

A SURVEY OF FRESHWATER FISH AND FISH HABITATS OF THE NORMAN RIVER, GULF OF CARPENTARIA

**A report as part of the NHT project “A Comprehensive Survey of Freshwater Fish
and their Key Management Issues Throughout Northern Australia”**

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EXECUTIVE SUMMARY

Despite some prior limited and ad-hoc sampling, the freshwater fish fauna of most of the Norman River catchment has not been examined. This report summarises the results of a catchment-wide freshwater fish survey of the Norman catchment, conducted as part of a larger analysis of freshwater fish distributions across northern Australia.

A total of 14 sites were surveyed in October 2006 including 12 sites in the Norman River catchment, and two sites in the adjacent Saxby River (Flinders River catchment). Twenty-six fish species were collected, including several specimens of an undescribed eel-tailed catfish, previously known only from the Flinders River. Seven of these records were new to the Norman catchment, representing significant extensions of their known range. The distribution of many fish species within the Norman catchment was also extended by these surveys. Combined with available literature records, and taking some unresolved taxonomic issues into account, we calculate that a total of 48 fish species are reliably known from the freshwaters of the Norman River catchment. This diversity is comparable to that of other rivers in the southern Gulf of Carpentaria and the number of fish species found at each site appeared comparable with other waterbodies sampled around the Gulf of Carpentaria. None of the species are endemic to the Norman catchment and nearly all of them have relatively wide distributions around the Gulf of Carpentaria and beyond. Two species of high conservation value – the freshwater sawfish and the freshwater whipray, are present within the catchment but their abundance and distribution is unknown. Tissue and gut content samples were taken from many fish species to contribute to additional ongoing studies on the genetic and dietary ecology of fish species in this region.

The Norman River is poorly known ecologically. Apart from its estuarine reaches where there has been considerable study of its habitats and fauna, the freshwater parts of the catchment have never been subject to significant study. The catchment has several distinctly different stream types ranging from persistently turbid waters in the southern tributaries to relatively clear waters in the northern tributaries. We were not able to survey springs in the upper reaches of several tributaries, which would be worth investigating. The Glenore Weir wall in the lower Norman River, was identified as a fish passage barrier, greatly restricting the upstream movement of fishes from the lower river. Although some species are able to negotiate this weir wall on some occasions, the opportunities for fish to move upstream are greatly restrict compared to their natural movement patterns and several species appeared to be completely absent form above the weir. This weir may also pose a special problem for the freshwater sawfish, which moves between estuarine and freshwaters during its life cycle.

1.0 INTRODUCTION

The Norman River is a 48,950 km² catchment originating in the Gregory Range and flowing through the gulf savannah black soil plains, ultimately discharging into the Gulf of Carpentaria at the port town of Karumba. The Norman River catchment is bounded by the Gilbert River in the north and the Flinders River in the south-west. During flood periods, the Norman catchment may receive overland flow water from both the Saxby River and Flinders River into Spear Creek (a southern tributary) and from the Gilbert River into the Carron River (a northern tributary). Thus the freshwater fish fauna is expected to be similar to these adjoining catchments given the extent of connectivity during flood times.

The Norman River is mostly a low gradient river running through gulf savannah and black soil plain land types but several contrasting riverine geomorphologies, water quality and habitat structures are found within the catchment. In the Spear Creek/Norman River area, the system is characterized by river reaches of low gradient containing large, deep and turbid lagoons flowing through black soil plains. In contrast, Walkers Creek on the lower Norman River is a clear water system with granite substrates. The Carron and Clara systems are seasonal dry rivers with few permanent waterholes and sandy gravel substrate. Permanent water sites are notable for dark tannin stained quality of the water. There are a few springs in the Upper Norman, Yappar River and Clara River but no large water bodies associated with these springs and these are hard to access. There are permanent springs along the road from Croydon to Richmond. Thus the waterbodies in the southern part of the Norman catchment resemble those of the adjoining Flinders River catchment and are likely to have different fish communities than waterbodies in the northern part of the Norman catchment.

The town of Karumba at the mouth of the Norman River supports a significant commercial fishing fleet and is a major recreational fishing destination (Hart and Perna 2004). Considerable research has also been conducted by the CSIRO on the fish fauna on the Norman River estuary (eg, Blaber *et al.* 1994, Salini *et al.* 1998). However, despite this effort, and the area's reputation for estuarine and marine fishing, the freshwater fish fauna of the Norman River catchment has been poorly studied with prior research being limited to ad-hoc museum collecting and spatially limited fisheries investigations. Castelnau (1878) presented a short list of freshwater fishes collected from the lower Norman River area near Normanton in 1878, including the description of several new species, three names of which (*Ambassis elongatus*, *Ambassis macleayi* and *Parambassis gulliveri* – all glassfish) still remain valid today. The Queensland Museum holds a number of records of fish species collected from Walkers Creek (a northern tributary) in 1953 and 1991 and from the Carron River (another northern tributary) in 1998/1999. The Queensland Department of Primary Industries and Fisheries (DPIF) have, associated with the fish stocking programs in those impoundments, surveyed Lake Belmore (Croydon) and Glenore Weir (Normanton) a number of times. The majority of the catchment remained unsurveyed for freshwater fish until the current study.

This survey was conducted as part of a larger project titled “A comprehensive survey of freshwater fish and their key management issues throughout northern Australia”. This study, funded by the Natural Heritage Trust (NHT), aims to systematically

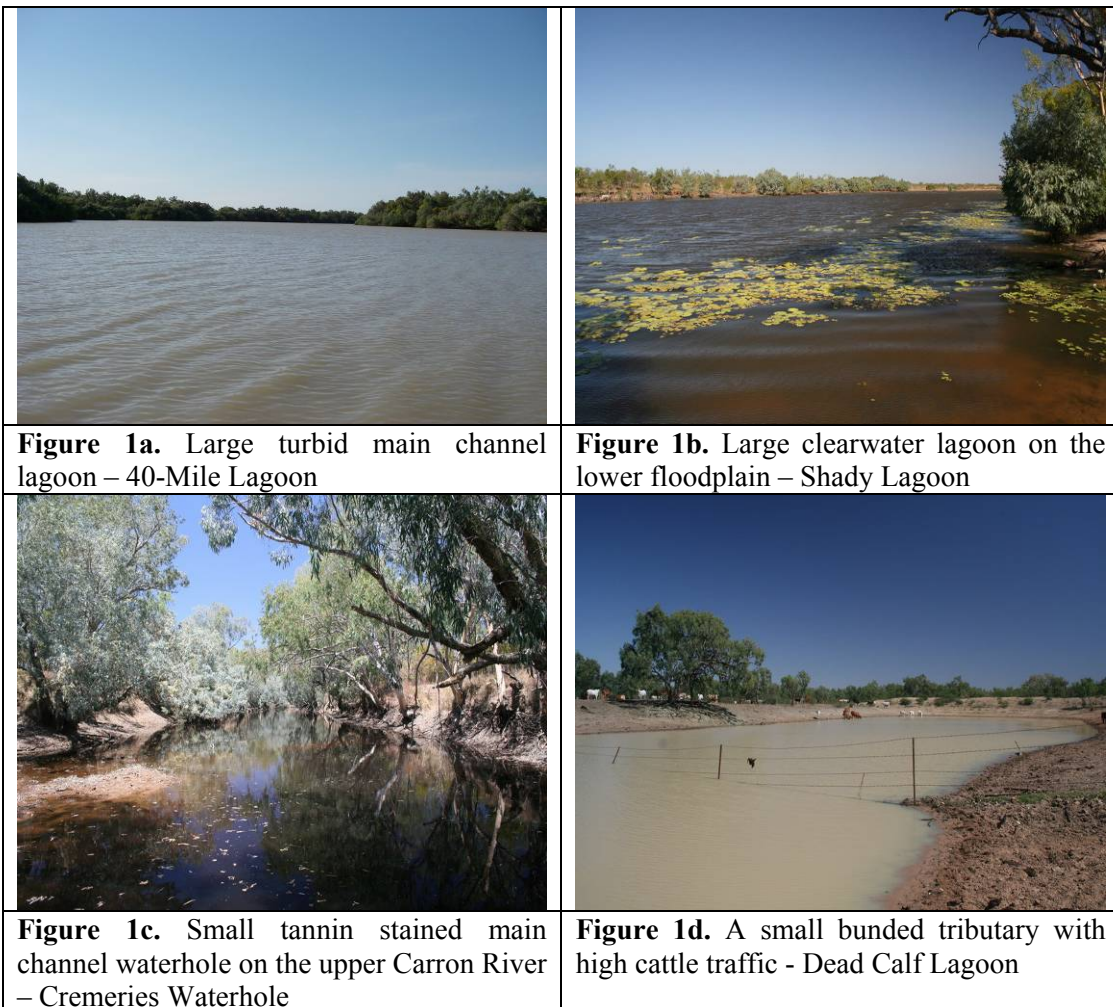
sample many of Australia's northern rivers, providing information on the species diversity, relative abundance and within-catchment distribution of the fish species found. Key management issues such as fish barriers, weed infestations and other indicators of fish habitat integrity are also identified. Tissues samples for later genetic analysis are collected to determine the taxonomy and phylogeographic structure of various fish groups across northern Australia, focusing on the terapontid grunters.

2.0 METHODS

2.1 Site Selection

Sites were sampled in October 2006, along most of the length of the Norman River and its tributaries, but suitable sites were not identified in the Clara and Yappar rivers. Site selection was limited to areas of permanent water and was restricted by vehicle and boat access constraints. A variety of habitats present within the Norman were represented in the survey with the exception of spring habitats, which were not surveyed due largely to lack of access. Sites sampled included large turbid lagoons, small permanent tannin-stained waterholes in the upper Carron River and lower floodplain, and clearwater rocky holes in the Normanton region. Examples of the variety of waterbodies sampled are shown in Figures 1a-1d. Within each selected site, fish and habitat sampling was conducted with the intention of characterising as much of the environmental and biological variation possible.

Figures 1a-1d. Examples of Different Types of Sites Sampled in the Norman River Catchment



2.2 Fish Sampling

Fish sampling followed the protocol outlined in Kennard *et al.* (2007 and available on the NAFF website www.actfr.jcu.edu.au) and involved the use of boat-mounted

electrofishing as the main fish collection technique. A Smith-Root model 2.5GPP electrofisher mounted on a 3.7m aluminium dingy was crewed by 2-3 people (one operator and one or two dip-netters). Boat mounted electrofishing consisted of at least 10 five minute (elapsed time) electrofishing samples (hereafter termed ‘shots’) in each study site. Each electrofishing shot was spatially independent of other shots and was conducted in as homogenous as possible habitat type. The allocation of within-site sampling effort reflected the proportional availability of major habitat types (i.e. riffles, runs, pools, macrophyte beds, stretches of mid-channel open water, undercut banks, woody debris piles) in that each major habitat type was sampled at least once and then remaining sampling effort occurred in the most abundant habitat types. At most study sites fewer than 10 electrofishing shots were able to be sampled, though up to 20 shots were conducted in some larger sites. In larger study sites and where species diversity was found to be low after 10 electrofishing shots, a further 30 minutes electrofishing occurred for the purpose of targeting the detection of any further species.

Following each electrofishing shot, all fish caught were identified and released at the site of capture. A maximum of 20 individuals of each species collected at each site were measured (SL in mm). Samples for genetic analysis were taken from chequered rainbowfish (*Melanotaenia splendida inornata*), all catfish species including the plotosid (eel-tailed) and ariid (fork-tailed) catfish, and all members of the recreationally important terapontid grunter group. Fin clippings were taken from the end of one pectoral fin and preserved in 100% ethanol. Also, whole specimens of terapontid grunters from a wide range of age classes were collected for an associated trophic study examining gut content analysis and digestive system morphology. The results of genetic and trophic analyses of the terapontid grunters will be reported on at a later date. Specimens of unknown or unclear identity were preserved in ethanol and returned to ACTFR for distribution to appropriate experts. All other fish collected were released at the point of capture. Taxonomy and usage of common names in this report follows that of Allen *et al.* (2002), except for the ariid catfish which follows that of the more recent revision of the group by Kailola (2004).

