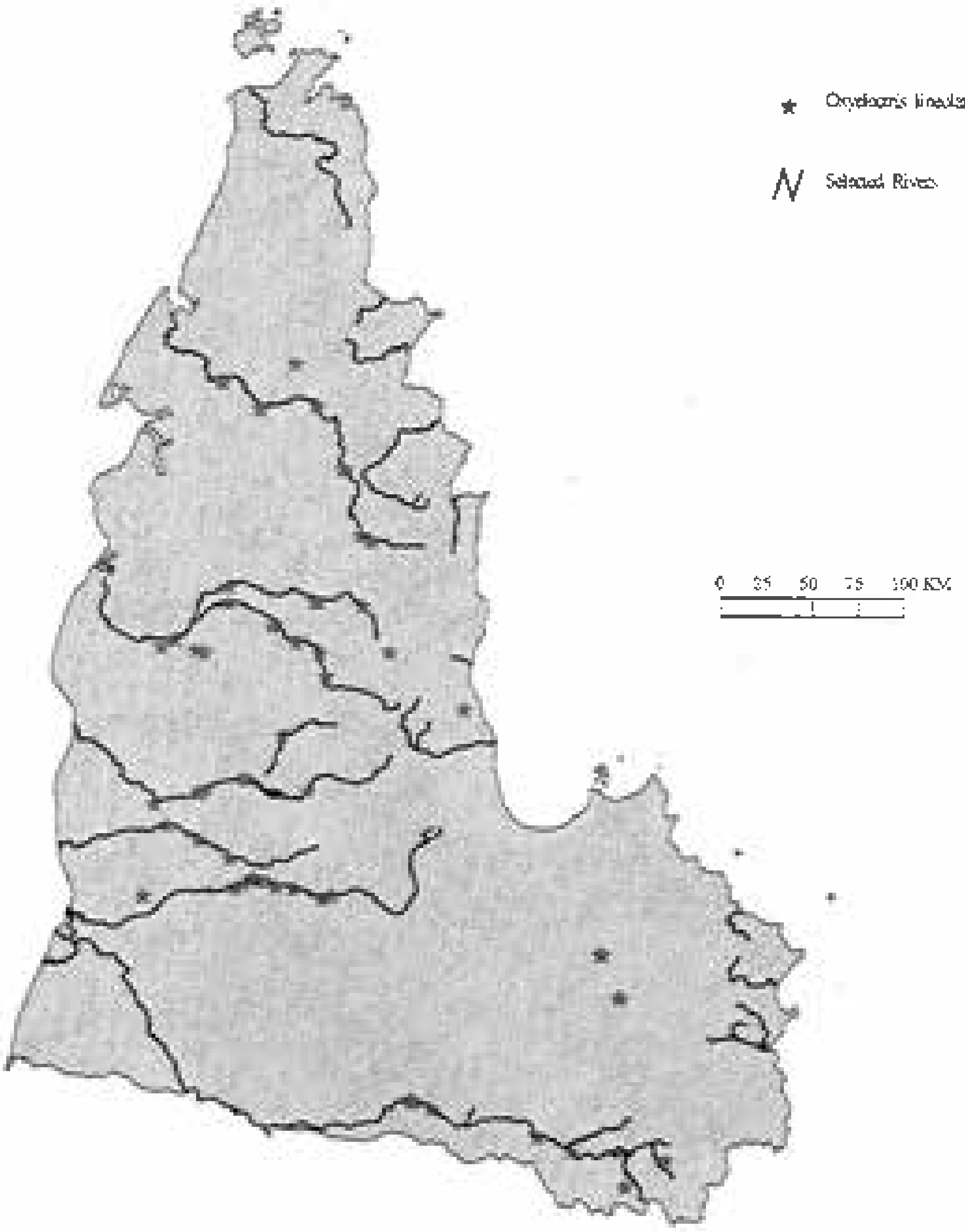
- Only selected major rivers are used in this analysis, the species may also occur in other river systems.

# Oxyeleotris lineolatus Distribution

## Selected rivers in CYPLUS Study Area




Projection: Albers equal area
Standard Parallels: 18 and 36 degrees South
Central Meridian: 132 degrees East
Spheroid: Australian National Spheroid

Reduction Ratio....1:4000000

Produced at ERIN : April 19, 1994

**Sources....**

* Species distribution data from NRAP project NR10 "Fish Fauna Survey"
* Rivers extracted from AUSLIG's Topo250K GEODATA
* Coastline from NRIC, provisional southern boundary from Qld. Dept. of Lands

**Caveats....**

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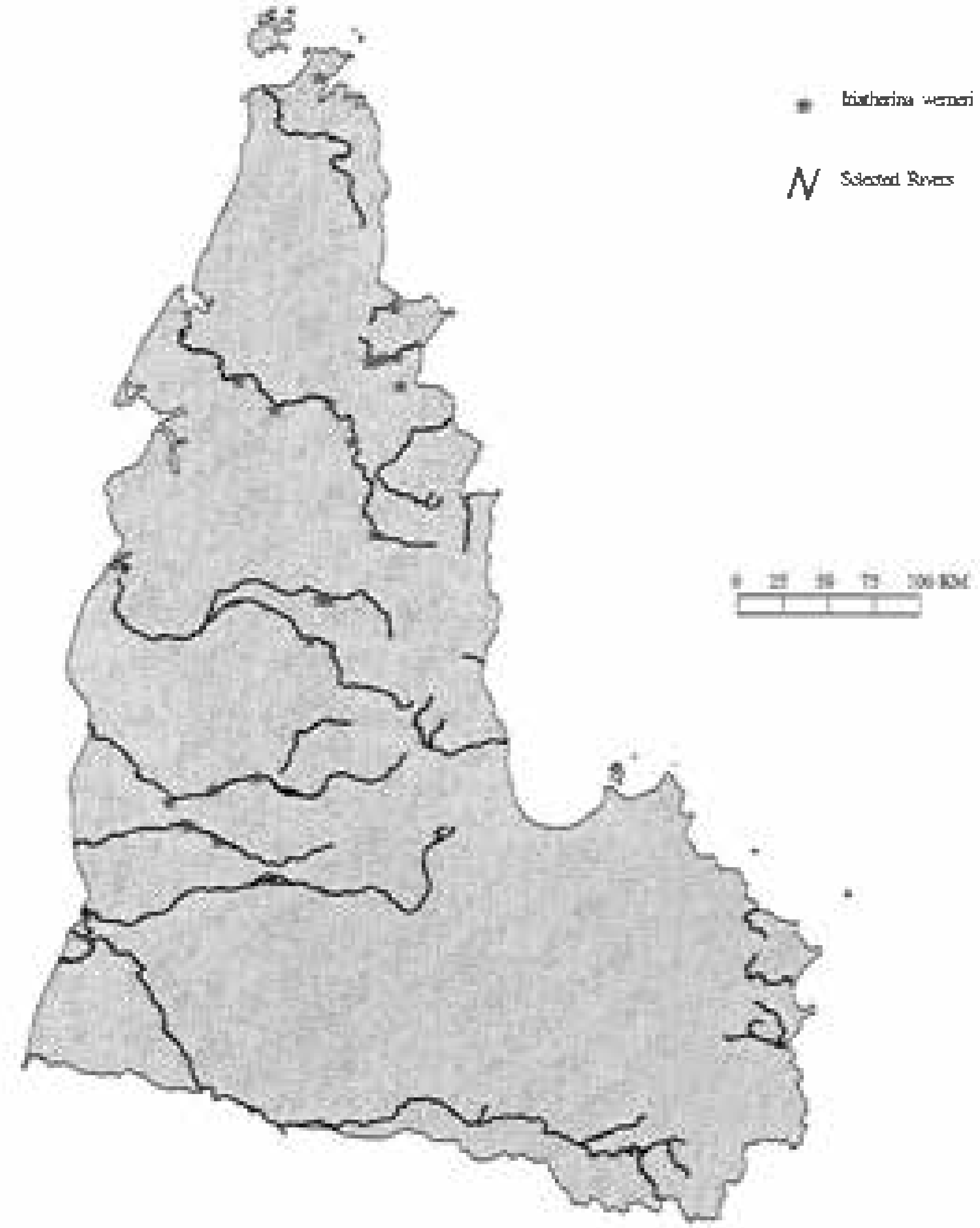
* Only selected major rivers are used in this analysis, the species may also occur in other river systems.

# Iriatherina werneri Distribution

## Selected rivers in CYPLUS Study Area




Projection: Albers equal area
Standard Parallels: 18 and 36 degrees South
Central Meridian: 132 degrees East
Spheroid: Australian National Spheroid

Reduction Ratio....1:4000000

Produced at ERIN : April 19, 1994

**Sources....**

* Species distribution data from NRAP project NR10 "Fish Fauna Survey"
* Rivers extracted from AUSLIG's Topo250K GEODATA
* Coastline from NRIC, provisional southern boundary from Qld. Dept. of Lands

**Caveats....**

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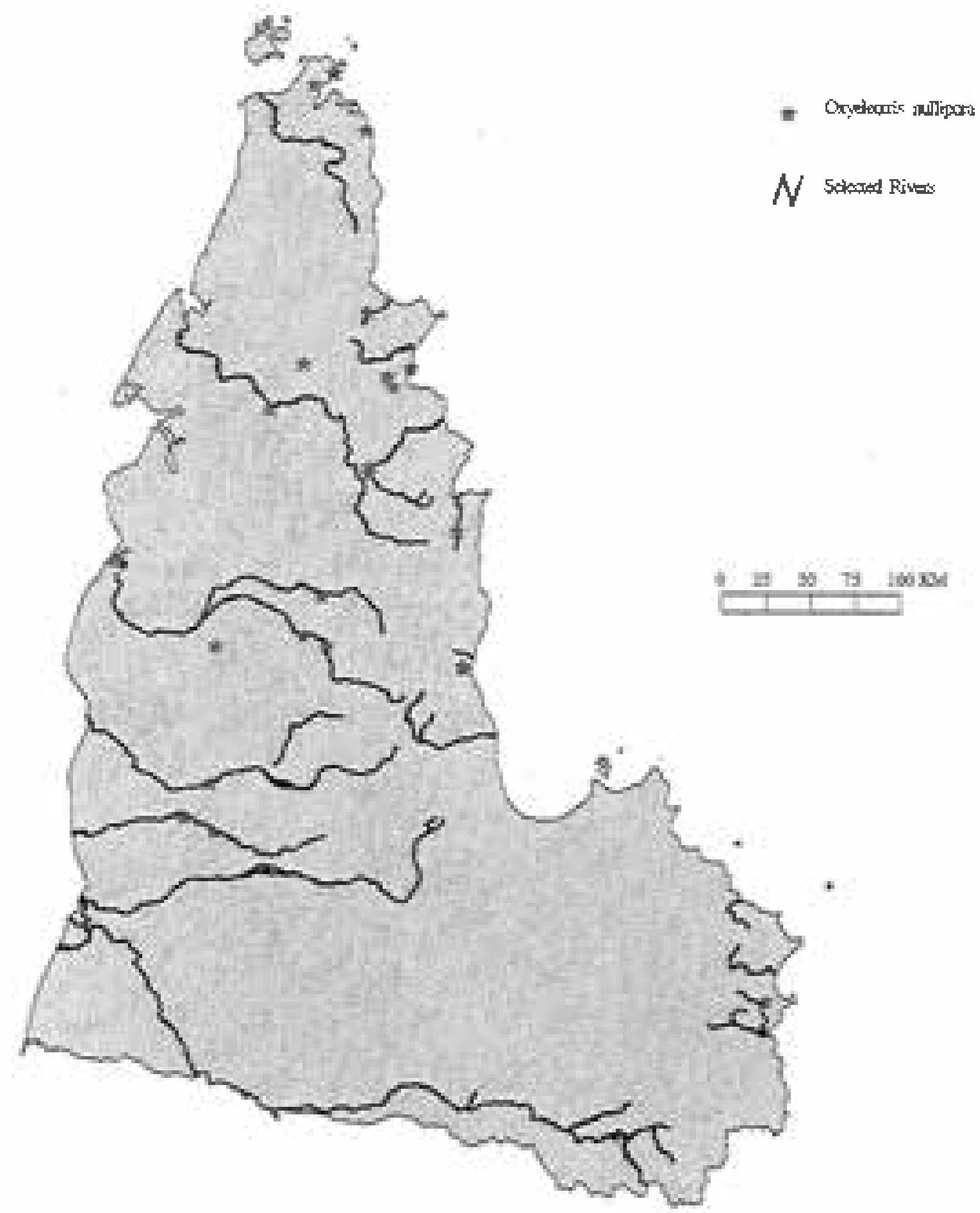
* Only selected major rivers are used in this analysis, the species may also occur in other river systems.

# Oxyeleotris nullipora Distribution
## Selected rivers in CYPLUS Study Area




Projection: Albers equal area
Standard Parallels: 18 and 36 degrees South
Central Meridian: 132 degrees East
Spheroid: Australian National Spheroid

Reduction Ratio....1:4000000

Produced at ERIN : April 19, 1994

**Sources....**
- Species distribution data from NRAP project NR10 'Fish Fauna Survey'
- Rivers extracted from AUSLIG's Topo250K GEODATA
- Coastline from NRIC, provisional southern boundary from Qld. Dept. of Lands

**Caveats....**
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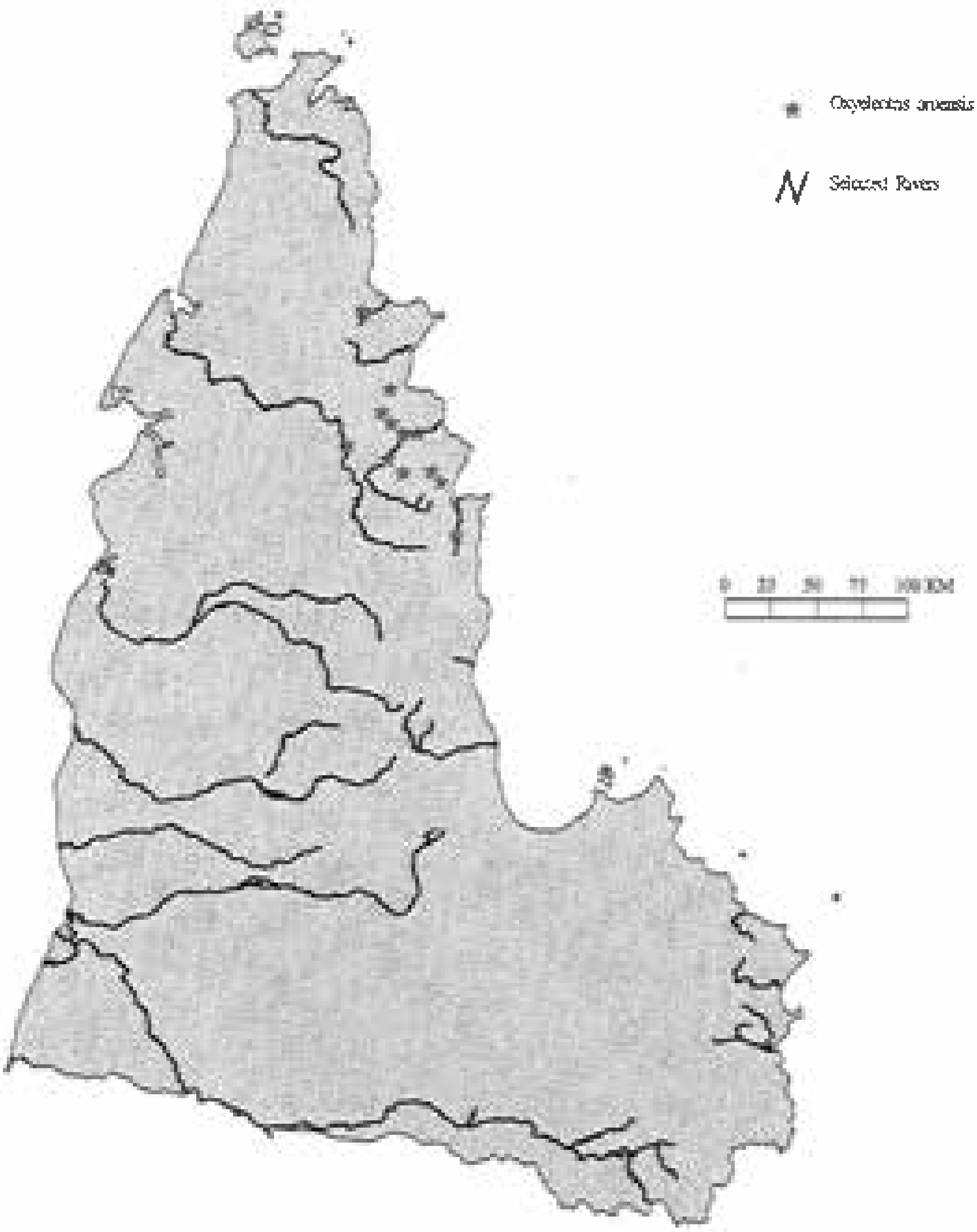
- Only selected major rivers are used in this analysis, the species may also occur in other river systems.

# Oxyeleotris aruensis Distribution

Selected rivers in CYPLUS Study Area




Projection: Albers equal area
Standard Parallels: 18 and 36 degrees South
Central Meridian: 132 degrees East
Spheroid: Australian National Spheroid

Reduction Ratio....1:4000000

Produced at ERIN : April 19, 1994

**Sources....**

* Species distribution data from NRAP project NR10 "Fish Fauna Survey"
* Rivers extracted from AUSLIG's Topo250K GEODATA
* Coastline from NRIC, provisional southern boundary from Qld. Dept. of Lands

**Caveats....**

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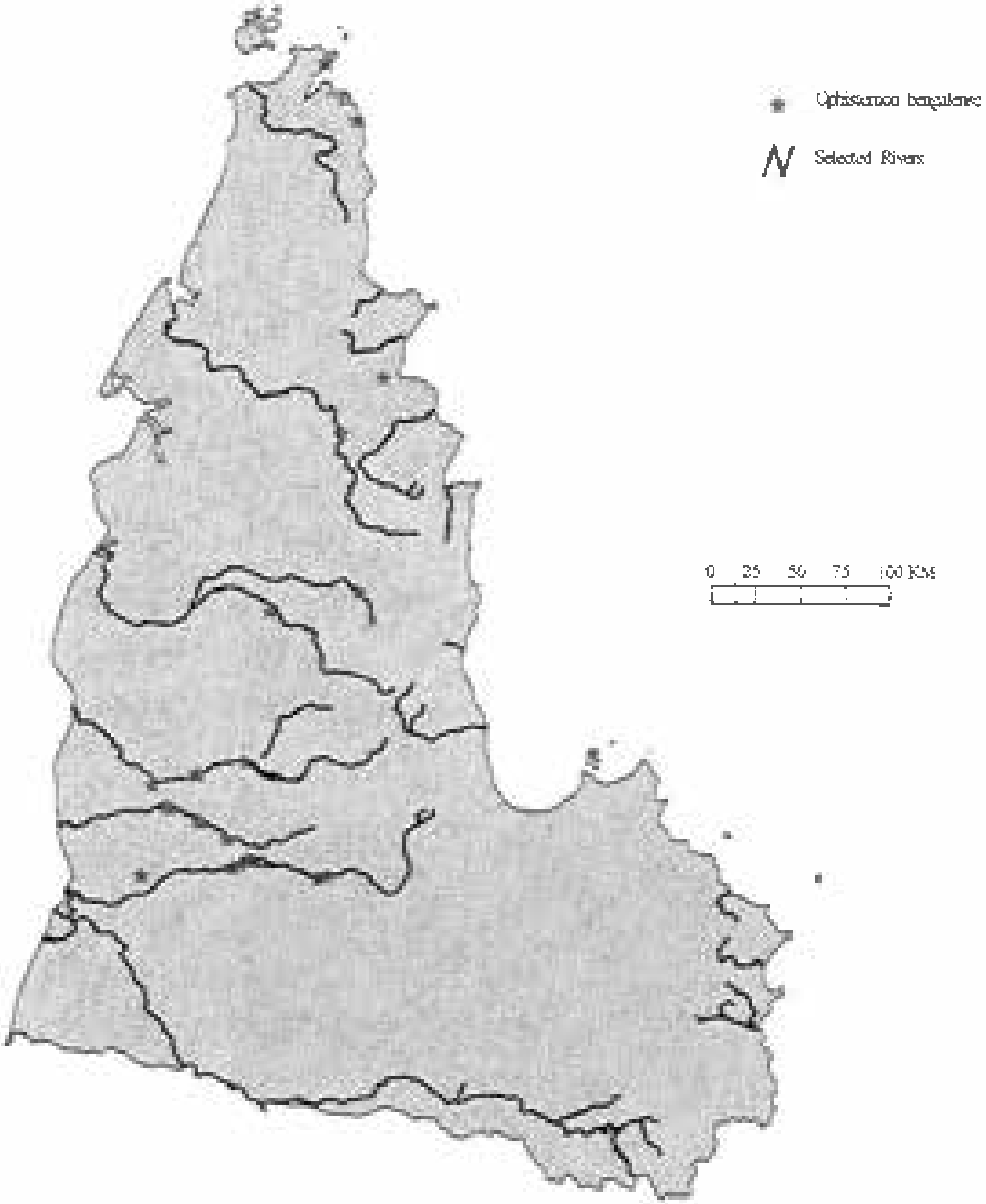
# Ophisternon bengalense Distribution

## Selected rivers in CYPLUS Study Area




Projection: Albers equal area
Standard Parallels: 18 and 36 degrees South
Central Meridian: 132 degrees East
Spheroid: Australian National Spheroid

Reduction Ratio....1:4000000

Produced at ERIN : April 19, 1994

**Sources....**

* Species distribution data from NRAP project NR10 "Fish Fauna Survey"
* Rivers extracted from AUSLIG's Topo250K GEODATA
* Coastline from NRIC, provisional southern boundary from Qld. Dept. of Lands

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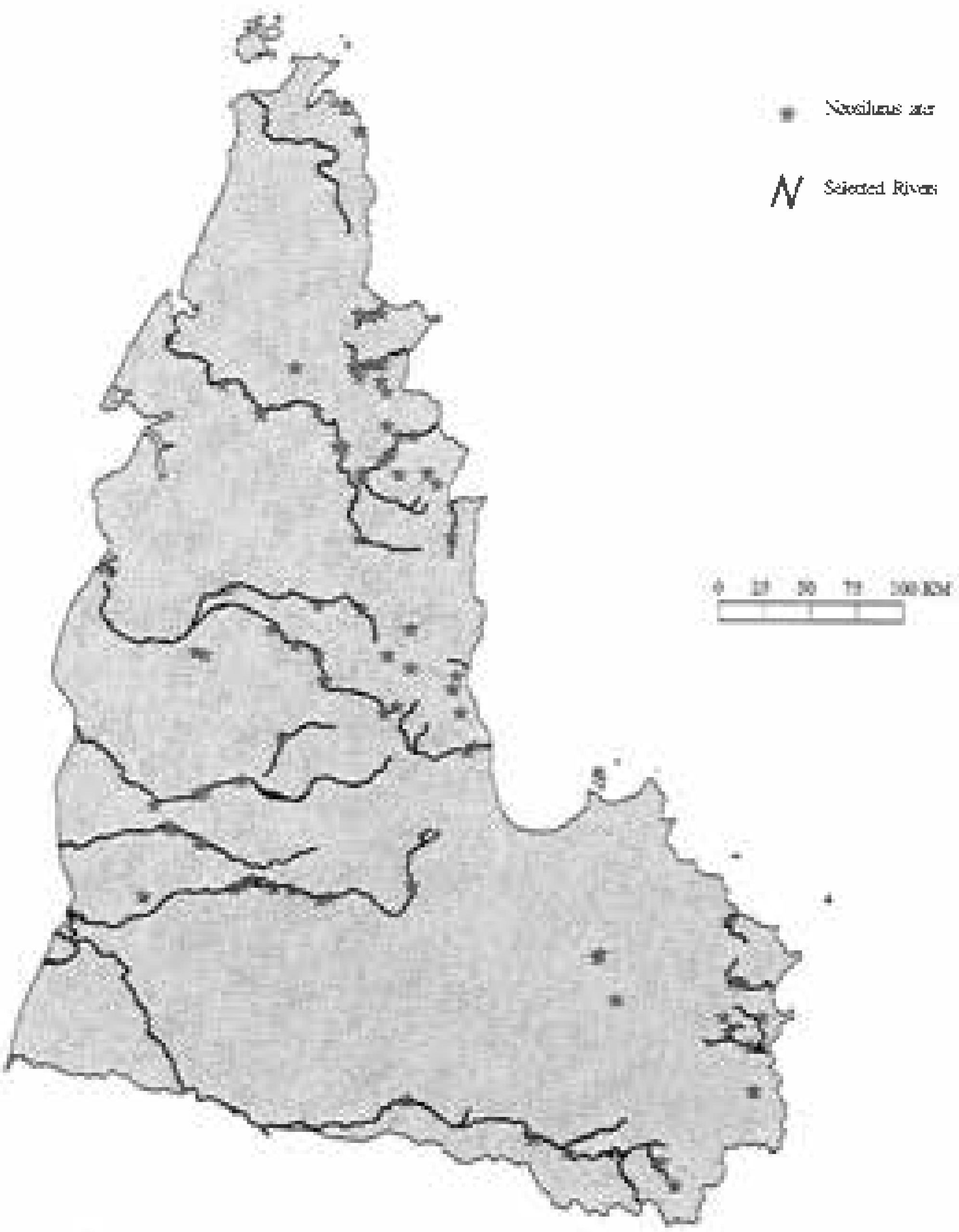
# Neosilurus ater Distribution

## Selected rivers in CYPLUS Study Area




Projection: Albers equal area
Standard Parallels: 18 and 36 degrees South
Central Meridian: 132 degrees East
Spheroid: Australian National Spheroid