2.3 Water Quality, Aquatic Habitat and Riparian Assessment

Water quality measurements were taken at the upstream, middle and downstream end of each site using a YSI model 556 MPS multimeter. Dissolved oxygen, electrical conductivity, temperature and turbidity were measured at the surface, and at one metre intervals thereafter to the bottom.

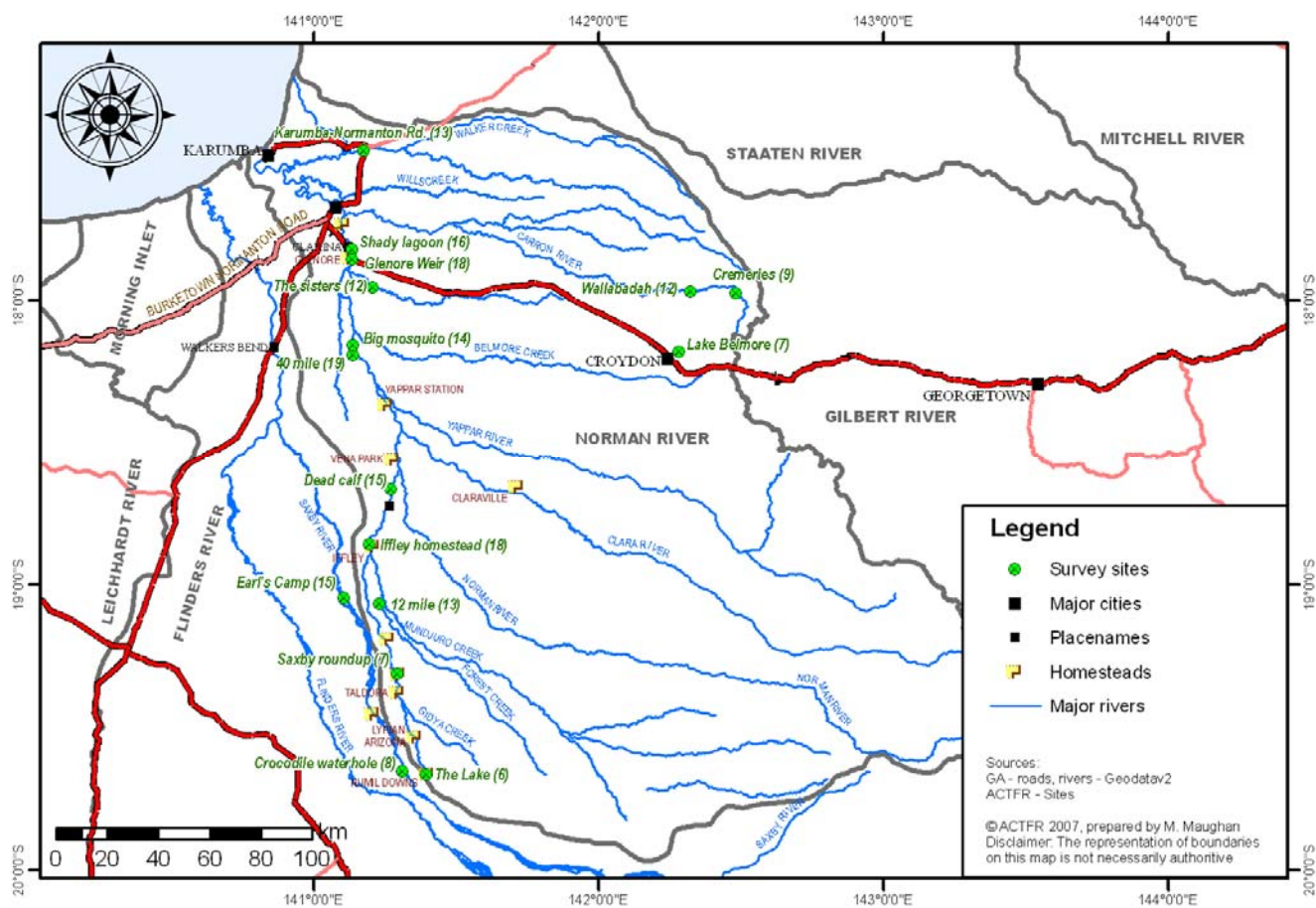
Aquatic habitat variables (percent cover of substrate types, mesohabitat and microhabitat variables, wetted width and depth) were recorded for each electrofishing shot (see Kennard *et al.* 2007). A rough map was drawn of the whole site to indicate approximate location of shots, water quality samples, major habitat attributes, flow direction and site orientation. Riparian habitat assessment was made based on a 250m visual transect along one bank. Variables noted included erosion, weed infestation, canopy cover and any other impacts that may affect instream habitat quality. Lastly, background information on flow, intervals of flushing, duration of flow and other species recorded outside of our survey were gained through landholder interviews, whenever possible.

3.0 RESULTS

3.1 Sites Surveyed

A total of 14 sites were surveyed, including 12 sites in the Norman River catchment, and two sites in the adjacent Saxby River (which is part of the Flinders River catchment, running parallel to Spear Creek and the Norman River). Survey sites are shown on the map in Figure 1 and their latitude/longitude indicated in Table 1. All sites sampled were located within the main channel of waterways except for three sites (N2, N7 and N11) which were located in off-channel locations.

Figure 2. Map of the Norman River Catchment Showing Fish Survey Sites and the Number of Species (in brackets) Found at Each Site



Between 6-19 fish species were recorded from each site (Table 1). The two sites with the most species sites were the Iffley Homestead waterhole with 18 species and the 40-Mile Lagoon with 19 species.

Table 1. Summary of Location, Species Richness, Abundance and Sampling Effort for Each Site

Site	Latitude	Longitude	No. fish species	Total abundance	Total sampling effort (seconds ON time) (# shots)
Norman River catchment					
The Lake-N1	19°39.987'S	141°23.749'E	6	126	1250 (13)
Saxby Roundup-N2	19°18.858'S	141°17.604'E	7	126	1120 (10)
Dead Calf Lagoon-N3	18°34.952'S	141°16.137'E	15	367	398 (5)
12 Mile Lagoon-N4	17°04.040'S	141°13.721'E	13	297	651 (7)
Iffley Homestead-N5	18°51.528'S	141°11.743'E	18	666	2122 (20)
40 Mile Lagoon-N6	18°11.425'S	141°08.231'E	19	143	2100 (20)
Big Mosquito Lagoon-N7	18°09.348'S	141°08.231'E	14	198	2104 (15)
The Sisters-N8	17°57.079'S	141°12.352'E	12	196	524 (5)
Shady Lagoon-N9	17°49.166'S	141°08.004'E	16	345	1897 (16)
Walkers Creek Weir-N10	17°28.227'S	141°10.429'E	13	482	700 (6)
Cremeries Waterhole-N11	17°58.446'S	141°29.057'E	9	210	468 (7)
Wallabadah Waterhole-N12	17°58.032'S	141°19.438'E	12	430	1210 (10)
Saxby River (Flinders River Catchment)					
Crocodile Waterhole-S1	19°39.262'S	141°18.690'E	8	89	612 (6)
Earls Camp-S2	19°02.790'S	141°06.333'E	15	92	1916 (12)

3.2 Fish Community Assessment

We recorded 26 species from 15 families in the 12 Norman River study sites and 16 species from 11 families in the two Saxby River sites (Tables 2 and 4). All of the fish species found in the two Saxby River sites were also sampled in the Norman catchment sites. A further 11 species from eight families have been caught or recorded by the landholders (Table 4). Queensland Museum records (from various sources) reveal the presence of a further 15 species including one alien species (goldfish) (Table 4, Appendix 2). Seven species collected in this study have not previously been reported from the Norman River catchment (Table 4).

The most abundant species recorded was the chequered rainbowfish, followed by bony bream and Macleay's glassfish (Table 4). Bony bream and spangled perch were recorded at all 14 sites surveyed and the chequered rainbowfish and Macleay's glassfish were recorded at 12 sites (Table 4).

Table 2. Species Recorded from the 14 sites sampled by boat electrofishing in the present study. *Listed from most abundant to least abundant*

Common name	Scientific name	Total caught	Number sites recorded at
Chequered rainbowfish	<i>Melanotaenia splendida inornata</i>	1357	12
Bony bream	<i>Nematalosa erebi</i>	996	14
Macleay's glassfish	<i>Ambassis macleayi</i>	449	12
Spangled perch	<i>Leiopotherapon unicolor</i>	311	14
Fly-specked hardyhead	<i>Craterocephalus stercusmuscarum</i>	108	4
Rendahl's tandan	<i>Porochilus rendahli</i>	97	8
Giant glassfish	<i>Parambassis gulliveri</i>	62	6
Giant gudgeon	<i>Oxyeleotris selheimi</i>	52	8
Sleepy cod	<i>Oxyeleotris lineolatus</i>	51	9
Papuan sprat	<i>Clupeoides cf papuensis</i>	38	4
Gulf grunter	<i>Scortum ogilbyi</i>	35	9
Mouth almighty	<i>Glossamia aprion</i>	34	9
Flathead goby	<i>Glossogobius giuris</i>	25	8
Freshwater anchovy	<i>Thryssa scratchleyi</i>	24	4
Toothless catfish	<i>Anodontoglanis dahli</i>	22	9
Seven-spot archer fish	<i>Toxotes chatareus</i>	21	9
Barramundi	<i>Lates calcarifer</i>	20	5
Barred grunter	<i>Amniataba percoides</i>	16	7
Carpentaria catfish	<i>Ariopsis paucus</i>	14	6
Hyrtl's tandan	<i>Neosilurus hyrtlii</i>	13	5
Berney's catfish	<i>Ariopsis berneyi</i>	9	4
Tarpon	<i>Megalops cyprinoides</i>	6	3
Longtom	<i>Strongylura krefftii</i>	4	2
Lesser salmon catfish	<i>Ariopsis graeffei</i>	3	3
Undescribed eel-tailed catfish	<i>Neosilurus</i> sp. nov.*	3	2
Munro's goby	<i>Glossogobius</i> sp. 2 'munroi'*	1	1

*=New species, not yet scientifically described



Figure 3. Undescribed species of eel-tailed catfish (*Neosilurus* sp. nov.) from 40 Mile Lagoon

3.3 Water Quality

Most of the sites within the Norman River, especially those in the Spear Creek, Saxby River and Norman River proper, had high turbidity water (Table 3). With the exception of Walkers Ck. Weir (N10) and Shady Lagoon (N9), all the sites surveyed had secchi depths of less than one metre. Due to the soil types throughout the catchment the waters tend to remain turbid throughout the year. Both Shady Lagoon and Walkers Creek are in more bedrock dominated sites with different soil types and thus have water of greater clarity. We only had access to one site at the lower end of the system but landholders informed us that Walkers Creek is relatively clear throughout the length of the system. The electrical conductivity of the sites ranged from 300 μ s/cm in the Saxby River down to 50 μ s/cm in the upper Carron River (Table 3).

Dissolved oxygen readings were all below 50% saturation and as low as 20% in the upper Carron River. The sites in the upper Carron River are permanent waterholes that recede by up to 50% in size through the dry season and have very high tannin levels. These sites are also more shaded than other larger sites in the Norman River, which may contribute to the low levels of oxygen in the water.

Table 3. Physico-Chemical Water Quality Data for Fish Survey Sites.
All data are from surface readings.