Reduction Ratio....1:4000000

Produced at ERIN : April 19, 1994

**Sources....**

- Species distribution data from NRAP project NR10 "Fish Fauna Survey"
- Rivers extracted from AUSLIG's Topo250K GEODATA
- Coastline from NRIC, provisional southern boundary from Qld. Dept. of Lands

**Caveats....**

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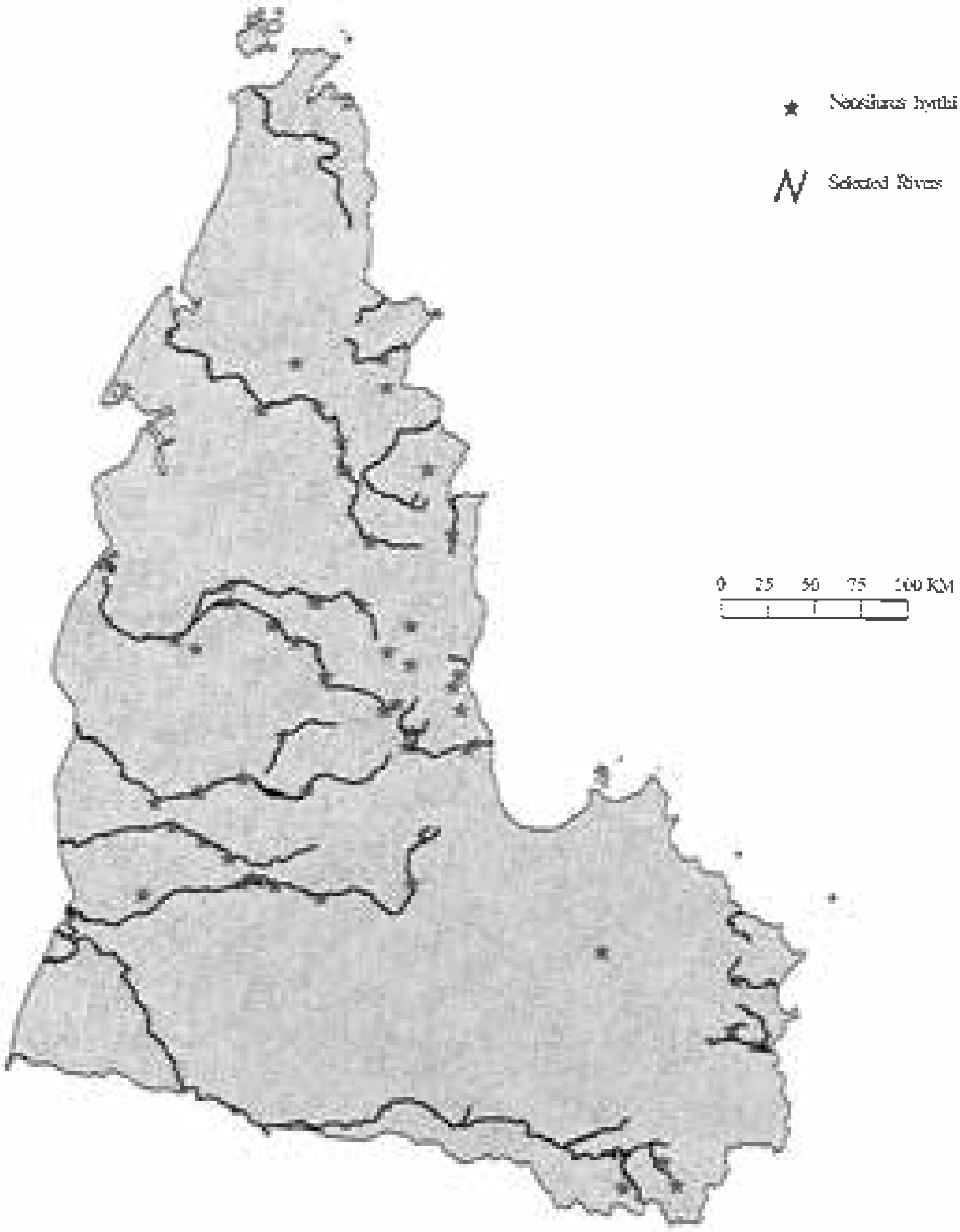
# Neosilurus hyrtlii Distribution

## Selected rivers in CYPLUS Study Area




Projection: Albers equal area
Standard Parallels: 18 and 36 degrees South
Central Meridian: 132 degrees East
Spheroid: Australian National Spheroid

Reduction Ratio....1:4000000

Produced at ERIN : April 19, 1994

**Sources....**

* Species distribution data from NRAP project NR10 "Fish Fauna Survey"
* Rivers extracted from AUSLIG's Topo250K GEODATA
* Coastline from NRIC, provisional southern boundary from Qld. Dept. of Lands

**Caveats....**

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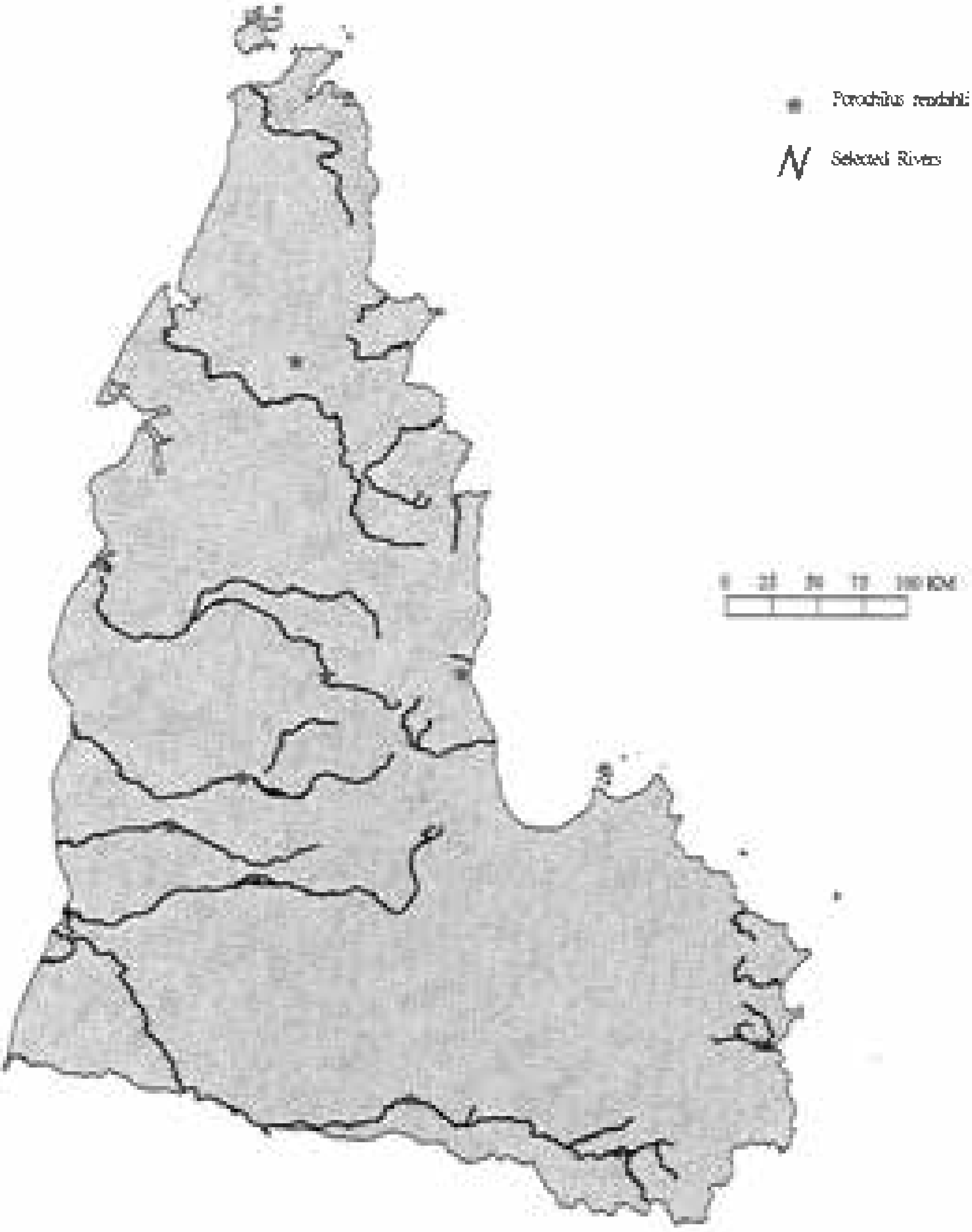
# Porochilus rendahli Distribution

Selected rivers in CYPLUS Study Area




Projection: Albers equal area
Standard Parallels: 18 and 36 degrees South
Central Meridian: 132 degrees East
Spheroid: Australian National Spheroid

Reduction Ratio....1:4000000

Produced at ERIN : April 19, 1994

**Sources....**

* Species distribution data from NRAP project NR10 "Fish Fauna Survey"
* Rivers extracted from AUSLIG's Topo250K GEODATA
* Coastline from NRIC, provisional southern boundary from Qld. Dept. of Lands

**Caveats....**

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* Only selected major rivers are used in this analysis, the species may also occur in other river systems.

# Melanotaenia splendida Distribution

## Selected rivers in CYPLUS Study Area


Projection: Albers equal area
Standard Parallels: 18 and 36 degrees South
Central Meridian 132 degrees East
Spheroid: Australian National Spheroid

Reduction Ratio....1:4000000

Produced at ERIN : June 13, 1994

**Sources....**

- Species distribution data from NRAP project NR10 "Fish Fauna Survey"
- Rivers extracted from AUSLIG's Topo250K GEODATA
- Coastline from NRIC, provisional southern boundary from Qld. Dept. of Lands

**Caveats....**

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- Only selected major rivers are used in this analysis, the species may also occur in other river systems.

# Melanotaenia Species Distribution

## Selected rivers in CYPLUS Study Area


Projection: Albers equal area
Standard Parallels: 18 and 36 degrees South
Central Meridian: 132 degrees East
Spheroid: Australian National Spheroid

Reduction Ratio....1:4000000

Produced at ERIN : June 14, 1994

**Sources....**

* Species distribution data from NRAP project NR10 "Fish Fauna Survey"
* Rivers extracted from AUSLIG's Topo250K GEODATA
* Coastline from NRIC, provisional southern boundary from Qld. Dept. of Lands

**Caveats....**

* Users are requested to acknowledge QDPI Fisheries, CYPLUS and ERIN when using information contained on this map.
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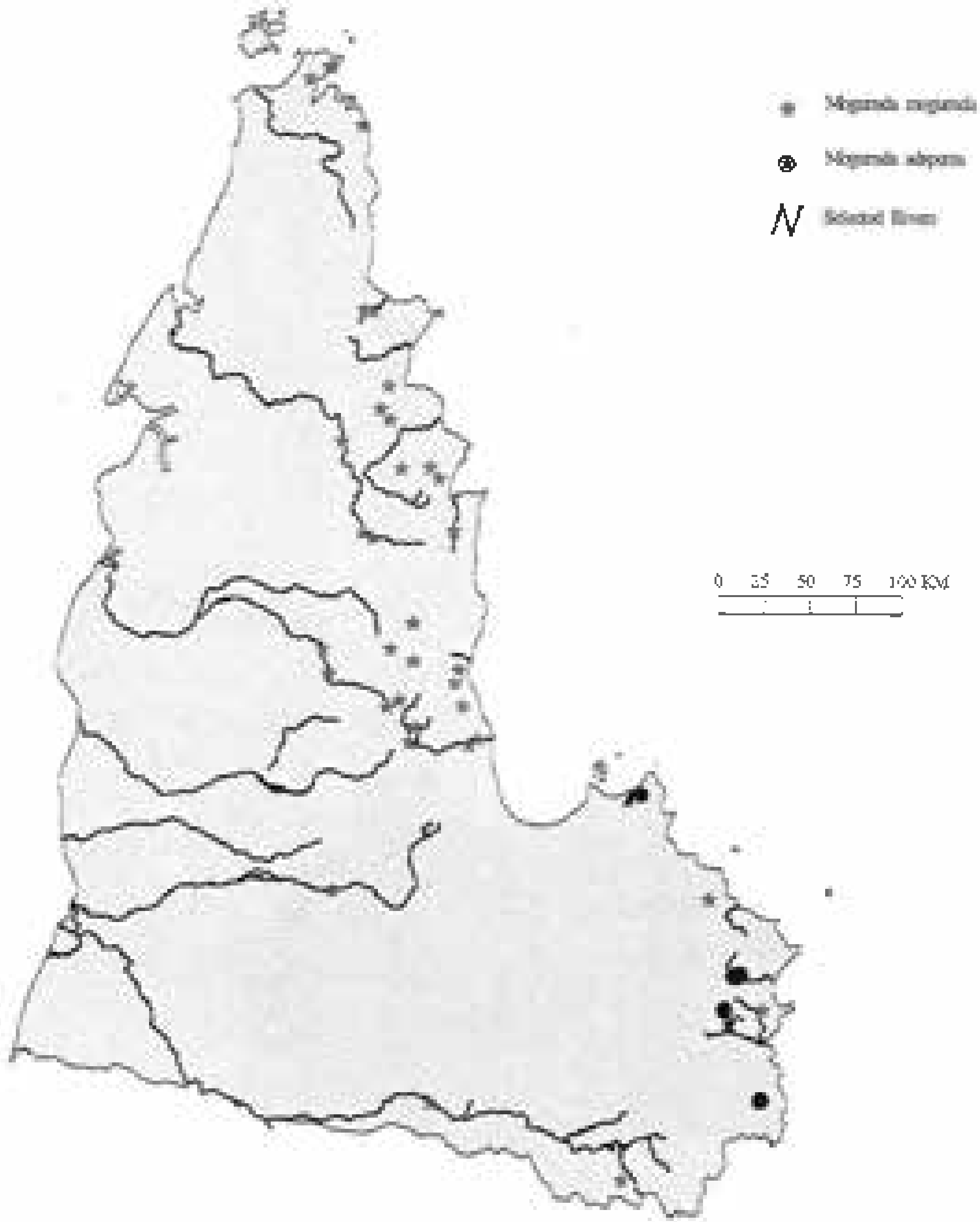
* Only selected major rivers are used in this analysis, the species may also occur in other river systems.

# Mogurnda Species Distribution

## Selected rivers in CYPLUS Study Area




Projection: Albers equal area
Standard Parallels: 18 and 36 degrees South
Central Meridian: 132 degrees East
Spheroid: Australian National Spheroid

Reduction Ratio....1:4000000

Produced at ERIN : June 13, 1994

**Sources....**

* Species distribution data from NRAP project NR10 "Fish Fauna Survey"
* Rivers extracted from AUSLIG's Topo250K GEODATA
* Coastline from NRIC, provisional southern boundary from Qld. Dept. of Lands

**Caveats....**

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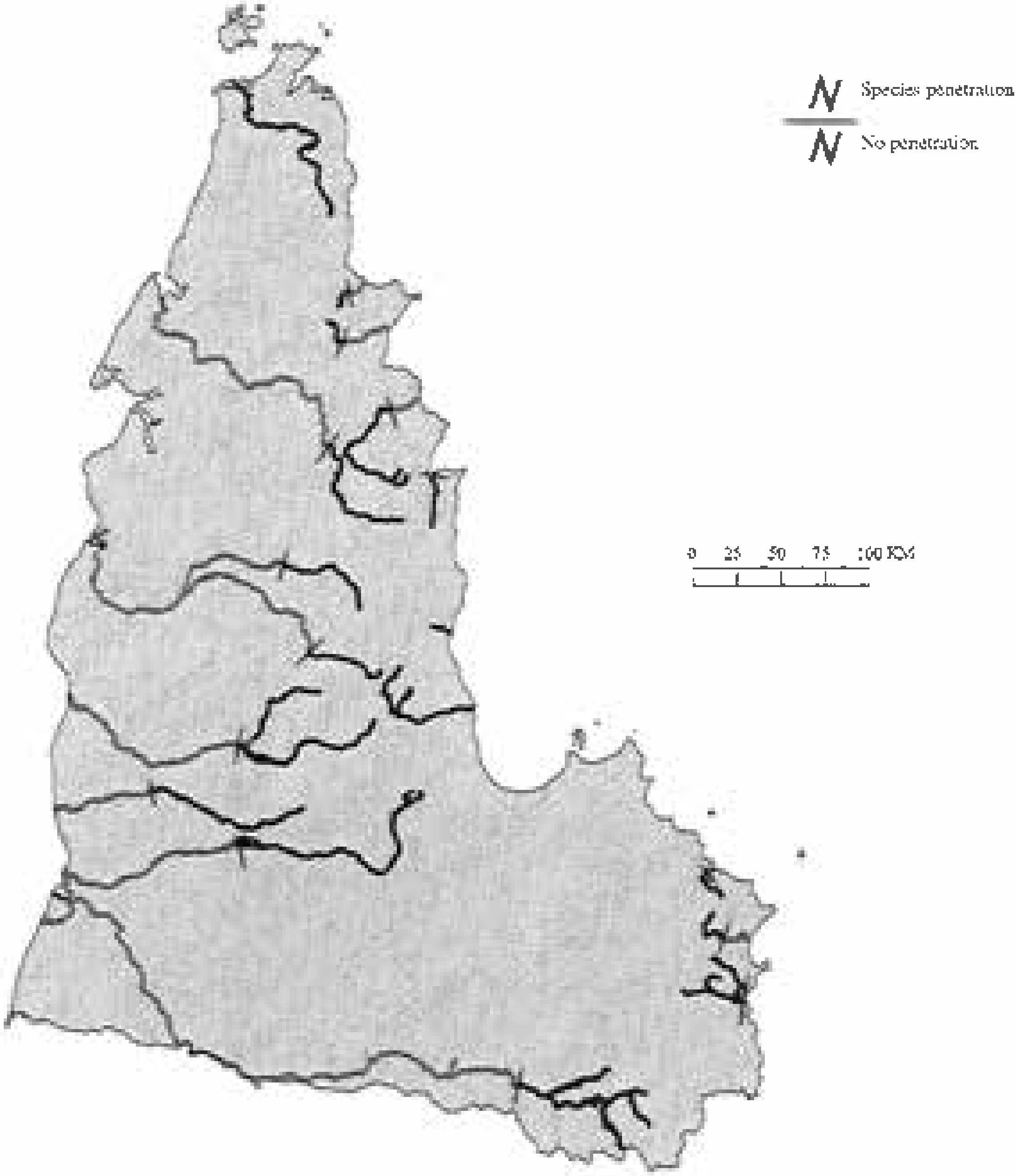
* Only selected major rivers are used in this analysis, the species may also occur in other river systems.

# Lates calcarifer Freshwater Penetration

## Selected rivers in CYPLUS Study Area




Projection: Albers equal area
Standard Parallels: 18 and 36 degrees South
Central Meridian: 132 degrees East
Spheroid: Australian National Spheroid

Reduction Ratio....1:4000000

Produced at ERIN : April 18, 1994

**Sources....**

* Species distribution data from NRAP project NR10 "Fish Fauna Survey"
* Rivers extracted from AUSLIG's Topo250K GEODATA
* Coastline from NRIC, provisional southern boundary from Qld. Dept. of Lands

**Caveats....**

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* Only selected major rivers are used in this analysis, the species may also occur in other river systems.

# APPENDIX FOUR

**Water chemistry results for CYPLUS field trips 1992-1994.**

See Chapter Three for methods used.

Explanation of terms:

Site code: this follows the national river system coding. The first three numbers are the national code for a particular drainage system. The following number is the identifier for subdivisions within that drainage system. The four numbers are usually the same for the whole data set. The following two numbers are our site code number, and the two after that indicate which visit to that site it was (in most cases we only visit a site once, hence it's usually 01).

Latitude and longitude: These are positions taken with a Magellan GPS. They are in degrees, minutes, and decimal points of minutes. Accuracy is to within 100m of actual location.

Flow type:

1 Swamp-shallow, generally temporary water body completely overgrown with emergent grasses, sedges and reeds.

2 Lagoon-permanent or temporary water body not connected to main river bed. Usually up on flood plain.

3 Pool-water body within the stream bed, low flow rate.

4 Backwater-water with no discernible flow, usually downstream of an obstruction like a sandbank.

5 Gentle flow-flow easily measurable but gentle.

6 Glide-water flows fast and deep (usually more than 50 cm deep).

7 Riffle-water flows fast and shallow (less than 50 cm deep).

8 Rapid-white water. Usually flows through large rocks or boulders.

9 Cascade-vertical drop of water more than 50 cm.

10 Flood-area of high flowing water near bank during flood event, or flooded area.

11 Soak/drain-swampy area or artificial drain.

12 Dam-artificially constructed water body.

13 Tidal-water level fluctuates with tides but saltwater intrusion infrequent.

Secchi: a measure of the clarity of the water. a black and white disc is lowered into the water until it cannot be seen, and then raised until it becomes visible. The depth at which it becomes visible is recorded in metres. A metre is the length of the path travelled by light in a vacuum during a time interval of 1/299 292 488 of a second.

Depth (cm): refers to the depth at which the readings or water samples were taken.

Temperature: measured in degrees Celsius.

pH: a measure of hydrogen ion concentration, above 7 being alkaline and below 7 being more acid.

Oxygen: The concentration of dissolved oxygen in the water measured in mg/L.

Cond: Conductivity- ability of the water to conduct an electrical current. Measured in μ siemens/cm. It is a measure of the quantity of ions in the water.

Alkalinity: a measure of the buffering capacity of the water, tested as $CaCO_3$, measured in mg/L.

T. Hard.: Total hardness. A measure of carbonate (calcium and magnesium) in the water. Measured as mg/L.

Ca: Calcium hardness. A measure of calcium carbonate in the water, measured in mg/L.

Mg: Magnesium hardness. Calculated by subtracting calcium hardness from total hardness.

PO4: total phosphate as $PO_4$.

Tannin: a measure of tannins and lignin (as mg/L) in the water.

Time: the time at which the water quality parameters were measured, in twenty four hour time.