Site	Time	Dissolved oxygen mg/l	Dissolved oxygen % sat.	Conductivity μ s/cm	Temperature $^{\circ}$ C	Secchi depth (m)
N1	8:00	3.7	44	113	22.9	0.15
N1	8:30	3.9	46	112	23.2	0.15
N2	13:30	3.4	43	72	26.5	0.35
N2	14:30	3.5	44	73	27.3	0.35
N3	10:30	2.8	35	70	26.4	0.10
N3	11:30	3.1	40	69	27.6	0.10
N4	9:30	2.5	31	298	26.3	0.15
N4	10:30	2.9	36	299	27.1	0.15
N5	14:00	3.0	39	226	29.2	0.55
N6	15:00	2.8	35	90	27.0	0.50
N6	15:30	2.9	37	90	27.7	0.50
N6	16:00	2.8	36	91	27.5	0.50
N7	11:00	2.6	32	70	26.4	0.65
N7	11:45	2.8	34	71	24.7	0.65
N8	9:00	2.5	31	101	25.0	0.40
N8	10:30	2.5	31	101	25.7	0.40
N9	15:30	2.5	33	85	21.5	1.30
N9	16:30	2.8	34	82	26.2	1.30
N10	11:30	1.9	24	170	25.9	1.00
N11	10:00	1.6	20	88	26.0	0.80
N11	10:30	2.0	26	81	28.0	0.80
N12	14:00	2.1	28	50	31.4	0.35
N12	14:30	2.3	30	49	29.1	0.35
S1	13:30	3.6	47	301	28.7	0.60
S1	14:00	3.8	48	302	27.3	0.50
S2	15:00	3.1	41	257	29.1	0.65
S2	15:45	3.0	40	254	29.4	0.65

4.0 DISCUSSION

4.1 Sampling Effort

The fish communities recorded throughout the Norman River catchment appear to be consistent with what would be expected in regards to catchment size and characteristics. Our survey included most habitat types within the catchment with the exception of upper catchment streams and springs. These springs would be expected to have a low species diversity, though it would be interesting to see what species occur that far upriver. The Norman River catchment is characterized by larger permanent waterbodies with high levels of suspended sediments contributing to turbid conditions in the water column. Only a relatively small percentage of permanent waterbodies within the Norman River catchment have clear water. The high turbidity may have decreased our ability to see and collect fish stunned by electrofishing and thus have decreased our efficiency of detecting species and collecting them in numbers corresponding to their relative abundance in the environment. However, concurrent assessment of sampling efficiency at these sites (and elsewhere during the project), the results of which are to be reported on elsewhere, indicates that, with respect to determining species richness at each site, the sampling protocol used here performs adequately in detecting the species that are present.

4.2 Site and Catchment Fish Diversity

Twenty-six fish species were recorded in this survey. This compares favourably with results from other fish surveys in rivers of the northern Gulf of Carpentaria. Burrows *et al.* (2006) found 28 species from 12 sites sampled in the Lynd River and 23 species from seven off-channel lagoons sampled in the middle Mitchell catchment. Electrofishing of the seven Mitchell River main-channel sites as part of the DPIF long-term monitoring program yielded 31 species in 2000 and 29 species in 2001 (Jebreen *et al.* 2002). Repeated electrofishing surveys of 16 sites in the Mitchell catchment and 11 sites in the Walsh catchment yielded 36 and 30 species respectively (Ryan *et al.* 2002). Surveys of nine sites in the Palmer catchment by Herbert *et al.* (1995) yielded 24 species.

In addition to the 26 fish species found in this survey, an additional 11 species are reported by landholders to be present, 4 of which have not been formally recorded from the catchment. Of the species from the catchment held by the Queensland Museum, 7 species have not been recorded elsewhere and a further three species are only known from surveys in Glenore Weir. Compiling the results from the current study with all of the other records obtained, and taking unresolved taxonomic issues into account as best we can, we conclude that a total of 48 fish species have been recorded from the fresh waters of the Norman catchment. All species recorded from the catchment and the source of their record are listed in Table 4. Generally in rivers, the number of fish species present increases in the lower reaches increases due to the presence of both estuarine-affiliated species and freshwater species restricted to lowland habitats. If more effort had been placed in lower reaches of rivers during this survey, the number of species collected may possibly have increased. Blaber *et al.* (1994) thoroughly surveyed the fish community of the Norman River estuary and

recorded 100 species. This is relatively low for a tropical estuary, with 197 being found in the Embley estuary at Weipa, for example (Blaber *et al.* 1994). Blaber *et al.* (1994) attributed this low diversity to the low habitat complexity of the Norman estuary, and the high turbidity and freshwater input, restricting the occurrence of marine species.

Table 4. Accepted Records of Fish Presence in the Norman River Catchment

Family	Species	Common Name	Source of Fish Record						
			1	2	3	4	5	6	7
Ambassidae	<i>Ambassis macleayi</i>	Macleay's glassfish	*		*				*
	<i>Ambassis elongatus</i>	Elongate perch			*		*		*
	<i>Ambassis nalua</i>	Scalloped glassfish				*			
	<i>Ambassis</i> sp. (Northwest glassfish)**	Northwest glassfish							
	<i>Ambassis</i> sp.	Glassfish						*	
	<i>Parambassis gulliveri</i>	Giant glassfish	*		*				*
Apogonidae	<i>Glossamia aprion</i>	Mouth almighty	*		*	*	*		*
Ariidae	<i>Ariopsis berneyi</i> #	Berney's catfish	*						
	<i>Ariopsis graeffei</i> #	Lesser salmon catfish	*		*				*
	<i>Ariopsis paucus</i> #	Carpentaria catfish	*						
	<i>Ariopsis leptaspis</i> #	Triangular shield catfish		*	*				
	<i>Ariopsis</i> sp.#	Fork-tailed catfish					*		
Atherinidae	<i>Craterocephalus stercusmuscarum</i>	Fly-specked hardyhead	*		*				
	<i>Craterocephalus</i> sp.	unidentified hardyhead			*				
Belonidae	<i>Strongylura krefftii</i>	Longtom	*		*				*
Carcharhinidae	<i>Carcharhinus leucas</i>	Bull shark		*					
Centropomidae	<i>Lates calcarifer</i>	Barramundi	*			*	*	*	
Chanidae	<i>Chanos chanos</i>	Milkfish					*		
Clupeidae	<i>Clupeoides cf papuensis</i>	Papuan sprat	*						
	<i>Nematalosa erebi</i>	Bony bream	*		*		*	*	*
	<i>Nematalosa come</i>	Bony bream				*			
Dasyatidae	<i>Himantura chaophrya</i>	Freshwater stingray		*					
Eleotridae	<i>Hypseleotris compressa</i> ***	Empire gudgeon							*
	<i>Oxyeleotris lineolatus</i> ***	Sleepy cod	*		*	*	*		
	<i>Oxyeleotris selheimi</i>	Giant gudgeon	*		*			*	
Engraulidae	<i>Thryssa scratchleyi</i>	Freshwater anchovy	*						
Gobiidae	<i>Chlamydogobius ranunculus</i>	Tadpole goby			*				
	<i>Glossogobius aureus</i>	Golden goby			*				
	<i>Glossogobius giuris</i>	Flathead goby	*						
	<i>Glossogobius</i> sp. 2 (<i>munroi</i>)	Munro's goby	*						
	<i>Glossogobius</i> sp.	unidentified goby			*				
Kurtidae	<i>Kurtus gulliveri</i>	Nursery fish		*					*
Megalopidae	<i>Megalops cyprinoides</i>	Tarpon	*				*		
Melanotaeniidae	<i>Melanotaenia splendida inornata</i>	Chequered rainbowfish	*		*	*	*	*	
	<i>Melanotaenia</i> sp.	unidentified rainbowfish			*				
Mugilidae	<i>Liza alata</i>	Diamond mullet			*				
	<i>Liza</i> sp.	Mullet			*				

	<i>Liza subviridis</i>	Greenback mullet			*				
Plotosidae	<i>Anodontoglanis dahli</i>	Toothless catfish	*		*		*		
	<i>Neosilurus hyrtlii</i>	Hyrtl's tandan	*		*			*	
	<i>Neosilurus</i> sp. nov.###	undescribed catfish	*						
	<i>Neosilurus</i> sp.	unidentified catfish					*		
	<i>Porochilus rendahli</i>	Rendahl's tandan	*		*				
Pristidae	<i>Pristis microdon</i>	Freshwater sawfish		*					
Scatophagidae	<i>Scatophagus argus</i>	Spotted scat		*					
	<i>Selenotoca multifasciata</i>	Banded scat		*					*
Scorpaenidae	<i>Notesthes robusta</i> *	Bullrout					*		
Soleidae	<i>Brachirus salinarum</i>	Saltpan sole		*					
	<i>Brachirus selheimi</i>	Freshwater sole		*	*				
Synbranchidae	<i>Ophisternon gutturale</i>	One-gilled eel			*				
Terapontidae	<i>Amniataba percoides</i>	Barred grunter	*		*	*		*	*
	<i>Hephaestus fuliginosus</i>	Sooty grunter		*	*			*	
	<i>Leiopotherapon unicolor</i>	Spangled perch	*		*	*		*	*
	<i>Pingalla gilberti</i> ***	Gilbert's grunter							
	<i>Scortum ogilbyi</i> ##	Gulf grunter	*		*	*	*		
Toxotidae	<i>Toxotes chatareus</i> ***	Seven-spot archer fish	*				*	*	*

Listed as *Arius* in original reports rather than the current generic name of *Ariopsis*, after Kailola (2004). Also *Arius midgleyi* is now *Ariopsis paucus* also after Kailola (2004).

This species may have been listed as *Scortum* sp. or *Scortum barcoo* in some original reports

New undescribed species. See main text for discussion

Listed as *Ophisternon bengalense* in Queensland Museum records. See main text for discussion

* Only known from the east coast of Australia so this record is either a doubtful identification of another scorpaenid species or a significant range extension

** Recorded at Martins waterhole (Saxby roundup – N3 in Spear Creek) by Hogan and Vallance (2005)

*** In addition to the records presented in Table 4, Wager (1993) lists records of *Toxotes chatareus* from the Norman River, Wills Creek and Walkers Creek and of *Oxyeleotris lineolatus* from Wills Creek and Glenore Weir. The Australian Museum also have a record of *Hypseleotris compressa* from the Norman River. Though we could not find any formal records, Allen *et al.* (2002) list the Norman River as part of the range of *Pingalla gilberti*.

Records of the silver tandan, *Porochilus argenteus*, and the sailfin glassfish, *Ambassis agrammus*, from the Queensland Museum: the barcoo grunter, *Scortum barcoo*, from Helmke and Garrett (1997); and Marjorie's hardyhead, *Craterocephalus marjoriae*, from Allen (1989) and Wager (1993); *C. munroi* from Pusey *et al.* (2004); and *Pseudomugil cyanodorsalis* from Allen *et al.* (2002) and Pusey *et al.* (2004) are considered dubious, and not included in the above list. See the Discussion section for explanation.

1. This report
2. Species recorded by landholders as reported in the main text or appendix of this report
3. Queensland Museum records (listed in full in Appendix 2)
4. Helmke and Garrett (1997) – Glenore Weir
5. Glenore Weir – see Pearce and McDougall (2000) ; or Pearce (QDPIF, unpub. data)
6. Lake Belmore - see Pearce and Vallance (2000); or Pearce (QDPIF, unpub. data)
7. Castelnau (1878)

Five of the 14 sites sampled in this study had 15 or more species present, with the maximum being 19 species at 40 Mile Waterhole. This number of species at any one site is comparable to other waterholes in the Gulf of Carpentaria streams. For example, the greatest number of species found at a single site in the Mitchell and Walsh catchments was 16 and 19 species, respectively Ryan *et al.* (2002). Burrows *et al.* (2006) reported 19 and 23 species at two sites in the Lynd River. Hogan and Vallance (2005) found 15 species or more only at 15 of the 41 sites they surveyed in

the southern Gulf of Carpentaria Rivers (Flinders, Leichhardt and Nicholson) up to a maximum of 22 species.

4.3 New Records

Seven species collected in this study have not previously been reported from the Norman River catchment (Table 4). These species included *Ariopsis berneyi*, *A. paucus*, *Thryssa scratchleyi*, *Clupeoides cf papuensis*, *Glossogobius guirus*, *Glossogobius sp. 2 (munroi)* and *Neosilurus sp. nov.*

The most significant record during the present study is the finding of three specimens of an undescribed eel-tailed catfish collected at two widely-separated sites (40 Mile Waterhole in the Norman River and N10 on Walkers Creek). Specimens were sent to Dr. Helen Larson, a fish taxonomist at the Museum and Art Galleries of the Northern Territory, who tentatively identified them as *Neosilurus sp.* (which is the closest it would key to). However, the specimens appear the same as the undescribed eel-tailed catfish shown in Plate 3 in Hogan and Vallance (2005), which were sent to Jeff Johnson at the Queensland Museum, who tentatively identified them as belonging to the related genus *Porochilus*. It is likely that these are the same, new undescribed species. Further, it may be found to belong to an as yet undescribed genus. The collection of more specimens would be very useful to its taxonomic description.

We did not catch any sooty grunter (*Hephaestus fuliginosus*) in our surveys. However, landholders report that sooty grunter occur in Shady Lagoon, the Sisters and 40 Mile Waterhole in the lower Norman River, and in the Carron River. In the upper Carron River we are told that this species is present some years and not in others, with their presence coinciding with higher flood years. The Queensland Museum holds a record of sooty grunter from Walkers Creek. Sooty grunter have been stocked into Lake Belmore on Belmore Creek, including 67,640 fingerlings in 1997-1998 (Pearce and McDougall 2000). Thus it appears that sooty grunter are present in the northerly tributaries (Walker, Carron and Belmore) but not the more southerly tributaries (Yappar, Clara, Norman, Forest and Spear) with the exception of the lower reaches of the Norman. Hogan and Vallance (2005) did not find any sooty grunter in the Flinders River in close proximity to the southerly tributaries (eg, Forrest, Spear creeks) of the Norman River either. Sooty grunter are more common in the Gilbert River which adjoins the northern tributaries of the Norman and connects with some of them during flood events. The sections of the Norman and Flinders Rivers catchments where sooty grunter are absent appear to be those that have greater turbidity (lower water clarity).

The fish that we have tentatively labelled as the Papuan river sprat may turn out to be a new species. The Papuan river sprat is only officially known from rivers in the central-south of Papua New Guinea (eg, Fly River). Hogan and Vallance (2005) recorded a similar species at three sites in the Flinders River catchment, noting it to be quite abundant. In this study, we have also detected what is probably the same species, at four sites, also noting it to be quite abundant.

We collected a single specimen of Munro's goby, *Glossogobius sp. (munroi)*, from Dead Calf in Spear Creek on Iffley Station. This species (also known as the square-

blotch goby), is yet to be formally described, although, the name *munroi* has become a common use name for this species (eg, in records of the Museum and Art Galleries of the Northern Territory) and is proposed to be put forward as the name for this species when it is officially described (Helen Larson pers. comm.). In Allen *et al.* (2002), this fish is referred to as *Glossogobius* sp. 2. and in Hogan and Vallance (2005) as *Glossogobius* sp. C. Hogan and Vallance (2005) caught this fish at 8 of the 20 sites they surveyed in the Flinders River catchment. It is distributed widely from the Northern Territory to Queensland (Allen *et al.* 2002).

Landholders were spoke with during the course of our fieldwork were keen to talk about the fish they have caught and observed. For many fish, the exact species is uncertain, but for others, such as barramundi, it is obvious. Landholders have reported to us, records of 4 fish species (bull shark, freshwater whipray, freshwater sawfish and spotted scat) that have not been formally recorded in fisheries surveys. The first three are large, obvious and not readily caught with standard survey techniques. Spotted scats are not usually found in freshwater surveys as they are largely an estuarine species that may penetrate into lower freshwater reaches. All these species are known from estuarine reaches of the Norman River (ie, downstream of Glenore Weir) but have not been caught in freshwater reaches above Glenore Weir during any formal surveys.

4.4 Literature Records

Field identification of gobies is difficult. Here, we have identified just two species – the flathead goby and Munro’s goby. Munro’s goby is discussed above. The flathead gobies we collected keyed out to *Glossogobius giuris* in the field, but this species is very similar to the golden goby, *G. aureus*. It is therefore possible that our field identifications were erroneous. We have only used the former name whereas other workers (eg, Hogan and Vallance (2005) in the Flinders catchment) have recorded only *G. aureus*. Both species have very wide geographic ranges, including much of northern Australia and south-east Asia (Pusey *et al.* 2004) so both species are probably present in both the Norman and Flinders catchments.

The record of *Ophisternon bengalense* from the Queensland Museum (Table 4, Appendix 2) is more likely to be *Ophisternon gutterale*, which is well-known from the Gulf of Carpentaria streams. There is some debate about the specific identity of swamp eels found in Australia (Tyson Roberts pers. comm. cited in Pusey *et al.* 2004). Similarly, the record of *Porochilus argenteus* from the Queensland Museum is also considered unlikely to be correct as this species is only known from inland desert drainages such as the Lake Eyre basin (Allen *et al.* 2002).

Helmke and Garrett (1997) recorded the barcoo grunter, *Scortum barcoo*, from Glenore Weir. The taxonomy of *Scortum* grunters is confused and although several authors (e.g., Herbert *et al.* 1995) have reported *S. barcoo* from various Gulf of Carpentaria and Cape York rivers, the current status is that only one *Scortum* species the gulf grunter *Scortum ogilbyi* (Allen *et al.* 2002) occurs in these catchments. The taxonomy and genetics of *Scortum* grunters from the Gulf of Carpentaria and Cape York are being investigated as part of the NHT project under which these surveys were conducted. Helmke and Garrett (1997) also report the bullrout, *Notesthes*

robusta, from Glenore Weir. This species is only known from the east coast of Queensland (Allen *et al.* 2002, Pusey *et al.* 2004). Thus, this record is either a misidentification of another bullrout species (though all other known species in Australia are not known to occur in freshwaters) or a significant new range extension.

There are a number of glassfish (*Ambassis* sp.) in the region and the exact identity of glassfish caught may be confusing at times. The Queensland Museum lists specimens of the sailfin glassfish, *Ambassis agrammus* from the Carron River, the only record we have for this species from the Norman catchment. We have only identified Macleay's glassfish *Ambassis macleayi* from our surveys. The recorded range of *A. agrammus* includes the Leichhardt and Gilbert Rivers, making the Norman a plausible location as well, but Pusey *et al.* (2004) considered them likely to be absent from these rivers. Helmke and Garrett (1997) also record the scalloped glassfish, *Ambassis nalua* from Glenore Weir. This species has not been recorded anywhere else in the freshwater surveys of the Gulf of Carpentaria or northern Australia (NAFF Database 2007). It is normally an estuarine species, but as Glenore Weir is very close to the estuary and Blaber *et al.* (1994) record this species from the Norman estuary, its occurrence there, although unlikely, is plausible. Hogan and Vallance (2005) record a widely recognised but as yet undescribed *Ambassis* species, the northwest glassfish, from a waterhole in a tributary of Spear Creek. They referred to this waterhole as Martins Waterhole. We sampled a waterhole we have referred to as Saxby Roundup which we believe to be the same waterhole. We have referred the glassfish we caught at this waterhole to *Ambassis macleayi*. The range of the northwest glassfish, as recognised in Allen *et al.* (2002) is from Western Australia through to the Leichhardt River (west of the Norman), although Hansen (2001) also report a northwest glassfish (as *Ambassis mulleri* sic) from the Edward River (western Cape York Peninsula).

Wager (1993) list Marjorie's hardyhead, *Craterocephalus marjoriae*, from the Norman River based on the record in Allen (1989). However, the range of *C. marjoriae* is eastern Australia and the records of Wager and Allen are more likely the similar-looking, *C. munroi* (Crawley and Ivantsoff 1988, 1992, Pusey *et al.* 2004). Although Pusey *et al.* (2004) listed this species for the Norman catchment, we have excluded it from our list here as all the records for this species (including those from the Norman catchment) are from estuarine water, not fresh water (Crawley and Ivantsoff 1988, 1992). Similarly, Allen *et al.* (2002) and subsequently Pusey *et al.* (2004) list the blueback blue-eye, *Pseudomugil cyanodorsalis* from the Norman catchment near Normanton, but this record is likely estuarine, not freshwater.

The Queensland Museum record of an alien species – goldfish (*Carrasius auratus*) – from the Norman River near Normanton is interesting, especially as it dates from 1914. No further records are known so it is presumed the species did not become established there. This is the only alien species recorded from this catchment.

4.5 Fish Stocking

There are two major impoundments in this catchment – Glenore Weir and Lake Belmore. Glenore Weir has a spillway approximately 2m high, and was built in 1968, on the Norman River, 103km upstream from its mouth, to provide a water supply for the towns of Normanton and Karumba (Pearce and McDougall 2000). Lake Belmore

was formed by damming Belmore Creek, just north of Croydon, in 1995. The dam wall is 18m high and the dam has a storage capacity of 5,800 ML (Pearce and Vallance 2000). Both impoundments have been stocked with hatchery-reared fish to boost recreational fishing opportunities in the region. Barramundi are regularly stocked into Glenore Weir by the Gulf Barramundi Fish Stocking Association. Barramundi, sooty grunter, striped sleepy cod and red claw crayfish have been stocked into Lake Belmore by the Croydon Boating and Fishing Club (Pearce and Vallance 2000, Hollaway and Hamlyn 2001). For barramundi and sooty grunter, this may be further up the creek than they naturally occurred. DPI-Fisheries have surveyed both impoundments on several occasions in relation to these fish stocking programs with the results reported in Helmke and Garrett (1997), Pearce and McDougall (1999) and Pearce and Vallance (2000).

4.6 Habitat and Fish Management Issues

Land use of the Norman River catchment is dominated by cattle grazing. Thus the main habitat issues relate to grazing, erosion, fire management and riparian weeds. There has not been a catchment-wide condition assessment for the Norman catchment, though such an assessment is warranted. The freshwater ecosystems of the Norman catchment are very poorly known. Habitat conditions vary widely between sites and this is likely to influence fish populations. Factors such as decreased water clarity (ie, increased turbidity) and damage to riverbanks and fringing riparian vegetation are particularly important in protecting habitat values for fish.

Overall the habitat condition of sites surveyed in this study was considered to be good (see Appendix 1 for information relating to each site). Public access to most riverbanks is limited therefore reducing impacts associated with uncontrolled visitation. No major weed infestations were found but moderate weed infestations in some riparian areas, mainly of rubber vine and noogoora burr, were noted. No instream weeds were identified. The main impacts identified were from creating a bund wall across the channel for livestock watering sites, a large weir on the Norman River near Normanton, and high cattle traffic at some sites. Riparian vegetation ranged from 95% contiguous canopy of *Melaleuca* to sparse tree cover and grassland surrounding habitat with open eucalypt woodland.

Fish kills due to a lack of dissolved oxygen in the water are relatively common in non-flowing tropical waters, but deeper waterbodies are more susceptible due to stratification of the water column. Fish kills have been reported from Glenore Weir on at least three occasions (1994, 1997 and 1999 – Pearce and McDougall 2000). Holes in Glenore Weir are at least 9m deep and Pearce and McDougall (2000) found that dissolved oxygen was limited in the deeper waters and recommended that an aeration device be installed to promote mixing of the water layers to improve the dissolved oxygen status of the weir.

Freshwater sawfish (*Pristis microdon*) have been reported by many landholders, and others, in the Norman catchment as far upstream as Crocodile Waterhole. With their long saw-like rostrum, they are readily recognised when sighted (Figure 4). The freshwater sawfish is the largest freshwater fish in Australia growing up to seven metres in length, though Australian specimens are generally only up to two metres

long (Last and Stevens 1994) with the largest known being 6 metres long (S. Peverell, QDPIF pers. comm.). They are listed as *Vulnerable* under the commonwealth EPBC Act, *Endangered* on the 2000 IUCN Red List of Threatened Species and *Critically Endangered* in SE Asia. They have recently been nominated for listing as ‘Vulnerable’ under the Queensland Nature Conservation Act (I. Briezze QEPA pers. comm.). The freshwater sawfish is known from at least 15 rivers across northern Australia as well as many parts of SE Asia and India. The records for the Northern Gulf region include specimens from the Mitchell, Lynd, Gilbert, Norman and Staaten rivers, and reports from the Palmer and Walsh rivers (Burrows 2004). Freshwater sawfish move between estuaries and freshwaters as part of their life-cycle and it appears they suffer considerable mortality through fishing pressure and entanglement in nets, resulting in a serious decline in their abundance across their range (Peverell 2005). They may also have trouble passing physical barriers (e.g. weirs) placed on rivers. No studies have been undertaken on the impact of Glenore Weir on this species but it is likely that it presents a formidable barrier to upstream movement of this species, and others, into the Norman catchment. Further investigation of this issue is warranted.



Figure 4. The Freshwater Sawfish, *Pristis microdon*.