| Site Code | Date | Latitude | | Longitude | | Flow Type | Secchi | Depth(m) | Temp. | pH | Oxygen | Cond | Alkalinity | T. Hard. | Ca | Mg | PO4 | Tanin | Time |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10100101 | 30-Sep-1992 | 11 | 57.5 | 142 | 56.2 | 2 | 0.83 | 0.2 | 26.3 | 5.48 | 8.74 | 128.5 | 13.1 | 12.1 | 1.8 | 10.3 | 0 | 1.8 | 7:50 |
| 10100201 | 29-Sep-1992 | 11 | 58.8701 | 142 | 50.6237 | 4 | 1.1 | 0.2 | 27.6 | 6.47 | 8.73 | 50.1 | 3.5 | 5 | 1 | 4 | 0 | 1 | 17:30 |
| 10100202 | 07-Aug-1993 | 11 | 58.8753 | 142 | 50.628 | 3 | >1.3 | 0.2 | 23.5 | 6.28 | 7.81 | 52.7 | 2.6 | 5 | 1.1 | 3.9 | 0 | 1.4 | 15:00 |
| 10100301 | 06-Aug-1993 | 11 | 58.4889 | 142 | 49.7841 | 3 | 1.38 | 0.2 | 22.1 | 6.24 | 8.02 | 56.1 | 3.2 | 5.1 | 1.5 | 3.6 | 0.04 | 1.6 | 12:30 |
| 10100401 | 08-Aug-1993 | 11 | 58.7474 | 142 | 53.4523 | 5 | >1.38 | 0.2 | 21.1 | 6.28 | 8.15 | 52.7 | 3.1 | 5.8 | 0.8 | 5 | 0 | 1.2 | 11:00 |
| 10100501 | 10-Aug-1993 | 10 | 46.2132 | 142 | 33.5836 | 2 | >2.6 | 0.2 | 26.1 | 5.69 | 7.48 | 43.5 | | 5 | 0.7 | 4.3 | 0 | 1 | 14:00 |
| 10100601 | 11-Aug-1993 | 10 | 46.1081 | 142 | 34.0175 | 2 | 0.52 | 0.2 | 26.6 | 5.08 | 6.6 | 26.9 | 0.3 | 5.7 | 1.8 | 3.9 | 0 | 5.4 | 10:00 |
| 10100701 | 12-Aug-1993 | 11 | 2.7269 | 142 | 44.7299 | 2 | >1.9 | 0.2 | 24.3 | 6.23 | 7.7 | 152 | 1.5 | 10.7 | 1.6 | 9.6 | 0 | 0 | 16:00 |
| 10100801 | 13-Aug-1993 | 11 | 10.1682 | 142 | 47.0432 | 2 | >1.9 | 0.2 | 27 | 3.28 | 6.8 | 292.2 | 0 | 29 | 5.8 | 23.2 | 0 | 0.8 | 14:05 |
| 10200101 | 18-Sep-1992 | 12 | 12.4754 | 142 | 58.2191 | 2 | 2.65 | 0.2 | 29.8 | 6.87 | 7.31 | 72.3 | 2.2 | 4.9 | 0.1 | 4.8 | 0 | 0 | 13:00 |
| 10200101 | 18-Sep-1992 | 12 | 12.4754 | 142 | 58.2191 | 2 | 2.65 | 3 | 28.9 | 6.98 | 7.48 | 69 | | | | | | | 13:00 |
| 10200201 | 18-Sep-1992 | 12 | 12.6306 | 142 | 58.2459 | 5 | 1.55 | 0.2 | 26.8 | 6.49 | 5.12 | 50.3 | 5.2 | 6 | 0.9 | 5.1 | 0 | 0 | 15:00 |
| 10200201 | 18-Sep-1992 | 12 | 12.6306 | 142 | 58.2459 | 5 | 1.55 | 2.3 | 25.4 | 6.52 | 4.33 | 49.5 | | | | | | | 15:00 |
| 10200302 | 17-Dec-1992 | 12 | 14.0433 | 142 | 52.6548 | 3 | 0.86 | 0.2 | 29 | 6.02 | 5.8 | 122 | | | | | | | 13:20 |
| 10200402 | 31-Oct-1992 | 12 | 14.6766 | 142 | 51.2557 | 3 | 0.55 | 0.2 | 27.6 | 7.25 | 8.03 | 106.7 | 8.6 | 10.7 | 1.7 | 9 | 1 | 2 | 15:30 |
| 10200501 | 01-Nov-1992 | 12 | 17.632 | 142 | 51.4816 | 3 | 0.84 | 0.2 | 24.7 | 6.9 | 5.86 | 71.2 | 9.9 | 10 | 2.1 | 7.9 | 1 | 2 | 14:00 |
| 10200601 | 16-Dec-1992 | 12 | 14.4958 | 142 | 50.011 | 3 | 0.72 | 0.2 | 28.6 | 5.52 | 6.27 | 115 | 10.8 | 16.2 | 6.3 | 9.9 | 1.5 | 3 | 12:00 |
| 10200701 | 17-Dec-1992 | 12 | 13.231 | 142 | 56.8994 | 3 | 0.45 | 0.2 | 28.6 | 6.06 | 2 | 115 | 22.5 | 20.8 | 6.2 | 14.6 | 1 | 2.5 | 10:00 |
| 10200801 | 05-Aug-1993 | 12 | 14.8763 | 143 | 4.853 | 3 | 0.65 | 0.2 | 23.2 | 4.19 | 6.16 | 122.3 | 0 | 8.3 | 0.7 | 7.6 | | 4 | 10:30 |
| 10200901 | 19-Aug-1993 | 12 | 13.4541 | 142 | 54.5279 | 2 | 1.2 | 0.2 | 25.9 | 6.23 | 8.02 | 75.2 | 4.6 | 9 | 1 | 8 | 0.3 | 2 | 16:00 |
| 10201001 | 20-Aug-1993 | 12 | 13.8995 | 142 | 52.8662 | 2 | 0.2 | 0.2 | 25.2 | 4.66 | 8.9 | 120 | | 10 | 2 | 8 | 0.4 | 3 | 10:15 |
| 10201101 | 19-Sep-1993 | 12 | 21.0781 | 142 | 59.9996 | 5 | >1.5 | 0.2 | 25.3 | 7.31 | 6.8 | 44.2 | 2.3 | 5.5 | 0.6 | 4.9 | 0.4 | 1.3 | 10:00 |
| 10201201 | 19-Sep-1993 | 12 | 21.0097 | 142 | 59.8852 | 2 | 1.2 | 1 | 27.4 | 5.81 | 1.52 | 77.5 | 7.5 | 7.4 | 1.6 | 5.8 | 0.05 | 2 | 13:00 |
| 10201301 | 20-Sep-1993 | 12 | 17.9101 | 142 | 58.0281 | 5 | >2 | 0.2 | 25.2 | 6.19 | 7.34 | 42 | 3.2 | 6.1 | 0.1 | 6 | 0.4 | 1.1 | 11:00 |
| 10210102 | 04-Aug-1993 | 12 | 28.4635 | 142 | 58.2402 | 3 | >0.5 | 0.2 | 24.5 | 6.83 | 6.45 | 74.8 | 2.4 | 4.7 | 0.6 | 4.1 | 0 | 0.6 | 13:05 |
| 10210201 | 26-Jun-1993 | 12 | 45.3909 | 143 | 6.2813 | 3 | >1.2 | 0.2 | 24 | 6.88 | 7.62 | 91.4 | 13.3 | 9 | 2.7 | 6.3 | 0.04 | 0.5 | 13:00 |
| 10210301 | 27-Jun-1993 | 12 | 39.5886 | 143 | 2.9505 | 3 | 2.6 | 0.2 | 24.7 | 6.49 | 7.25 | 78.7 | 10.8 | 9.6 | 4.4 | 5.2 | 0.04 | 0.5 | 14:30 |
| 10210401 | 29-Jun-1993 | 12 | 33.7446 | 143 | 8.8767 | 3 | 2.65 | 0.2 | 25 | 6.25 | 7.56 | 64.2 | 7.9 | 7.8 | 2.9 | 6.9 | 0.06 | 0.5 | 14:40 |
| 10210501 | 30-Jun-1993 | 12 | 30.9918 | 143 | 0.9693 | 3 | >2.5 | 0.2 | 24.5 | 5.88 | 7.61 | 39.9 | 2.1 | 3.9 | 0.4 | 3.5 | 0 | 0.6 | 15:00 |
| 10210601 | 01-Jul-1993 | 12 | 33.9225 | 143 | 4.6307 | 6 | >2 | 0.2 | 24.6 | 6.01 | 7.53 | 33.5 | 2 | 3.1 | 0.7 | 2.4 | 0 | 0.6 | 17:30 |
| 10210701 | 16-Jul-1993 | 12 | 49.3215 | 142 | 55.3561 | 2 | 1.19 | 0.2 | 23.8 | 6.24 | 5.05 | 91.4 | 12 | 7.7 | 1.5 | 6.2 | 0.08 | 2 | 12:30 |
| 10210801 | 17-Jul-1993 | 12 | 47.9676 | 142 | 55.483 | 6 | >1.1 | 0.2 | 26.7 | 6.5 | 7.9 | 95.8 | 13 | 13.7 | 3.3 | 10.4 | 0.06 | 1 | 13:30 |
| 10210901 | 18-Jul-1993 | 12 | 42.0245 | 143 | 1.4215 | 3 | >1.7 | 0.2 | 23.4 | 6.54 | 7.79 | 76.3 | 10.3 | 10.4 | 3.6 | 6.8 | 0.1 | 1 | 10:00 |
| 10300101 | 24-Jun-1993 | 13 | 2.812 | 143 | 23.6508 | 5 | >1.4 | 0.2 | 23 | 7.07 | 7.11 | 143.7 | 21.7 | 20.8 | 10.9 | 9.9 | 0.08 | 1 | 11:30 |
| 10300201 | 25-Jun-1993 | 12 | 44.6506 | 143 | 14.1772 | 3 | >1.3 | 0.2 | 23 | 7.01 | 7.12 | 144.7 | 17.5 | 20.8 | 10.3 | 10.5 | 0 | 0.5 | 16:00 |
| 10300301 | 15-Jul-1993 | 12 | 47.6469 | 143 | 17.5434 | 3 | 1.7 | 0.2 | 24.6 | 7.14 | 5.96 | 257 | 67.1 | 74.6 | 40.8 | 33.8 | 0.08 | 1 | 16:20 |
| 10300401 | 10-Jun-1993 | 13 | 44.916 | 143 | 29.3376 | 2 | 0.73 | 0.2 | 23.1 | 4.14 | 2.71 | 75.5 | 0 | 8.5 | | | | 4.8 | 12:00 |

| Site Code | Date | Latitude | Longitude | Flow Type | Secchi | Depth(m) | Temp. | pH | Oxygen | Cond | Alkalinity | T. Hard. | Ca | Mg | PO4 | Tanin | Time |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10300402 | 02-Dec-1992 | 13 44.916 | 143 29.3376 | 2 | 0.2 | 0.2 | 26.27 | 4.53 | | 543 | | 36.1 | 7.9 | | | 4.4 | 14:30 |
| 10300501 | 10-Jun-1993 | 13 44.6591 | 143 28.5068 | 3 | 0.5 | 0.2 | 21.9 | 5.65 | 5.9 | 49.6 | 4.8 | 6.2 | 1 | 5.2 | 0 | 1 | 16:00 |
| 10400101 | 03-Dec-1992 | 13 48.8232 | 143 27.9026 | 3 | >0.75 | 0.2 | 28.2 | 6.93 | 2.31 | 136.3 | 26.7 | 19.4 | 10.6 | 8.8 | | | |
| 10400102 | 11-Jun-1993 | 13 48.8232 | 143 27.9026 | 3 | >0.5 | 0.2 | 21.5 | 6.96 | 8.25 | 61 | 18.6 | 13.2 | 7.8 | 5.4 | 0 | 0 | 13:00 |
| 10400201 | 04-Dec-1992 | 13 55.4401 | 143 30.8972 | 3 | >0.78 | 0.2 | 29.8 | 6.95 | 1.85 | 166.8 | 30.7 | 25.3 | 12 | 13.3 | 1.2 | 1.8 | 12:00 |
| 10400202 | 12-Jun-1993 | 13 55.4401 | 143 30.8972 | 3 | >2 | 0.2 | 20.7 | 6.94 | 8.44 | 70 | 11.3 | 6.8 | 3.2 | 3.6 | 0 | 0 | 13:30 |
| 10400301 | 21-Apr-1993 | 14 7.9811 | 143 16.3572 | 3 | >0.4 | 0.2 | 22.5 | 7.31 | 7.26 | 114.4 | 16.8 | 14.6 | 7.3 | 7.3 | 0.3 | 0 | 9:00 |
| 10400401 | 22-Apr-1993 | 14 2.7763 | 143 17.331 | 3 | >1.2 | 0.2 | 22.4 | 7.28 | 8.11 | 85.9 | 11.1 | 8.7 | 3.2 | 5.5 | 0.4 | 0 | 13:00 |
| 10400501 | 23-Apr-1993 | 14 6.4448 | 143 34.3893 | 3 | >0.4 | 0.2 | 28.8 | 7.27 | 6.97 | 118.8 | 23.7 | 16.7 | 8.7 | 8 | 0.2 | 0 | 14:45 |
| 10400601 | 24-Apr-1993 | 14 6.412 | 143 32.6685 | 2 | | 0.2 | 23.2 | 5.88 | 1.55 | 18 | 7.2 | 7.6 | 4.2 | 3.4 | 0.5 | 0 | 10:30 |
| 10400701 | 24-Apr-1993 | 14 4.7695 | 143 36.5263 | 3 | 1 | 0.2 | 26.5 | 6.55 | 6.28 | 70.9 | 15.1 | 7.4 | 3.8 | 3.6 | 0.3 | 0 | 14:30 |
| 10400701 | 24-Apr-1993 | 14 4.7695 | 143 36.5263 | 3 | | 1.5 | 26 | 6.56 | 5.9 | 69.9 | | | | | | | |
| 10510101 | 17-Nov-1992 | 15 16.3582 | 144 26.6522 | 2 | 0.5 | 0.2 | 30.8 | 6.77 | 5.3 | 92 | | | | | | | 15:00 |
| 10510201 | 18-Nov-1992 | 15 16.3356 | 144 26.7098 | 2 | 0.91 | 0.2 | 32.1 | 6.41 | 4.8 | 79 | | | | | | | 12:30 |
| 10510301 | 19-Nov-1992 | 15 4.0341 | 144 19.8279 | 2 | 1.3 | 0.2 | 31.4 | 6.41 | 7.4 | 146 | | | | | | | 15:30 |
| 10510401 | 20-Nov-1992 | 15 4.0336 | 144 19.9114 | 2 | 1.01 | 0.2 | 31.1 | 6.74 | 6.3 | 178 | | | | | | | 17:20 |
| 10510501 | 21-Nov-1992 | 15 3.2476 | 144 20.2437 | 3 | 1.7 | 0.2 | 29.5 | 6.43 | 7.4 | 141 | | | | | | | 10:30 |
| 10510601 | 22-Nov-1992 | 15 3.7634 | 144 19.8445 | 2 | 0.82 | 0.2 | 34.2 | 6.37 | 6.74 | 168 | | | | | | | 15:40 |
| 10510701 | 23-Nov-1992 | 15 3.8804 | 144 19.8205 | 2 | 0.96 | 0.2 | 30.2 | 6.38 | 3.2 | 185 | | | | | | | 11:00 |
| 10600101 | 20-Jan-1993 | 15 7.2471 | 145 4.4519 | 3 | 1.12 | 0.2 | 25.8 | 6.78 | 7.16 | 73 | 13.3 | 13.8 | 4.2 | 9.7 | 0 | 0 | 14:00 |
| 10600102 | 26-Apr-1993 | 15 7.2471 | 145 4.4519 | 3 | 1.335 | 0.2 | 24.1 | 7.19 | 6.59 | 179 | 50.9 | 58.9 | 24.6 | 35.2 | 0 | 0 | 13:10 |
| 10600201 | 27-Apr-1993 | 15 7.2674 | 145 1.8095 | 3 | 1.56 | 0.2 | 23.3 | 7.06 | 7.23 | 163.7 | 35.4 | 45.5 | 18.7 | 26.8 | 0 | 0 | 12:00 |
| 10600301 | 13-May-1993 | 14 45.6625 | 144 51.3276 | 5 | 1.5 | 0.2 | 24.5 | 6.87 | 8.04 | 141.8 | 19.8 | 19.7 | 5.7 | 14 | 0 | 1.5 | 11:30 |
| 10600401 | 14-May-1993 | 14 49.051 | 144 58.2031 | 3 | >1.5 | 0.2 | 24.2 | 6.78 | 6.67 | 158.9 | 14.9 | 21.8 | 7.3 | 14.5 | 0 | 0.5 | 9:30 |
| 10600501 | 12-May-1993 | 14 36.3031 | 144 40.9226 | 2 | 1.34 | 0.2 | 24.5 | 6.91 | 7.37 | 80.3 | 26.1 | 18.7 | 8.4 | 10.3 | 0.08 | 1 | 11:00 |
| 10600601 | 12-May-1993 | 14 36.3746 | 144 41.0378 | 5 | >0.5 | 0.2 | 24.8 | 7.24 | 7.57 | 93.4 | 11.6 | 8.9 | 2.3 | 6.6 | 0.02 | 1 | 14:00 |
| 10600701 | 06-Jun-1994 | 14 17.0189 | 144 27.3881 | 3 | >1.8 | 0.2 | 23.3 | 6.39 | 5.91 | 117.4 | 8.3 | 9.3 | 3.1 | 6.2 | 0 | 0.08 | 10:30 |
| 10600801 | 07-Jun-1994 | 14 17.8637 | 144 25.8876 | 2 | >1 | 0.2 | 23.9 | 2.81 | 2.17 | 1749 | 0 | 178 | 25 | 153 | 0 | 2.6 | 8:30 |
| 10600901 | 07-Jun-1994 | 14 15.5027 | 144 27.5996 | 5 | >1.4 | 0.2 | 21.9 | 6.51 | 9.92 | 149.8 | 6.4 | 11.2 | 3.1 | 8.1 | 0 | 0.6 | 17:00 |
| 10700101 | 21-Jan-1993 | 15 18.1137 | 145 0.2676 | 6 | 0.57 | 0.2 | 24.8 | 5.95 | 7.26 | 48.4 | 1.8 | 4 | 0.9 | 3.1 | 4 | 0.15 | 14:00 |
| 10700101 | 21-Jan-1993 | 15 18.1137 | 145 0.2676 | 8 | 0.57 | 0.2 | 24.8 | 6.05 | 8.34 | 49.7 | 1.8 | 4 | 0.9 | 3.1 | 4 | 0.15 | 14:00 |
| 10700201 | 22-Jan-1993 | 15 25.7275 | 145 9.1226 | 2 | 0.87 | 0.2 | 29.5 | | 5 | | 13.9 | 15 | 7.4 | 7.6 | 1.65 | 2.4 | 14:00 |
| 10700301 | 09-Feb-1993 | 15 29.2152 | 145 14.7361 | 12 | 1.29 | 0.2 | 28.2 | 7.48 | 7.65 | 108 | 9.6 | 11.5 | 2.2 | 9.3 | 0.5 | 0 | 16:40 |
| 10700401 | 28-Apr-1993 | 15 22.3831 | 145 1.7945 | 2 | 1.28 | 0.2 | 22.9 | 7.74 | 8.07 | 185.6 | 49.2 | 57.2 | | | 0 | 0 | 11:15 |
| 10700501 | 29-Apr-1993 | 15 16.7088 | 145 11.2361 | 5 | 0.43 | 0.2 | 23.3 | 4.05 | 5.37 | 91.6 | ND | ND | ND | ND | 0 | 5 | 10:15 |
| 10700601 | 12-Feb-1993 | 15 43.6109 | 145 13.6716 | 6 | 0.98 | 0.2 | 24.6 | 6.85 | 7.96 | 54 | 6.2 | 6.4 | 1.4 | 5 | 0 | 0 | 14:00 |
| 10700701 | 10-Feb-1993 | 15 38.7794 | 145 11.5087 | 12 | 1.69 | 0.2 | 24.4 | 7.07 | 8.39 | 63.9 | 8.3 | 8.4 | 3.1 | 5.3 | 3.5 | 0 | 14:30 |