Photo courtesy Stirling Peverell, QDPIF

Many fish move between freshwaters and estuarine waters as part of their life cycle or for a variety of other reasons. For many species, such as barramundi, that spawn in estuarine waters, structures (eg, weirs, road culverts) that inhibit their passage back upstream will lead to their loss from freshwater habitats as the existing population is not replaced by new recruits. These barriers may be complete barriers over which fish cannot pass, or they may be partial barriers that fish can swim over only when the flow conditions are right. In the latter scenario, fish such as barramundi may still be found above the barrier but probably not in the same numbers that would otherwise occur if there was no barrier present. It is considered that passage barriers may prove particularly difficult to negotiate for freshwater sawfish, making them more sensitive to impacts from these structures. However, the migratory habits and abilities of sawfish are poorly known in this regard. The Queensland Museum records of mullet from Glenore in 1953 (Appendix 2) are interesting in that these species have not officially been collected from any location upstream of the Glenore Weir wall in recent years, probably due to fish barriers effects. The number of estuarine fish known to move upstream into freshwater waters that have been caught in Glenore Weir and sites upstream, is low, though this may reflect insufficient sampling effort. More thorough collection of angling records from reliable local sources is warranted.

Marsden and Stewart (2005) undertook an assessment of fish passage issues in the southern Gulf of Carpentaria catchments, inspecting 15 locations considered to be of interest. Glenore Weir was the only location inspected in the Norman catchment. Marsden and Stewart (2005) considered that fish could only swim upstream past this weir for very short periods during wet season flow events, greatly reducing opportunities for upstream movements. They thus considered that Glenore Weir was a significant fish passage barrier that should be a high priority for restoration of fish passage. They also recommended that the migratory habits of the freshwater sawfish be determined before a design for improved fish passage was initiated.

5.0 CONCLUSIONS

This survey collected 26 fish species from 14 sites. Overall, the freshwater fish fauna of the Norman River is very similar to that of the adjoining rivers in the Gulf of Carpentaria. This study provided new catchment records for seven species and greatly expanded the known within-catchment distribution of many other species. We also collected additional specimens of new undescribed species of eel-tailed catfish, goby and river sprat, thus greatly expanding our knowledge of northern Australian freshwater fish. The fish records collected in this study and that of various other sources bring the total number of fish collected from freshwater in the Norman catchment to 48. Numerous tissue samples were also collected for use in various genetic studies. No alien species are known to be currently present within the waters of the Norman catchment. Further survey work in the Norman catchment should focus on the fish faunas of the permanent springs in the upper catchment areas. An examination of the fish passage issue at Glenore Weir and how it might be rectified is a top priority. As for all catchments in the region, further studies on the freshwater sawfish and the freshwater whipray are urgently needed.

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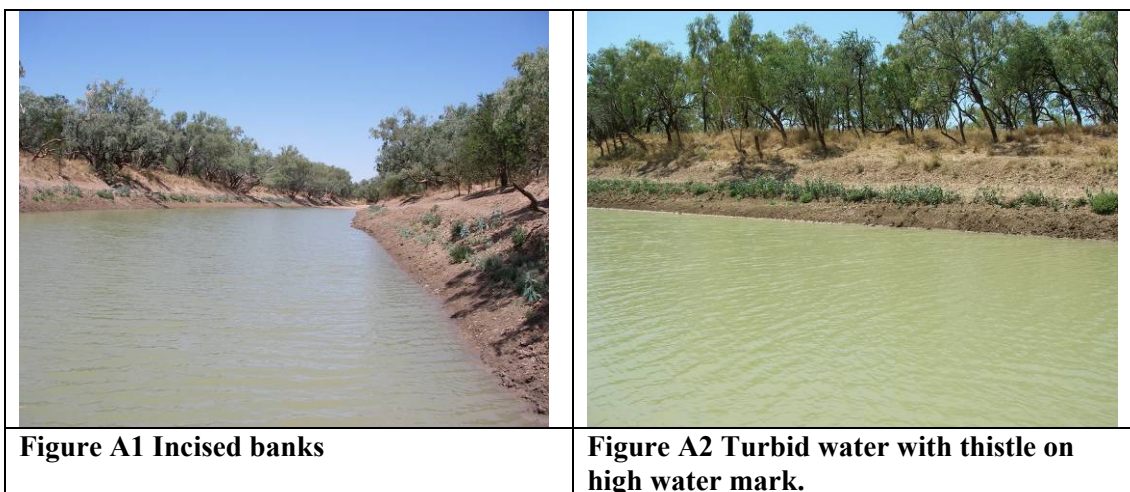
APPENDIX 1 - Site Habitat Descriptions and Raw Data

The following section includes our own observations made by Colton Perna with observations (especially on flow patterns) made by local landholders and other knowledgeable locals.

Numil Downs Station

S1 Crocodile Waterhole, Saxby River (Flinders River catchment)

Crocodile waterhole is a permanent main channel site on the Saxby River in the Flinders catchment. This is a turbid site year round with a secchi depth of 0.6m at the time of sampling. The site flows on average for 6-8 weeks and has major scouring once every 7 years on average. The site is in an incised bank area with little water edge habitat (Figure A1 & A2). The site had little shallow water except in the upstream and downstream ends and averaged 2m depth with a maximum of 3.5m.



We recorded 8 species of fish at this site with a further 3 species reported by the landholder (Table A1). By far the most abundant species was bony bream with 67 caught and the rest of the species had less than 10 individuals caught. The depth and turbidity may have restricted the ability to record or capture deep water species such as ariid catfish, sharks and barramundi. Although no records were given for ariid catfish they would most certainly be present at times in this site.

Table A1. Fish Species Recorded at Crocodile Waterhole

Common name	Scientific name	Total caught
Bony bream	<i>Nematalosa erebi</i>	67
Spangled perch	<i>Leiopotherapon unicolor</i>	3
Rendahl's tandan	<i>Porochilus rendahli</i>	7
Sleepy cod	<i>Oxyeleotris lineolatus</i>	3
Gulf grunter	<i>Scortum ogilbyi</i>	1
Flathead goby	<i>Glossogobius giuris</i>	1
Freshwater anchovy	<i>Thryssa scratchleyi</i>	2
Seven-spot archer fish	<i>Toxotes chatareus</i>	5
Barramundi*	<i>Lates calcarifer</i>	0
River whaler*	<i>Carcharhinus leucas</i>	0
Sawfish*	<i>Pristis microdon</i>	0

*=landholder records but not recorded in survey

The riparian areas of this site are subject to high cattle traffic and low level infestation of thistle. The riparian trees were dominated by red gum, wattle and gutta percha all on the high bank. Recruitment of these trees was noted on the high bank as well. There was little riparian shading at time of sample as the water had receded into the main channel away from the high banks where the riparian trees were growing. Canopy continuity was around 60%. The surrounding area had black soil.

N2 The Lake at Numil Downs homestead, Spear Ck.

The Lake is a semi-permanent site within the main channel of Spear Ck. According to the landholders it has dried nine times in the past 36 years. The site only flows for two or three weeks in average years. The site flows 90% of wet seasons and has a proper flush every 10 years on average. The site does not stay turbid all year and will clear for a period after wet season flows but the landholders report that the turbidity (secchi depth of 0.15m at the time of sampling) returns when sediments are resuspended with the onset of northerly winds. There is little shading of the water body by trees as the riparian vegetation is predominantly grassland (Figure A3). Instream there is high biomass of lily and naidoo with other macrophytes as an understorey in the shallow verges of the site (Figure A4).

Our survey consisted of 13 shots recording six species of fish (Table A2). The landholders had a good record of species presence in the site from past fish kills due to the drying of the site. They reported both fork-tailed catfish and eel-tailed catfish, barramundi (3 over one metre in one very dry year) and whiplays. The species of catfish can only be speculated but most likely would have included berney’s catfish and lesser salmon catfish. They have also noted the seven-spot archerfish around their pump station and have caught gulf grunter. With landholder records this site may have up to 13 species (Table A2). The landholders report that barramundi and whiplays would likely enter the Lake from overflows from the Saxby River upstream where these species are regularly caught from the road crossing.



	
<p>Figure A3 The Lake showing low shading and high cover of floodplain grassland of the riparian area</p>	<p>Figure A4 High turbidity of water but high cover of lily and naidoo in the shallow areas</p>

Table A2. Fish Species Recorded at the Lake

Common name	Scientific name	Total caught
Bony bream	<i>Nematalosa erebi</i>	74
Chequered rainbowfish	<i>Melanotaenia splendida inornata</i>	27
Macleay's glassfish	<i>Ambassis macleayi</i>	20
Spangled perch	<i>Leiopotherapon unicolor</i>	2
Giant gudgeon	<i>Oxyeleotris selheimi</i>	2
Toothless catfish	<i>Anodontoglanis dahli</i>	1
Gulf grunter*	<i>Scortum ogilbyi</i>	0
Seven-spot archer fish*	<i>Toxotes chatareus</i>	0
Barramundi*	<i>Lates calcarifer</i>	0
Freshwater whiplay*	<i>Himantura chaophrya</i>	0
Hyrtl's tandan*	<i>Neosilurus hyrtlii</i>	0
Berney's catfish*	<i>Ariopsis berneyi</i>	0
Lesser salmon catfish*	<i>Ariopsis graeffei</i>	0

*=landholder records but not recorded in survey

This site is located at the homestead of the station and is used for domestic supply as well as a water source for a nearby yard for cattle. The low gradient bank with high grass and macrophyte cover are also heavily used by pigs on the opposite side from the homestead. Minor bunding has occurred in the past on the eastern side to increase water retention. The riparian trees are gutta percha and wattle with little recruitment noted. At the downstream end there is a shallow basin with regrowth *Melaleuca*.

Taldora Station

N3 Saxby Roundup, Spear Creek

This is an off-channel site at a rodeo grounds on Taldora Station. The site is within the Spear Creek catchment. The site is turbid (secchi depth of 0.35m) and would flow for only a short period of time after significant rains. There is little information on this site as the manager was not available for interview. The site had high level of pig activity in the shallow margins and there was a high level of disturbance in and around the rodeo grounds. The riparian trees were gutta percha and wattle with little or no recruitment. We recorded seven species from this site (Table A3). DPIF have also surveyed what we believe to be this site and also recorded seven species, two of which we did not record (Table A3).

Table A3. Fish Species Recorded at Saxby Roundup

Common name	Scientific name	Total caught
Chequered rainbowfish	<i>Melanotaenia splendida inornata</i>	49
Bony bream	<i>Nematalosa erebi</i>	38
Macleay's glassfish	<i>Ambassis macleayi</i>	16
Giant gudgeon	<i>Oxyeleotris selheimi</i>	14
Toothless catfish	<i>Anodontoglanis dahli</i>	6
Spangled perch	<i>Leiopotherapon unicolor</i>	2
Gulf grunter	<i>Scortum ogilbyi</i>	1
Rendahl's tandan*	<i>Porochilus rendahli</i>	0
Northwest glassfish*	<i>Ambassis</i> sp.	0

* record from Hogan and Vallance (2005)

Iffley Station

N4 Dead Calf Lagoon, Spear Creek

This site contained a diverse fish assemblage despite being structurally monotonous. It is a main-channel site that is bunded for watering cattle (Figure A5). The water was highly turbid (secchi depth of 0.1m). There was evidence of high cattle traffic around and through the site, especially along the fence line that transects the waterhole. In the shallow upstream section there were very high levels of filamentous algae, probably reflecting nutrient enrichment,. The site would flow every year but flows would not persist for more than 3 weeks in average years. The water at this site never clears. It is a permanent water site, however without the bunding it is questionable if the site would persist most years.

We recorded 15 species from this site, plus barramundi, which have been recorded by the landholder (Table A4). Both Macleay’s and giant glassfish were very abundant at this site. Due to its size, only five shots were conducted and this site may contain more species than was detected.

The bunding of the site in conjunction with the high cattle traffic make this site highly disturbed. Riparian trees were dominated by gutta percha, wattle and *Callistemon* but no recruitment was noted and the bund wall was mostly barren of trees. Little shading of the waterbody was noted at the time of the sample.

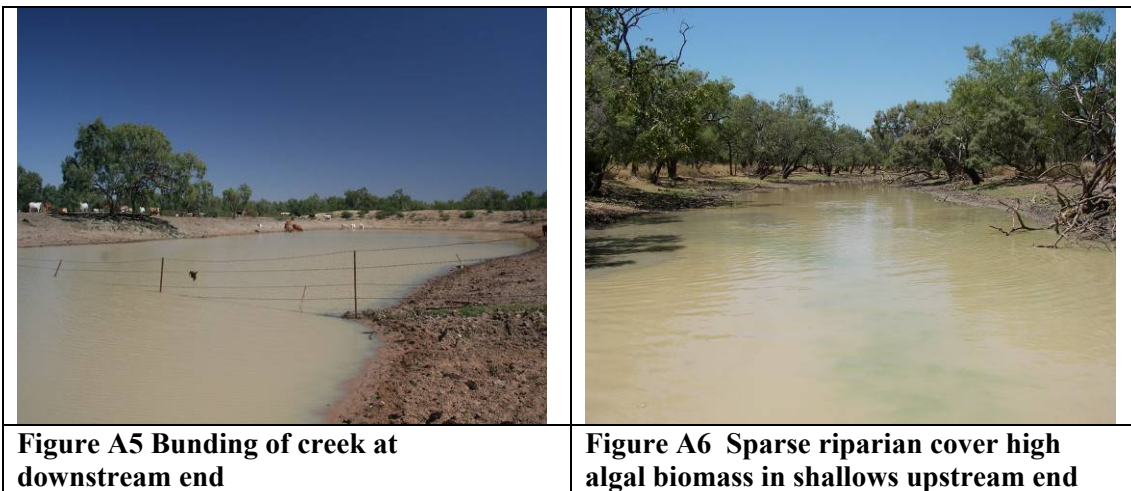


Table A4. Fish Species Recorded at Dead Calf Lagoon

Common name	Scientific name	Total caught
Macleay's glassfish	<i>Ambassis macleayi</i>	194
Chequered rainbowfish	<i>Melanotaenia splendida inornata</i>	69
Giant glassfish	<i>Parambassis gulliveri</i>	31
Rendahl's tandan	<i>Porochilus rendahli</i>	21
Giant gudgeon	<i>Oxyeleotris selheimi</i>	17
Bony bream	<i>Nematalosa erebi</i>	10
Gulf grunter	<i>Scortum ogilbyi</i>	9
Spangled perch	<i>Leiopotherapon unicolor</i>	5
Toothless catfish	<i>Anodontoglanis dahli</i>	3
Carpentaria catfish	<i>Ariopsis paucus</i>	2
Sleepy cod	<i>Oxyeleotris lineolatus</i>	2
Fly-specked hardyhead	<i>Craterocephalus stercusmuscarum</i>	1
Mouth almighty	<i>Glossamia aprion</i>	1
Berney's catfish	<i>Ariopsis berneyi</i>	1
Munro's goby	<i>Glossogobius munroi</i>	1
Barramundi*	<i>Lates calcarifer</i>	0

*=landholder records but not recorded in survey

S2 Earl's Camp, Saxby River (Flinders River catchment)

Earl's camp is the second site we sampled in the Flinders catchment. This is a long deeply incised site in the main-channel of the Saxby River (Figures A7 & A8). There was no shading of the water by trees as the trees were restricted to the high bank and the water had receded into the main channel. The site is within a large black soil plain. Water clarity was moderate (secchi depth of 0.65m), and remains turbid all year. The river at this point flows on average for six to eight weeks each year and flushes once every seven years.

We recorded a total of 15 species from 12 shots (Table A5). A further two species not recorded during the survey have been recorded by landholders. Nurseryfish (*Kurtus gulliveri*) have been recorded from a similar but larger site (Lyrian waterhole) just upstream (Hogan and Vallance, 2005), but this species was not recorded at any site during our survey. Although said by landholder to be commonly caught, we only recorded one barramundi. Landholders also have records of freshwater sawfish and whiprays and well as river whalers.

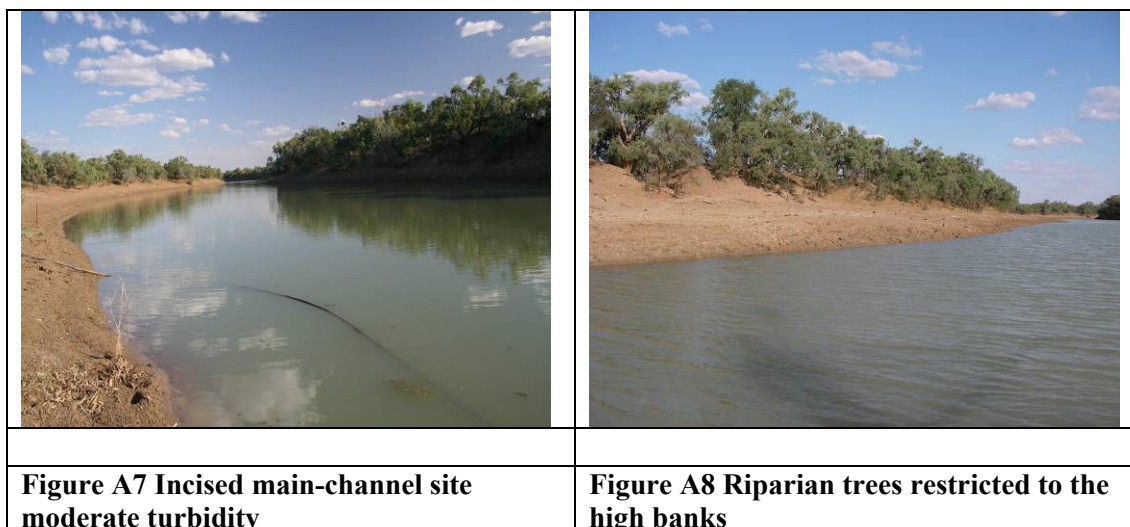


Table A5. Fish Species Recorded at Earl's Camp

Common name	Scientific name	Total caught
Bony bream	<i>Nematalosa erebi</i>	46
Sleepy cod	<i>Oxyeleotris lineolatus</i>	9
Flathead goby	<i>Glossogobius giuris</i>	8
Seven-spot archer fish	<i>Toxotes chatareus</i>	7
Freshwater anchovy	<i>Thryssa scratchleyi</i>	5
Berney's catfish	<i>Ariopsis berneyi</i>	4
Spangled perch	<i>Leiopotherapon unicolor</i>	3
Mouth almighty	<i>Glossamia aprion</i>	2
Toothless catfish	<i>Anodontoglanis dahli</i>	2
Giant glassfish	<i>Parambassis gulliveri</i>	1
Papuan sprat	<i>Clupeoides cf papuensis</i>	1
Gulf grunter	<i>Scortum ogilbyi</i>	1
Macleay's glassfish	<i>Ambassis macleayi</i>	1
Barramundi	<i>Lates calcarifer</i>	1
Carpentaria catfish	<i>Ariopsis paucus</i>	1
Freshwater sawfish*	<i>Pristis microdon</i>	0
Freshwater whipray*	<i>Himantura chaophrya</i>	0

*=landholder records but not recorded in survey

The site had low impact with good habitat condition. The riparian trees were mainly wattle, gutta percha and *Grevillia* with low recruitment. There was little or no shading of the water at this site as the trees were on the high bank and the water had receded into the channel way from the high banks. Canopy continuity was less than 50%. Some evidence of cattle disturbance was noted mainly and either the upstream or downstream ends as the main body of the site had steep banks. Water extraction occurs at this site but no information is available on amounts extracted. Gully erosion was noted with gullies up to 5m wide along the banks of the site.

N4 12 Mile, Forrest Creek

This is a permanent-water main-channel site with high turbidity (secchi depth of 0.15m). The site is on a small tributary of Spear Creek and flows for up to three weeks in average years. No further landholder information was available to us. The riparian trees are dominated by gutta percha and wattle with notable recruitment; canopy continuity was 50% (Figure A9 & A10). Noogoora burr was present in the riparian vegetation. No erosion was noted. Moderate pig and cattle activity found throughout the site. Overall the site was in good condition.

We conducted seven shots to record 13 species of fish. There was a high abundance of chequered rainbowfish and bony bream. No barramundi were recorded although the site could support this species. There are no landholder records for this site. There was a ringer camp present and many yabby traps and set lines were in evidence, indicating that some recreational species are present.

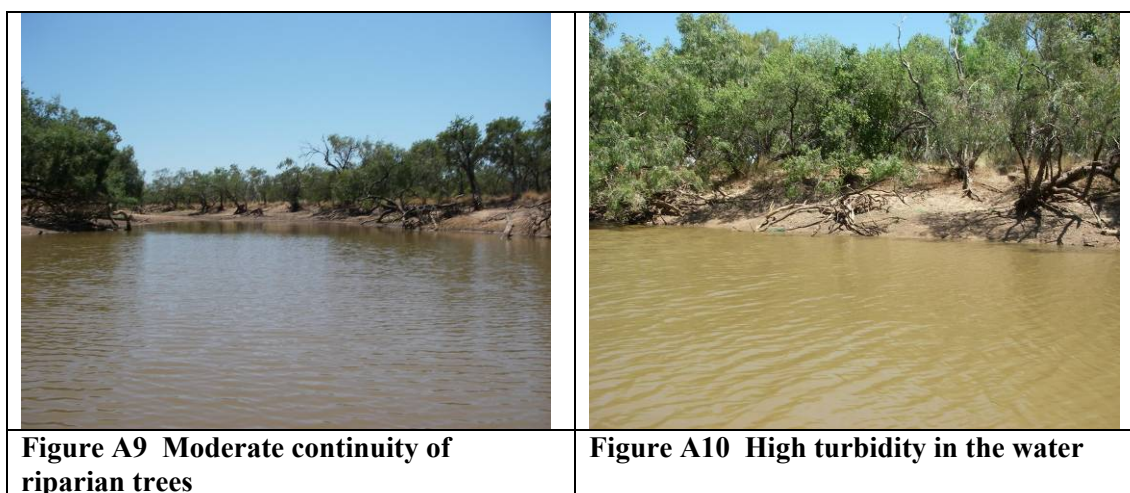


Figure A9 Moderate continuity of riparian trees

Figure A10 High turbidity in the water

Table A6. Fish Species Recorded at 12 Mile

Common name	Scientific name	Total caught
Chequered rainbowfish	<i>Melanotaenia splendida inornata</i>	138
Bony bream	<i>Nematalosa erebi</i>	64
Macleay's glassfish	<i>Ambassis macleayi</i>	38
Giant glassfish	<i>Parambassis gulliveri</i>	19
Spangled perch	<i>Leiopotherapon unicolor</i>	15
Sleepy cod	<i>Oxyeleotris lineolatus</i>	6
Giant gudgeon	<i>Oxyeleotris selheimi</i>	5
Rendahl's tandan	<i>Porochilus rendahli</i>	4
Gulf grunter	<i>Scortum ogilbyi</i>	3
Toothless catfish	<i>Anodontoglanis dahli</i>	2
Flathead goby	<i>Glossogobius giuris</i>	1
Seven-spot archer fish	<i>Toxotes chatareus</i>	1
Barred grunter	<i>Amniataba percoides</i>	1

N5 Iffley Homestead, Spear Creek

This is a large turbid black soil main-channel site on Spear Creek located at the Iffley homestead (secchi depth of 0.55m). The site flows every year and would flush one in seven years on average. This site is over 2km long and contains a wide range of habitats including rock bars, deep holes, submerged grass and macrophyte beds (Figures A11 & A12). The site flows on average for four to six weeks but the waters remain turbid year round. The average depth is two metres.

The site's large size allowed for 20 shots, resulting in a total of 18 species of fish. The landholder has recorded another two that we did not record (Table A7). At this site only a moderate abundance of papuan sprat were recorded however it is suspected that this is an underestimate as they were recorded in all open water shots and widely distributed along the length of the site. Only three barramundi were caught but the station cook tells of good catches of barramundi when the site is flowing.