| Site Code | Date | Latitude | | Longitude | | Flow Type | Secchi | Depth(m) | Temp. | pH | Oxygen | Cond | Alkalinity | T. Hard. | Ca | Mg | PO4 | Tanin | Time |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 91920101 | 08-Mar-1993 | 16 | 2.737 | 144 | 45.3074 | 6 | 0.56 | 0.2 | 29.5 | 7.32 | 7.64 | 64.6 | 26.6 | 21 | 10.3 | 10.7 | 0.2 | 2.5 | 14:00 |
| 91920201 | 09-Mar-1993 | 16 | 9.5286 | 144 | 50.2821 | 6 | 1.11 | 0.2 | 26.4 | 7.07 | 8.88 | 42 | 11.5 | 4.3 | 2.5 | 1.8 | 0.1 | 0.2 | 15:30 |
| 91920301 | 15-Mar-1993 | 16 | 12.7726 | 144 | 57.7577 | 3 | 1.7 | 0.2 | 17 | 6.53 | 9.74 | 38.7 | 4.9 | 3.3 | 1.2 | 2.1 | 0.06 | 0.6 | 15:30 |
| 91920301 | 15-Mar-1993 | 16 | 12.7726 | 144 | 57.7577 | 3 | | 1 | 16.9 | 6.5 | 8.82 | 38.4 | | | | | | | |
| 91920401 | 01-Apr-1993 | 16 | 3.2921 | 144 | 17.0351 | 3 | 1.7 | 0.2 | 30.3 | 7.76 | 8.15 | 95.2 | 29.3 | 19.7 | 13.1 | 6.4 | 0.1 | 0 | 13:30 |
| 91920501 | 02-Apr-1993 | 15 | 59.9758 | 144 | 5.826 | 5 | 1.5 | 0.2 | 31.3 | 7.8 | 7.8 | 122.8 | 45.1 | 36 | 18.9 | 17.1 | 0.14 | 0 | 13:30 |
| 91920601 | 03-Apr-1993 | 15 | 52.8529 | 143 | 27.8197 | 5 | 0.96 | 0.2 | 28.5 | 7.29 | 7.65 | 82.3 | 13.5 | 8.1 | 3.1 | 5 | 0.05 | 0 | 12:00 |
| 91920701 | 04-Apr-1993 | 15 | 52.2387 | 143 | 26.4337 | 2 | 0.74 | 0.2 | 28.1 | 6.19 | 6.4 | 16.61 | 5.1 | 3.8 | 2.2 | 1.6 | 0.04 | 0 | 13:00 |
| 91920801 | 18-Jun-1993 | 16 | 12.2077 | 144 | 34.4854 | 2 | 1.8 | 0.2 | 21.9 | 7 | 6.4 | 39.2 | 13.3 | 8.5 | 6.9 | 1.6 | 0 | 0 | 11:00 |
| 91920901 | 17-Jun-1993 | 15 | 54.4756 | 144 | 33.1561 | 3 | 1 | 0.2 | 19.4 | 7.41 | 6.1 | 123 | 32.6 | 23.8 | 8.2 | 15.6 | 0 | 1 | 11:00 |
| 92000101 | 06-Oct-1993 | 14 | 47.9092 | 143 | 21.59.35 | 2 | 1.1 | 0.2 | 26.4 | 7.62 | 6.7 | 59.8 | 12.7 | 5.9 | 2.9 | 3 | 0.7 | 2.2 | 12:00 |
| 92000201 | 07-Oct-1993 | 14 | 55.4306 | 142 | 54.6626 | 2 | 1.4 | 0.2 | 27 | 6.95 | 6.95 | 49.9 | 7.8 | 5.3 | 1.8 | 3.5 | 0.2 | 1 | 12:45 |
| 92000301 | 08-Oct-1993 | 14 | 53.9079 | 142 | 57.1647 | 2 | 0.55 | 0.2 | 25.8 | 7.2 | 8.26 | 78.9 | 13.9 | 10.6 | 3.8 | 6.8 | 0.4 | 1.1 | 13:00 |
| 92000401 | 09-Oct-1993 | 14 | 52.8761 | 142 | 45.8937 | 2 | 0.02 | 0.2 | 25.7 | 7.4 | 7.7 | 82.9 | | | | | 0.5 | | 11:00 |
| 92000501 | 09-Oct-1993 | 14 | 52.643 | 142 | 40.4905 | 3 | 0.5 | 0.2 | 29.5 | 6.9 | 6.5 | 122 | 29.9 | 29.4 | 14.4 | 150 | 0.02 | 2.5 | 13:00 |
| 92000601 | 10-Oct-1993 | 14 | 51.0488 | 142 | 32.8193 | 3 | 0.9 | 0.2 | 28.8 | 7.19 | 7 | 102 | 23.4 | 20.3 | 9.5 | 10.8 | 0.2 | 1 | 13:00 |
| 92000701 | 12-Oct-1993 | 14 | 54.225 | 142 | 28.2345 | 3 | 0.7 | 0.2 | 29.5 | 7.32 | 6.7 | 76.2 | 20.7 | 18.4 | 9 | 9.4 | 0.35 | 1 | 14:20 |
| 92000801 | 27-Oct-1993 | 14 | 52.9025 | 142 | 30.3388 | 3 | 0.95 | 0.2 | 33 | 6.64 | 4.94 | 125.8 | 29.4 | 28.1 | 14.1 | 14 | 0.3 | 1.6 | 14:40 |
| 92000801 | 27-Oct-1993 | 14 | 52.9025 | 142 | 30.3388 | 3 | 0.95 | 1 | 30.6 | 6.72 | 4.35 | 124.2 | | | | | | | 14:40 |
| 92000901 | 29-Oct-1993 | 14 | 58.8061 | 142 | 0.86518 | 3 | 0.75 | 0.2 | 31.3 | 6.82 | 5.45 | 78.7 | 17.5 | 12.6 | 6.1 | 6.5 | 0 | 1 | 12:30 |
| 92010101 | 27-Oct-1993 | 14 | 45.685 | 142 | 26.017 | 3 | 0.01 | 0.2 | 30 | 4.7 | 3.83 | 137.6 | 12 | | | | | | 11:00 |
| 92010201 | 30-Oct-1993 | 14 | 40.9797 | 142 | 15.3385 | 3 | 1 | 0.2 | 33.8 | 6.77 | 5.58 | 74.4 | 10.2 | 8.3 | 0.13 | 8.17 | 2 | 1 | 13:15 |
| 92010301 | 30-Oct-1993 | 14 | 41.5705 | 142 | 17.4963 | 2 | 1.15 | 0.2 | 35.4 | 6.78 | 6.18 | 26.1 | 4.8 | 4.3 | 1.9 | 2.4 | 0 | 1.2 | 16:00 |
| 92010301 | 30-Oct-1993 | 14 | 41.5705 | 142 | 17.4963 | 2 | | 3 | 30.4 | 6.39 | 2.23 | 26.8 | | | | | | | 16:00 |
| 92010401 | 31-Oct-1993 | 14 | 37.3047 | 142 | 5.9834 | 3 | 1.3 | 0.2 | 33.6 | 6.79 | 6.35 | 54.7 | 4.7 | 4 | 0.9 | 3.1 | 0 | 1.1 | 15:45 |
| 92010401 | 31-Oct-1993 | 14 | 37.3047 | 142 | 5.9834 | 3 | | 2 | 31 | 6.72 | 6.35 | 56.8 | | | | | | | 15:45 |
| 92010501 | 01-Nov-1993 | 14 | 38.0664 | 142 | 7.5716 | 2 | 1.9 | 0.2 | 31.1 | 6.24 | 2.86 | 36.1 | 3.7 | 2.1 | 0.8 | 1.3 | 0.6 | 1.1 | 12:00 |
| 92010501 | 01-Nov-1993 | 14 | 38.0664 | 142 | 7.5716 | 2 | | 2 | 29.6 | 5.75 | 0.16 | 36.1 | | | | | | | 12:00 |
| 92100101 | 02-Nov-1993 | 14 | 31.0116 | 142 | 2.0926 | 2 | 0.7 | 0.2 | 33.8 | 6.67 | 6.78 | 22.2 | 3.1 | 1.6 | 0.1 | 1.5 | 0 | 0.4 | 15:30 |
| 92100101 | 02-Nov-1993 | 14 | 31.0116 | 142 | 2.0926 | 2 | | 3 | 31.2 | 6.2 | 6.18 | 22.6 | | | | | | | 15:30 |
| 92100201 | 16-Nov-1993 | 14 | 7.6961 | 142 | 38.1186 | 2 | 1 | 0.2 | 31.5 | 6.95 | 8.85 | 34.3 | 11.1 | 8.3 | 3.9 | 4.4 | 0 | 0 | 14:00 |
| 92100201 | 16-Nov-1993 | 14 | 7.6961 | 142 | 38.1186 | 2 | | 3 | 29.8 | 7.01 | 8.71 | 33.6 | | | | | | | 14:00 |
| 92100301 | 17-Nov-1993 | 14 | 21.7329 | 142 | 29.6438 | 3 | 1.1 | 0.2 | 30.4 | 6.64 | 7.52 | 62.1 | 17.4 | 13.9 | 4.5 | 9.4 | 0.5 | 1 | 13:30 |
| 92100301 | 17-Nov-1993 | 14 | 21.7329 | 142 | 29.6438 | 3 | | 3 | 29.3 | 6.55 | 6.81 | 62.1 | | | | | | | 13:30 |
| 92100401 | 18-Nov-1993 | 14 | 21.6024 | 142 | 27.584 | 2 | 0.67 | 0.2 | 31.5 | 6.65 | 7.76 | 50.3 | 10.5 | 3.8 | 0.8 | 3 | 0 | 0 | 11:30 |
| 92100401 | 18-Nov-1993 | 14 | 21.6024 | 142 | 27.584 | 2 | | 2 | 29.5 | 6.35 | 5.87 | 58 | | | | | | | 11:30 |
| 92100501 | 19-Nov-1993 | 14 | 26.7453 | 142 | 14.9232 | 2 | 1.47 | 0.2 | 32.9 | 6.72 | 8.02 | 32.9 | 8.5 | 3.2 | 1.3 | 1.9 | 0 | 1.4 | 13:10 |