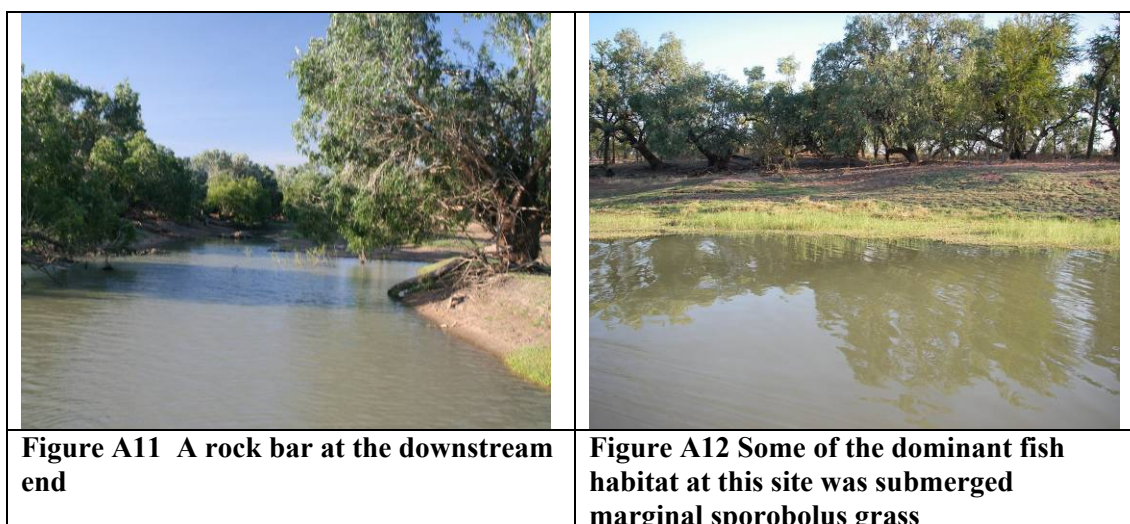


Figure A11 A rock bar at the downstream end

Figure A12 Some of the dominant fish habitat at this site was submerged marginal sporobolus grass

Table A7. Fish Species Recorded at Iffley Homestead

Common name	Scientific name	Total caught
Chequered rainbowfish	<i>Melanotaenia splendida inornata</i>	374
Bony bream	<i>Nematalosa erebi</i>	152
Spangled perch	<i>Leiopotherapon unicolor</i>	31
Papuan sprat	<i>Clupeoides cf papuensis</i>	23
Macleay's glassfish	<i>Ambassis macleayi</i>	18
Sleepy cod	<i>Oxyeleotris lineolatus</i>	18
Gulf grunter	<i>Scortum ogilbyi</i>	13
Freshwater anchovy	<i>Thryssa scratchleyi</i>	10
Mouth almighty	<i>Glossamia aprion</i>	6
Giant glassfish	<i>Parambassis gulliveri</i>	5
Barramundi	<i>Lates calcarifer</i>	3
Berney's catfish	<i>Ariopsis berneyi</i>	3
Carpentaria catfish	<i>Ariopsis paucus</i>	3
Rendahl's tandan	<i>Porochilus rendahli</i>	2
Seven-spot archer fish	<i>Toxotes chatareus</i>	2
Flathead goby	<i>Glossogobius giuris</i>	1
Toothless catfish	<i>Anodontoglanis dahli</i>	1
Lesser salmon catfish	<i>Ariopsis graeffei</i>	1
Freshwater sawfish*	<i>Pristis microdon</i>	0
Freshwater whipray*	<i>Himantura chaophrya</i>	0

*=landholder records but not recorded in survey

The riparian condition at this site was good. There was cattle and pig traffic along the length of the site but it was low to moderate and the impacts are restricted to the areas with higher traffic. Noogoora burr and a herbaceous weed were noted in the riparian areas as well as goats-head burr (*Tribolus* sp.) in along the high bank. The riparian trees were dominated by gutta percha, wattle, melaleuca with eucalyptus species scattered throughout.

New Glenore Station

N6 40 Mile Waterhole, Norman River

This is a very large main-channel site located on the Norman River. The site is well vegetated with wide range of habitats along its length (Figures A13 & A14). The water was moderately turbid (secchi depth 0.5m) and rarely clears. This site flows

every year and flushes one in five years. At the time of our survey, water was still flowing into the site at the upstream inlet channel (Figure A14). The instream habitats were dominated by overhanging vegetation, submerged grass in shallow margins and rock bars.

We conducted 20 shots at this site and recorded 19 species of fish (Table A8). The landholder reports another four species. Although the site is similar in size to the Iffley homestead site (N7), species abundances were low at this site. This may be due to it being deeper and we fished on the outer edge of overhanging vegetation which was in deeper water. Barramundi abundance at this site was high. The landholder said that sooty grunter have been caught here although we did not record them. This was historically a popular fishing spot for barramundi and catfish.

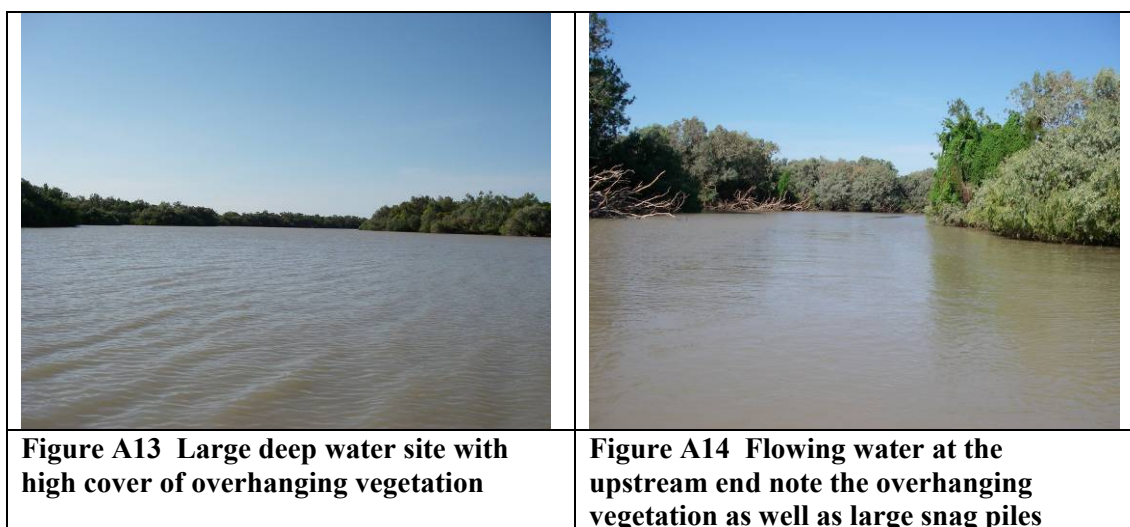


Table A8. Fish Species Recorded at the 40 Mile Waterhole

Common name	Scientific name	Total caught
Macleay's glassfish	<i>Ambassis macleayi</i>	32
Bony bream	<i>Nematalosa erebi</i>	20
Papuan sprat	<i>Clupeoides cf papuensis</i>	13
Barramundi	<i>Lates calcarifer</i>	13
Chequered rainbowfish	<i>Melanotaenia splendida inornata</i>	11
Mouth almighty	<i>Glossamia aprion</i>	8
Hyrtl's tandan	<i>Neosilurus hyrtlii</i>	8
Spangled perch	<i>Leiopotherapon unicolor</i>	7
Sleepy cod	<i>Oxyeleotris lineolatus</i>	7
Freshwater anchovy	<i>Thryssa scratchleyi</i>	7
Barred grunter	<i>Amniataba percoides</i>	4
Tarpon	<i>Megalops cyprinoides</i>	3
Rendahl's tandan	<i>Porochilus rendahli</i>	2
Seven-spot archer fish	<i>Toxotes chatareus</i>	2
Gulf grunter	<i>Scortum ogilbyi</i>	2
Giant glassfish	<i>Parambassis gulliveri</i>	1
Flathead goby	<i>Glossogobius giuris</i>	1
Lesser salmon catfish	<i>Ariopsis graeffei</i>	1
Undescribed	<i>Neosilurus</i> sp. nov	1
Freshwater sawfish*	<i>Pristis microdon</i>	0
River whaler*	<i>Carcharhinus leucas</i>	0
Freshwater whipray*	<i>Himantura chaophrya</i>	0
Sooty grunter*	<i>Hephaestus fuliginosus</i>	0

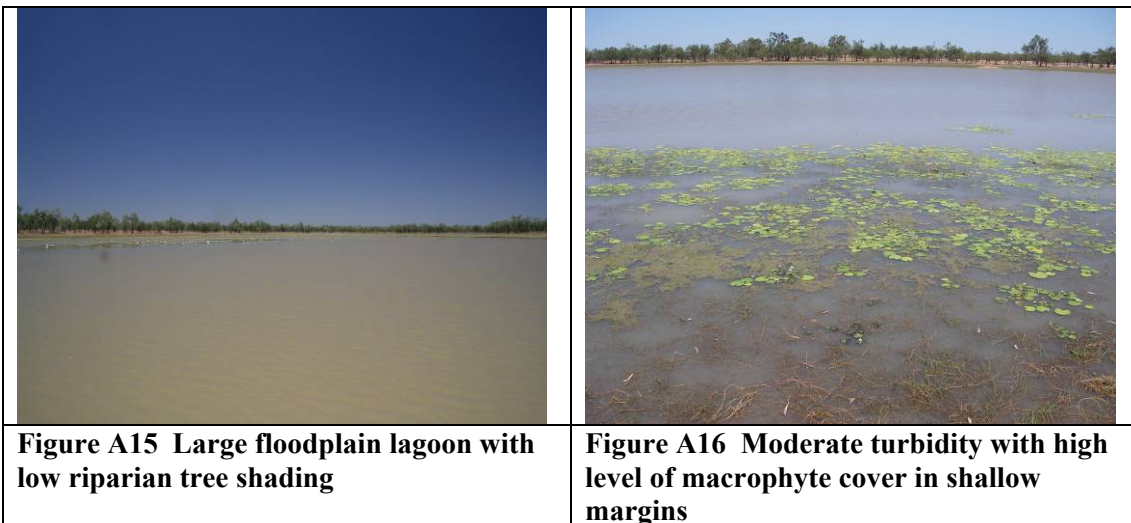
*=landholder records but not recorded in survey

The habitat condition at this site was good to very good. The riparian trees were dominated by broad and narrow leafed *Melaleuca*, gutta percha and iron bark. The trees were dense (90% contiguous canopy) with a high level of understorey recruitment. Light cattle activity was noted and but pig activity was noted in the downstream end of the site where there was a greater abundance of unwooded banks. There was prickly acacia noted in the riparian areas but not yet at a high infestation level, though this should be monitored. Overall the disturbance at this site was low.

N7 Big Mosquito Lagoon, Wynard Creek (Norman River)

This was a large shallow low-gradient off-channel floodplain lagoon (Figure A15). The water was moderately turbid (secchi depth of 0.65m) but may become clearer later in the dry season. The site is permanent most years but has been known to dry out in drought years. The site is a shallow depression in a black soil plain. There was moderate cover of lily with understorey macrophytes around the shallow margins of the site (Figure A16). The site would flow in most years but only for a short time. Flushing of this site would only occur in the largest floods.

A total of 14 species were recorded from 15 shots (Table A9). Landholder records include another two species - freshwater sawfish and whiprays. Abundances were low at this site but diversity was relatively high.



The habitat condition of this site was good with low cattle and pig activity and riparian recruitment of eucalypt trees. Due to the low gradient of the site, erosion is not present in any form that would impact the instream habitat conditions. The riparian vegetation has gutta percha and eucalypt trees but is mainly floodplain grassland which provides little shading of the water. Overall this site has a low disturbance rating.