| Site Code | Date | Latitude | | Longitude | | Flow Type | Secchi | Depth(m) | Temp. | pH | Oxygen | Cond | Alkalinity | T. Hard. | Ca | Mg | PO4 | Tanin | Time |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 92100501 | 19-Nov-1993 | 14 | 26.7453 | 142 | 14.9232 | 2 | | 2.5 | 31.4 | 6.38 | 7.96 | 34 | | | | | | | 13:10 |
| 92100601 | 20-Nov-1993 | 14 | 26.4842 | 142 | 15.2841 | 2 | 0.83 | 0.2 | 32.2 | 6.63 | 8.07 | 49.2 | 11.9 | 7.9 | 2.5 | 5.4 | 0 | 1.4 | 11:00 |
| 92100601 | 20-Nov-1993 | 14 | 26.4842 | 142 | 15.2841 | 2 | | 1.3 | 30.1 | 6.16 | 5.92 | 53.6 | | | | | | | 11:00 |
| 92100701 | 21-Nov-1993 | 14 | 26.0145 | 142 | 17.001 | 3 | 1.32 | 0.2 | 30.4 | 6.84 | 7.66 | 75.5 | 19.8 | 11.9 | 6.3 | 5.6 | 0.2 | 1 | 13:15 |
| 92100701 | 21-Nov-1993 | 14 | 26.0145 | 142 | 17.001 | 3 | | 1.5 | 29.9 | 6.76 | 7.66 | 74.4 | | | | | | | 13:15 |
| 92100801 | 23-Nov-1993 | 14 | 23.652 | 142 | 47.3418 | 3 | 0.9 | 0.2 | 30.7 | 6.88 | 7.77 | 51.9 | 14.5 | 8.7 | 2.6 | 6.1 | 0.2 | 1.6 | 10:00 |
| 92100801 | 23-Nov-1993 | 14 | 23.652 | 142 | 47.3418 | 3 | | 3 | 29.5 | 6.42 | 5.72 | 53.7 | | | | | | | 10:00 |
| 92200101 | 29-Nov-1992 | 13 | 24.6685 | 142 | 18.7038 | 3 | 1 | 0.2 | 30.7 | 7.18 | 3.09 | 147.4 | 24.2 | 16 | 5.7 | 10.3 | 0 | 0 | 12:00 |
| 92200101 | 29-Nov-1992 | 13 | 24.6685 | 142 | 18.7038 | 3 | 1 | 2.65 | 29.9 | 7.39 | 3.08 | 145 | | | | | | | 12:00 |
| 92200102 | 02-Sep-1993 | 13 | 24.7381 | 142 | 18.6774 | 3 | 1.3 | 0.2 | 27.5 | 7.25 | 7.86 | 122.5 | 19.7 | 18.3 | 8.7 | 9.6 | 0 | 1.4 | 15:30 |
| 92200102 | 02-Sep-1993 | 13 | 24.7381 | 142 | 18.6774 | 3 | | 3 | 26 | 7.02 | 4.9 | 123 | | | | | | | 15:30 |
| 92200201 | 30-Nov-1992 | 13 | 27.0938 | 142 | 41.8117 | 2 | 0.98 | 0.2 | 32.1 | 7.46 | 2.94 | 61.3 | 13.1 | 9.7 | 4.1 | 5.6 | 0.4 | 0 | 14:30 |
| 92200201 | 30-Nov-1992 | 13 | 27.0938 | 142 | 41.8117 | 2 | 0.98 | 3 | 29.2 | 7.41 | 3.09 | 58 | | | | | | | 14:30 |
| 92200301 | 15-May-1993 | 13 | 31.667 | 143 | 13.6146 | 5 | 2 | 0.2 | 24.2 | 7.09 | 7.28 | 148.2 | 16.6 | 18.7 | 8.6 | 10.1 | 0 | 0.022 | 16:00 |
| 92200401 | 16-May-1993 | 13 | 40.4141 | 143 | 7.5306 | 6 | >1.3 | 0.2 | 22.9 | 7.2 | 7.82 | 106.6 | 18 | 16.6 | 7.6 | 9 | 0 | 0.02 | 9:30 |
| 92200501 | 17-May-1993 | 13 | 43.3146 | 143 | 14.7008 | 4 | >1.5 | 0.2 | 23.8 | 6.86 | 8.17 | 67 | 6.1 | 5.5 | 0.6 | 4.9 | 0 | 0 | 15:00 |
| 92200601 | 04-Jun-1993 | 13 | 27.2457 | 142 | 44.3544 | 2 | 2.42 | 0.2 | 25.6 | 6.75 | 6.84 | 26.8 | 10.8 | 8.3 | 4.9 | 3.4 | 0 | 1.3 | 12:30 |
| 92200601 | 04-Jun-1993 | 13 | 27.2457 | 142 | 44.3544 | 2 | | 3 | 24.7 | 6.66 | 5.86 | 26.5 | | | | | | | |
| 92200701 | 05-Jun-1993 | 13 | 27.0411 | 142 | 45.3181 | 5 | >1.5 | 0.2 | 24.2 | 7.09 | 7.57 | 73.9 | 18.3 | 15.6 | 7 | 8.6 | 0 | 1.2 | 11:30 |
| 92200801 | 31-Aug-1993 | 13 | 27.0562 | 142 | 58.7225 | 3 | 1.25 | 0.2 | 25.5 | 7.14 | 5.4 | 105.2 | 45.2 | 17.1 | 13.6 | 3.5 | 0 | 1 | 10:50 |
| 92200901 | 01-Sep-1993 | 13 | 35.4587 | 142 | 32.1145 | 2 | 0.75 | 0.2 | 26.5 | 6.59 | 4.61 | 54.7 | 13.2 | 9.1 | 4.7 | 4.4 | 0 | 1.2 | 15:30 |
| 92201001 | 05-Sep-1993 | 13 | 44.7779 | 142 | 13.1948 | 2 | 1.3 | 0.2 | 27.7 | 6.63 | 6.15 | 33.7 | 10.3 | 6.9 | 2.9 | 4 | 0 | 1.2 | 14:30 |
| 92201101 | 05-Sep-1993 | 13 | 44.69 | 142 | 10.1641 | 3 | 0.8 | 0.2 | 25.2 | 6.32 | 5.45 | 24.2 | 7.2 | 6.7 | 3.9 | 2.8 | 0.5 | 2.4 | 16:00 |
| 92201201 | 06-Sep-1993 | 13 | 42.2038 | 142 | 3.3443 | 3 | 0.8 | 0.2 | 27.8 | 6.27 | 6.85 | 27.1 | 6.2 | 3.3 | 1.4 | 1.9 | 0 | 0 | 15:00 |
| 92201301 | 07-Sep-1993 | 13 | 44.165 | 141 | 59.763 | 2 | 1.8 | 0.2 | 27.2 | 6.45 | 7.22 | 17.1 | 3.5 | 2.9 | 1.2 | 1.7 | 0.3 | 0.8 | 15:00 |
| 92210101 | 26-Nov-1992 | 13 | 39.8226 | 142 | 39.4238 | 2 | 1.4 | 0.2 | 29.5 | 6.54 | 2.9 | 65.4 | 19 | 15.7 | 9.2 | 6.5 | 0 | 0 | 9:00 |
| 92210101 | 26-Nov-1992 | 13 | 39.8226 | 142 | 39.4238 | 2 | 1.4 | 3 | 29.5 | 6.97 | 2.76 | 64.2 | | | | | | | 9:00 |
| 92210201 | 27-Nov-1992 | 13 | 49.0449 | 142 | 50.0665 | 2 | 1 | 0.2 | 29.8 | 6.67 | 3.3 | 86.3 | 17.2 | 10.8 | 4.8 | 6 | 0.3 | 1.6 | 14:00 |
| 92210201 | 27-Nov-1992 | 13 | 49.0449 | 142 | 50.0665 | 2 | 1 | 3 | 27.6 | 6.88 | 1 | 89.1 | | | | | | | 14:00 |
| 92210202 | 07-Jun-1993 | 13 | 49.0449 | 142 | 50.0665 | 2 | 1.06 | 0.2 | 25.2 | 6.51 | 5.78 | 46 | 12.6 | 7.9 | 2.7 | 5.2 | 0 | 1 | 13:50 |
| 92210202 | 07-Jun-1993 | 13 | 49.0449 | 142 | 50.0665 | 2 | | 3 | 23.4 | 6.35 | 4.68 | 43.1 | | | | | | | |
| 92210301 | 27-Nov-1992 | 13 | 42.1652 | 142 | 47.198 | 2 | | 0.2 | 31.3 | 8.5 | 3.8 | 57.2 | 11.7 | 5.1 | 4 | 1.1 | 0.3 | 0 | 17:00 |
| 92210302 | 08-Jun-1993 | 13 | 42.1652 | 142 | 47.198 | 2 | 1.96 | 0.2 | 24.5 | 6.31 | 6.34 | 26.5 | 8.6 | 2.9 | 2.4 | 0.5 | 0 | 0.6 | 14:15 |
| 92210302 | 08-Jun-1993 | 13 | 42.1652 | 142 | 47.198 | 2 | | 3 | 23.9 | 6.34 | 4.68 | 27.8 | | | | | | | |
| 92210401 | 19-May-1993 | 13 | 57.741 | 143 | 8.3329 | 5 | >1 | 0.2 | 26.7 | 7.58 | 7.91 | 82.5 | 10.6 | 8.7 | 4.4 | 4.3 | 0 | 1 | 14:40 |
| 92210501 | 20-May-1993 | 13 | 55.3371 | 143 | 11.8807 | 3 | 1.9 | 0.2 | 21.6 | 7.66 | 8.14 | 64.9 | 7 | 5.3 | 3.5 | 1.8 | 0.1 | 1 | 8:00 |
| 92210601 | 02-Jun-1993 | 13 | 39.6764 | 142 | 40.3752 | 3 | 1.63 | 0.2 | 22.9 | 6.74 | 4.82 | 96.9 | 18.1 | 14.7 | 8.1 | 6.6 | 0 | 1 | 12:30 |

| Site Code | Date | Latitude | Longitude | Flow Type | Secchi | Depth(m) | Temp. | pH | Oxygen | Cond | Alkalinity | T. Hard. | Ca | Mg | PO4 | Tanin | Time |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 92210601 | 02-Jun-1993 | 13 39.6764 | 142 40.3752 | 3 | | 2 | 22.5 | 6.64 | 4.34 | 85.6 | | | | | | | |
| 92210701 | 03-Jun-1993 | 13 39.6665 | 142 40.0507 | 2 | 1.35 | 0.2 | 24.9 | 6.98 | 6.37 | 63 | 25.5 | 19.1 | 10.3 | 8.8 | 0 | 0.8 | 11:30 |
| 92210701 | 03-Jun-1993 | 13 39.6665 | 142 40.0507 | 2 | | 3 | 24 | 6.82 | 4.9 | 64.8 | | | | | | | |
| 92210801 | 06-Jun-1993 | 13 49.4676 | 142 49.6946 | 5 | >1.0 | 0.2 | 26.1 | 7.56 | 7.81 | 87 | 16.9 | 7.3 | 3.9 | 3.4 | 0.3 | 1.2 | 13:10 |
| 92210901 | 03-Sep-1993 | 13 29.3382 | 142 19.3331 | 3 | 0.5 | 0.2 | 23.8 | 6.86 | 2.95 | 91.1 | 26.2 | 21 | 10.9 | 10.1 | 0 | 0.6 | 16:00 |
| 92211001 | 03-Sep-1993 | 13 29.2035 | 142 19.3833 | 2 | 0.2 | 0.2 | 31 | 7.42 | 7.34 | 78 | 15.6 | 8.4 | 4.8 | 3.6 | 0.4 | 1.2 | 15:30 |
| 92410101 | 10-Mar-94 | 12 39.5947 | 141 59.9739 | 2 | >2 | 0.2 | 32.3 | 5.67 | 7.18 | 15.1 | 1.5 | 3 | 1.2 | 1.8 | 0 | 0.2 | 11:00 |
| 92410101 | 10-Mar-94 | 12 39.5947 | 141 59.9739 | 2 | >2 | 2 | 32.2 | 5.93 | 8.49 | 15.5 | | | | | | | 11:00 |
| 92410201 | 11-Mar-94 | 12 29.101 | 141 49.6998 | 2 | >3 | 0.2 | 31 | 5.1 | 6.64 | 13 | 2.1 | 1.2 | 0.2 | 1 | 0 | 0.4 | 13:15 |
| 92410401 | 12-Mar-94 | 12 30.9869 | 141 48.3392 | 2 | >3.43 | 0.2 | 31.7 | 5.37 | 6.77 | 12 | 2.6 | 2.4 | 0.4 | 2 | 0 | 0.6 | 12:15 |
| 92410401 | 12-Mar-94 | 12 30.9869 | 141 48.3392 | 2 | >3.43 | 3 | 30.4 | 5.42 | 6.46 | 13 | | | | | | | 12:15 |
| 92410501 | 15-Mar-94 | 12 37.5553 | 141 54.8667 | 5 | >.8 | 0.2 | 28.5 | 5.2 | 5.95 | 16.3 | 1.2 | 2.9 | 0.9 | 2 | 0 | 2 | 14:00 |
| 92410601 | 17-Mar-94 | 12 39.8229 | 141 54.4485 | 12 | 0.92 | 0.2 | 29.8 | 5.52 | 7.26 | 8.5 | 1.2 | 0.8 | 0.4 | 0.4 | 0 | 0 | 10:30 |
| 92500101 | 21-Jul-1992 | 13 7.3354 | 142 59.6217 | 3 | 1.04 | 0.2 | 24 | 6.25 | 6.08 | 119.7 | 15.9 | 16.5 | 6.8 | 9.7 | 0 | 0 | 14:00 |
| 92500201 | 23-Jul-1992 | 13 7.6465 | 142 59.6248 | 2 | 1.25 | 0.2 | 22.8 | 5.52 | 5.32 | 33.1 | 7.7 | 8.4 | 3.7 | 4.7 | 0.16 | 0 | 11:00 |
| 92500301 | 25-Jul-1992 | 13 6.0842 | 142 56.326 | 2 | 1.38 | 0.2 | 23.8 | 5.73 | 5.75 | 27.6 | 5.3 | 2.4 | 0.6 | 1.8 | 0.1 | 0 | 13:00 |
| 92500301 | 25-Jul-1992 | 13 6.0842 | 142 56.326 | 2 | | 1 | 23.4 | 5.52 | 5.45 | 27.6 | | | | 0 | | | 13:00 |
| 92500401 | 25-Jul-1992 | 13 5.7063 | 142 56.385 | 3 | 1.2 | 0.2 | 22.2 | 6.4 | 6.01 | 107.5 | 19.6 | 16.3 | 6.7 | 9.6 | 0 | | 10:00 |
| 92500501 | 19-Aug-1992 | 12 46.0096 | 142 49.2268 | 3 | 1.5 | 0.2 | 25.6 | 7.41 | 7.67 | 87.4 | 18.3 | 14.5 | 4 | 10.5 | 0 | 0 | 10:20 |
| 92500601 | 20-Aug-1992 | 12 46.6252 | 142 49.8299 | 3 | 0.64 | 0.2 | 26.1 | 6.54 | 6.32 | 78.6 | 18.3 | 14.5 | 4 | 10.5 | 0 | 0 | 13:20 |
| 92500701 | 22-Aug-1992 | 12 28.8098 | 142 39.9175 | 3 | 1.5 | 0.2 | 26.4 | 6.52 | 6.83 | 64 | 16.2 | 7.9 | 1.9 | 6 | 0 | 0 | 12:45 |
| 92500801 | 23-Aug-1992 | 12 28.0109 | 142 39.4898 | 2 | 2.02 | 0.2 | 26.7 | 6.48 | 7.02 | 22.4 | 9.7 | 2.8 | 1.7 | 1.1 | 0 | 0 | 13:50 |
| 92500901 | 21-Sep-1992 | 12 23.2019 | 142 11.4204 | 3 | 1.58 | 0.2 | 29.6 | 6.68 | 6.68 | 68 | 12.6 | 9.7 | 4.1 | 5.6 | 0 | 0 | 15:30 |
| 92500901 | 21-Sep-1992 | 12 23.2019 | 142 11.4204 | 3 | | 3 | 28.8 | 7.26 | 6.3 | 66.7 | | | | 0 | | | 15:30 |
| 92501001 | 22-Sep-1992 | 12 23.8209 | 142 12.1797 | 2 | 2.27 | 0.2 | 29.5 | 7.1 | 6.84 | 23.4 | 6.4 | 4.1 | 2.4 | 1.7 | 0 | 0 | 13:45 |
| 92501001 | 22-Sep-1992 | 12 23.8209 | 142 12.1797 | 2 | | 2.5 | 28.2 | 6.93 | 6.77 | 23.4 | | | | 0 | | | 13:45 |
| 92501101 | 04-Nov-1992 | 12 29.3794 | 142 29.0262 | 3 | >1.5 | 0.2 | 32.2 | 7.19 | 7.74 | 66.9 | 8.5 | 12.8 | 2.9 | 9.9 | 0.2 | 0 | 15:00 |
| 92501101 | 04-Nov-1992 | 12 29.3794 | 142 29.0262 | 3 | | 1 | 31.7 | 7.57 | 6.94 | 53.3 | | | | | | | 15:00 |
| 92501201 | 05-Nov-1992 | 12 31.3386 | 142 23.3006 | 2 | 2.06 | 0.2 | 30.2 | 7.69 | 7.59 | 32.3 | 10.5 | 9 | 2.2 | 6.8 | 0.02 | 0 | 12:30 |
| 92501201 | 05-Nov-1992 | 12 31.3386 | 142 23.3006 | 2 | | 2 | 28.8 | 7.51 | 6.9 | 31 | | | | | | | |
| 92501202 | 21-Jul-1993 | 12 31.3386 | 142 23.3006 | 2 | 1.34 | 0.2 | 25.3 | 6.15 | 5.7 | 29.2 | 10.2 | 8.8 | 2.9 | 5.9 | 0.5 | 0.5 | 12:00 |
| 92501302 | 22-Jul-1993 | 12 30.685 | 142 23.209 | 3 | 2.2 | 0.2 | 23.9 | 6.48 | 7.1 | 66.4 | 10.2 | 8.3 | 3.7 | 4.6 | 0.06 | 0.5 | 9:00 |
| 92501401 | 19-Jul-1993 | 12 38.3451 | 142 47.9536 | 3 | 2.1 | 0.2 | 25.3 | 6.77 | 7.36 | 62 | 8.4 | 7.9 | 1.9 | 8 | 0.08 | 0.5 | 14:30 |
| 92501501 | 20-Jul-1993 | 12 38.8558 | 142 47.5287 | 2 | 0.64 | 0.2 | 24.5 | 6.46 | 6.9 | 30.6 | 3.4 | 5.2 | 1.4 | 3.8 | 0.08 | 0.5 | 11:30 |
| 92501601 | 17-Sep-1993 | 12 39.2495 | 142 49.2352 | 3 | >2.3 | 0.2 | 26.5 | 7.17 | 6.8 | 42.1 | 2.3 | 4.5 | 1.4 | 3.1 | 0.08 | 0 | 13:00 |
| 92501601 | 17-Sep-1993 | 12 39.2495 | 142 49.2352 | 3 | | 2.2 | 26.2 | 6.73 | 7.34 | 42.6 | | | | | | | |
| 92501701 | 22-Sep-1993 | 12 16.3 | 142 32.2994 | 2 | 0.85 | 0.2 | 27.1 | 5.5 | 2.75 | 75.9 | 5.5 | 7.1 | 1.5 | 5.6 | 0.24 | 1.6 | 11:00 |

| Site Code | Date | Latitude | Longitude | Flow Type | Secchi | Depth(m) | Temp. | pH | Oxygen | Cond | Alkalinity | T. Hard. | Ca | Mg | PO4 | Tanin | Time |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 92501701 | 22-Sep-1993 | 12 16.3 | 142 32.2994 | 2 | | 1.1 | 26.5 | 5.58 | 1.45 | 70.1 | | | | | | | |
| 92700101 | 15-Aug-1993 | 10 50.3324 | 142 28.1953 | 2 | >1.17 | 0.2 | 26.3 | 4.65 | 3.11 | 118.3 | 0 | 9.8 | 1.8 | 8 | 0 | 1.8 | 13:30 |

# APPENDIX FIVE

**CYPLUS data sheets**

Following are the data sheets used in field work during the CYPLUS Freshwater fish fauna survey 1992-1994

## CYPLUS DATA CODES

| SUBSTRATE | | INSTREAM COVER | | WATER TYPE | |
|---|---|---|---|---|---|
| Type | Code | Type | Code | Type | Code |
| Bedrock | 1 | Open Water | 1 | Swamp | 1 |
| Boulders | 2 | Rocks | 2 | Lagoon | 2 |
| Pebbles | 3 | Branches (sml snag) | 3 | Pool | 3 |
| Gravel | 4 | Logs ( snag) | 4 | Backwater | 4 |
| Sand | 5 | Log Jam (lge snag) | 5 | Gentle Flow | 5 |
| Clay | 6 | Branch overhang | 6 | Glide (mod/deep) | 6 |
| Composite | 7 | Roots | 7 | Riffle(fast/shallow) | 7 |
| Mud | 8 | Undercut | 8 | Rapid (white water) | 8 |
| Sand & Mud | 9 | Submerged veg | 9 | Cascade | 9 |
| Pebbles & Mud | 10 | Floating veg | 10 | Flood | 10 |
| Sand& Clay | 11 | Emergent veg | 11 | Soak/Drain | 11 |
| Sand & Pebbles | 12 | Algae | 12 | Dam | 12 |
| | | Leaf Litter | 13 | Tidal | 13 |
| | | Constructions | 14 | Turbulence at W'fall | 14 |
| | | Urban rubbish | 15 | | |
| | | Rock & vegetation | 16 | | |
| | | Snag & vegetation | 17 | | |
| | | Standing Timber | 18 | | |
| | | Roots & Undercut | 19 | | |
| | | Emerg. & Float Veg. | 20 | | |

| Fishing method | |
|---|---|
| Electrofishing | 1 |
| 1"gill net | 2 |
| 2.5"gill Net | 3 |
| 3.5"gill net | 4 |
| 6"gill net | 5 |
| Fine seine | 6 |
| 0.5"seine | 7 |
| Sighted | 8 |
| Baited line | 9 |
| Lure fishing | 10 |
| Fyke Net | 11 |
| Panel Net | 12 |

# CYPLUS FISH DATA

Page No. ______

Date ___/___/9___ Catchment ______________________ Staff ______________ Data Entered ________

Air Temp ______ Cloud Cover ______% Rain ______________ Wind ______km Wind Dir __________ Other ______________

| SITE CODE | SPECIES | TL (mm) | SL | FL | WT(g) | SUBSTRATE 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | COVER | FLOW TYPE | DEPTH (m) | WATER TEMP | TIME FISHING | TIME START | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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Mark off for different sample methods. Weigh and measure a sample of 10; estimate numbers >50 and record on this sheet.
Enter site code and sample number for preserved specimens, slides, etc. in the comments column.

## CYPLUS SITE DESCRIPTION

DATE ....../....../9... STREAM ............................................................ LOCAL SITE NAME ..............................

TIME .............................. STAFF ................................... DATA ENTERED ........................

SITE CODE .............................. LATITUDE ............. . ............ S LONGTITUDE 14 ..... . ........... E

Length ...............m Width (avg) ...................m
Water Level (tick) steady ........(1) high ........(2) low ........(3) rising ....(4) falling ........(5)
Secchi ..................(m) Temp .......... pH .......... O2 .............. ppm
Conductivity ..................us/cm Salinity ..............ppt Alkalinity ........................ Total Hardness ........................
Ca ............... mg/l Mg .................. mg/l Phosphate ................ mg/l Tannin ............... mg/l
Bank Type (R) .................. Bank Slope (R) .................. Bank Type (L) .............. Bank Slope (L) ..........

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FLOW TYPE | Code | | | | | | | | |
| | % area | | | | | | | | |
| MAX DEPTH | (m) | | | | | | | | |
| FLOW READING | / 40secs | | | | | | | | |
| SUBSTRATE | Code | | | | | | | | |
| | % area | | | | | | | | |
| COVER | Code | | | | | | | | |
| | % area | | | | | | | | |

| RIPARIAN VEGETATION | | AQUATIC VEGETATION | | STREAM DISTURBANCE | |
|---|---|---|---|---|---|
| 10m zone | % Area | Species | % Area | Type | Rating |
| Native Trees >20m | | | | Overall Disturbance | |
| Native Trees <20m | | | | Sand/gravel extract | |
| Exotic Trees | | | | Road | |
| Rubber Vine | | | | Bridge | |
| Native Shrubs | | | | Ford | |
| Exotic Shrubs | | | | Bank Erosion | |
| Native Grasses | | | | Catchment Erosion | |
| Exotic Grasses | | | | Siltation | |
| Sedges/Rushes | | | | Cattle Access | |
| Mangroves | | | | Feral Pigs | |
| | | | | Pump Inlet | |
| | | | | Drain Outlet | |
| | | | | Urban Rubbish | |
| | | | | Campsite | |
| | | | | | |

NEARBY CATCHMENT ACTIVITY :

Use substrate codes for bank type. Enter bank slope in degrees.
Disturbance Ratings: Extreme - 1, Very High - 2, High - 3, Moderate - 4, Low - 5, Very Low - 6.

Sketch of site showing landmarks and key features of the waterbody. Show North, the direction of flow, and mark photo points and direction.

**ACCESS:** Draw a mud map of the track to the site from the Cape Road.
List GPS coordinates of landmarks, eg turnoffs.

| Point | Lat | Long |
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| FILM | SLIDE No | VIEW No | DESCRIPTION |
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