Table A9. Fish Species Recorded at Big Mosquito Lagoon

Common name	Scientific name	Total caught
Chequered rainbowfish	<i>Melanotaenia splendida inornata</i>	65
Macleay's glassfish	<i>Ambassis macleayi</i>	39
Bony bream	<i>Nematalosa erebi</i>	37
Fly-specked hardyhead	<i>Craterocephalus stercusmuscarum</i>	27
Spangled perch	<i>Leiopotherapon unicolor</i>	9
Mouth almighty	<i>Glossamia aprion</i>	8
Sleepy cod	<i>Oxyeleotris lineolatus</i>	4
Tarpon	<i>Megalops cyprinoides</i>	2
Barred grunter	<i>Amniataba percoides</i>	2
Papuan sprat	<i>Clupeoides cf papuensis</i>	1
Seven-spot archer fish	<i>Toxotes chatareus</i>	1
Barramundi	<i>Lates calcarifer</i>	1
Hyrtl's tandan	<i>Neosilurus hyrtlii</i>	1
Berney's catfish	<i>Ariopsis berneyi</i>	1
Freshwater sawfish	<i>Pristis microdon</i>	0
Freshwater whipray	<i>Himantura chaophrya</i>	0

*=landholder records but not recorded in survey

Hayden Station

N8 The Sisters, Hayden Creek (Norman River)

The Sisters is a permanent bedrock substrate main-channel site on Hayden Ck. The site consists of three separate pools (Figures A17 & A18) however sampling only occurred in one pool due to limited boat access. Turbidity at the site was moderate (secchi depth of 0.40m) with no macrophyte beds noted. The site clears slightly after wet season flows but then becomes more turbid in the late dry season. The creek flows every year and flushes one in five years.

The site was small and only five shots were conducted but 12 species were recorded. A further two species were recorded from landholder records (Table A10). Abundances were dominated by chequered rainbowfish, bony bream and Macleay's glassfish. Although barramundi and sooty grunter have been caught here we did not record them. This site is a common fishing site for many locals of Normanton and after wet season flow can be quite productive for barramundi and sooty grunter.



Figure A17 Bedrock shelf separating pools



Figure A18 Moderate turbidity

Table A10. Fish Species Recorded at the Sisters

Common name	Scientific name	Total caught
Chequered rainbowfish	<i>Melanotaenia splendida inornata</i>	93
Bony bream	<i>Nematalosa erebi</i>	48
Macleay's glassfish	<i>Ambassis macleayi</i>	26
Spangled perch	<i>Leiopotherapon unicolor</i>	8
Flathead goby	<i>Glossogobius giuris</i>	7
Giant glassfish	<i>Parambassis gulliveri</i>	5
Longtom	<i>Strongylura krefftii</i>	3
Mouth almighty	<i>Glossamia aprion</i>	2
Rendahl's tandan	<i>Porochilus rendahli</i>	1
Giant gudgeon	<i>Oxyeleotris selheimi</i>	1
Sleepy cod	<i>Oxyeleotris lineolatus</i>	1
Barred grunter	<i>Amniataba percoides</i>	1
Barramundi*	<i>Lates calcarifer</i>	0
Sooty grunter*	<i>Hephaestus fuliginosus</i>	0

*=landholder records but not recorded in survey

The habitat condition at this site was moderate. Gully erosion covered about 10% of the bank. Cattle activity was very high especially at the two upstream pools where there is a cattle yard. The riparian trees were dominated by red gum, gutta percha and iron bark but provided little shade to the waterhole. There was little or no recruitment seen in the riparian area.

Shady Lagoon Station

N9 Shady Lagoon, lower Norman River

This was the first of the clear water sites we surveyed (secchi depth of 1.3m). This is an off-channel lagoon on the lower Norman River floodplain. The site flows most years but flushes only in the largest floods when overflow from the Norman River enters the lagoon. The water clears quickly after wet season flows and remains clear through the dry season. Due to low turbidity, there was very high cover of aquatic macrophytes and lilies (Figure A19 & A20). The substrate was dominated by mud and sand over bedrock. The average depth was 2m with a maximum of 4m.

We conducted 16 shots to record 16 species as well as records of a further four species from the traditional owners of the area (Table A11). This has been a popular fishing spot and until a year ago, camping was allowed for fishing parties. Barramundi, sooty grunter and catfish were the main targets.

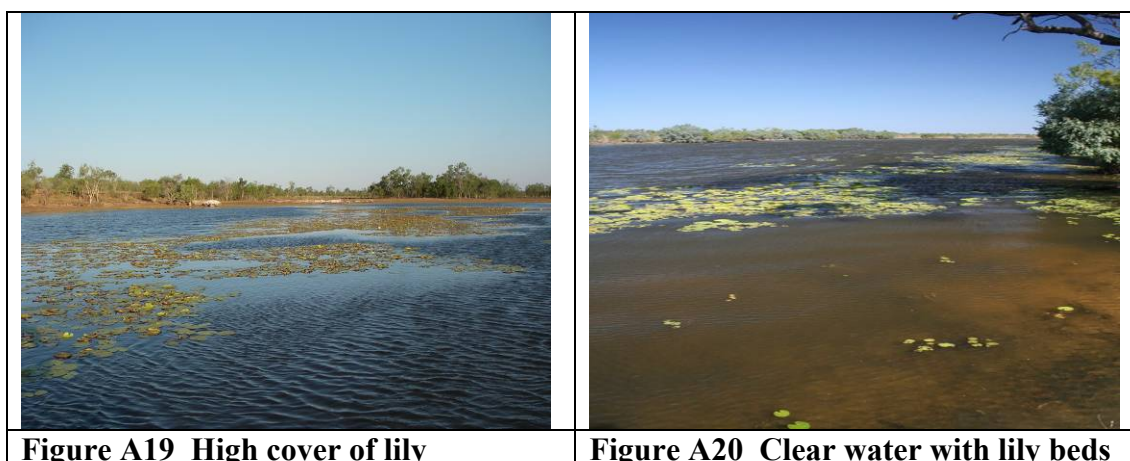


Figure A19 High cover of lily

Figure A20 Clear water with lily beds

Table A11. Fish Species Recorded at Shady Lagoon

Common name	Scientific name	Total caught
Bony bream	<i>Nematalosa erebi</i>	143
Fly-specked hardyhead	<i>Craterocephalus stercusmuscarum</i>	73
Spangled perch	<i>Leiopotherapon unicolor</i>	57
Chequered rainbowfish	<i>Melanotaenia splendida inornata</i>	25
Macleay's glassfish	<i>Ambassis macleayi</i>	18
Rendahl's tandan	<i>Porochilus rendahli</i>	8
Barred grunter	<i>Amniataba percoides</i>	6
Toothless catfish	<i>Anodontoglanis dahli</i>	4
Barramundi	<i>Lates calcarifer</i>	2
Giant gudgeon	<i>Oxyeleotris selheimi</i>	2
Mouth almighty	<i>Glossamia aprion</i>	2
Seven-spot archer fish	<i>Toxotes chatareus</i>	1
Hyrtil's tandan	<i>Neosilurus hyrtlii</i>	1
Carpentaria catfish	<i>Ariopsis paucus</i>	1
Longtom	<i>Strongylura krefftii</i>	1
Lesser salmon catfish	<i>Ariopsis graeffei</i>	1
Freshwater sawfish*	<i>Pristis microdon</i>	0
River whaler*	<i>Carcharhinus leucas</i>	0
Freshwater whipray*	<i>Himantura chaophraya</i>	0
Sooty grunter*	<i>Hephaestus fuliginosus</i>	0

*=landholder records but not recorded in survey

This site was in good condition. There was a campground and light cattle use but overall the impacts at this site were low. Riparian vegetation was only impacted in the old campgrounds. Riparian trees were predominantly melaleuca with high level of recruitment. There was moderate gully erosion at an old homestead site with gullies up to 2m wide.

Delta Downs, Walkers Creek

N10 Weir on Karumba-Normanton Rd. Walkers Creek

This is a weir site on the main-channel of Walkers Creek. The water is clear at this site (secchi depth of 1.0m) and landholders report that Walkers Creek is clear along its whole length (Figures A21 & A22). This site is a bedrock pool with elevated water level due to the weir. The site flows every year from river flow and flushes only in

larger floods due to the effects of the weir. The average depth is 1m with a maximum of 3m.

The site was small and only six shots were conducted recording a total of 13 species (Table A12). The landholders report a further four species from this site that we did not record. No barramundi were caught but during wet season flows this is a popular fishing site for this species, especially at the bottom of the weir. Sooty grunter are also reported from this site but not caught in survey. Queensland museum records show a sooty grunter from Walkers Creek as well.

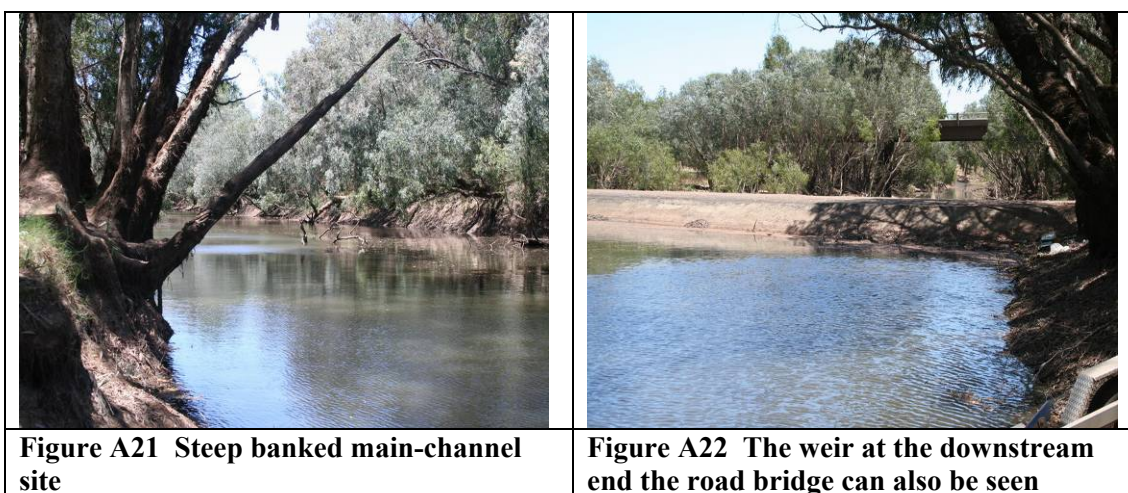


Figure A21 Steep banked main-channel site

Figure A22 The weir at the downstream end the road bridge can also be seen

Table A12. Fish Species Recorded at Walker Creek Weir

Common name	Scientific name	Total caught
Chequered rainbowfish	<i>Melanotaenia splendida inornata</i>	348
Spangled perch	<i>Leiopotherapon unicolor</i>	53
Rendahl's tandan	<i>Porochilus rendahli</i>	52
Bony bream	<i>Nematalosa erebi</i>	17
Macleay's glassfish	<i>Ambassis macleayi</i>	3
Undescribed	<i>Neosilurus</i> sp.**	2
Sleepy cod	<i>Oxyeleotris lineolatus</i>	1
Mouth almighty	<i>Glossamia aprion</i>	1
Flathead goby	<i>Glossogobius giuris</i>	1
Seven-spot archer fish	<i>Toxotes chatareus</i>	1
Barred grunter	<i>Amniataba percoides</i>	1
Hyrtil's tandan	<i>Neosilurus hyrtlii</i>	1
Tarpon	<i>Megalops cyprinoides</i>	1
Sooty grunter**^	<i>Hephaestus fuliginosus</i>	0
Freshwater sawfish*	<i>Pristis microdon</i>	0
Freshwater whipray*	<i>Himantura chaophrya</i>	0
Barramundi*	<i>Lates calcarifer</i>	0

*=landholder records but not recorded in survey, ^=Queensland museum records

This site is not used by cattle however its proximity to the main road and high use as a recreational fish spot has impacted on the site. There was rubbish along the whole north bank where fishing occurs and the understorey vegetation was all but absent. The weir would also be somewhat of a barrier as no fish passage was incorporated and at receding flows passage would be absent. The riparian trees, mainly melaleuca were in good condition with high shading and recruitment. The overall disturbance rating at this site was moderate.

Tabletop Station

N11 Cremeries Waterhole, Carron River

This is a permanent tannin-stained site on the main channel of the Carron River in the upstream section of the catchment. The site was located in a bedrock area preventing water from flowing into the river bed (Figures A23 & A24). The water was heavily tannin stained and the secchi depth was 0.80m. Overall this was a shallow site with one deep section in a bedrock restriction in the middle of what waterhole. The site flows every year with flows lasting for up to four weeks but flushes one in seven years.

The site was small and only seven shots were conducted recording a total of nine species (Table A12). This site is well upstream of the range of barramundi, freshwater sawfish, whiprays and river whalers. However the landholder reported that in certain years, especially years of large flooding, sooty grunter are a common catch. The Queensland Museum records (Table 4 in the main text) show three more species that we did not record being found in the Carron River but not at this site.

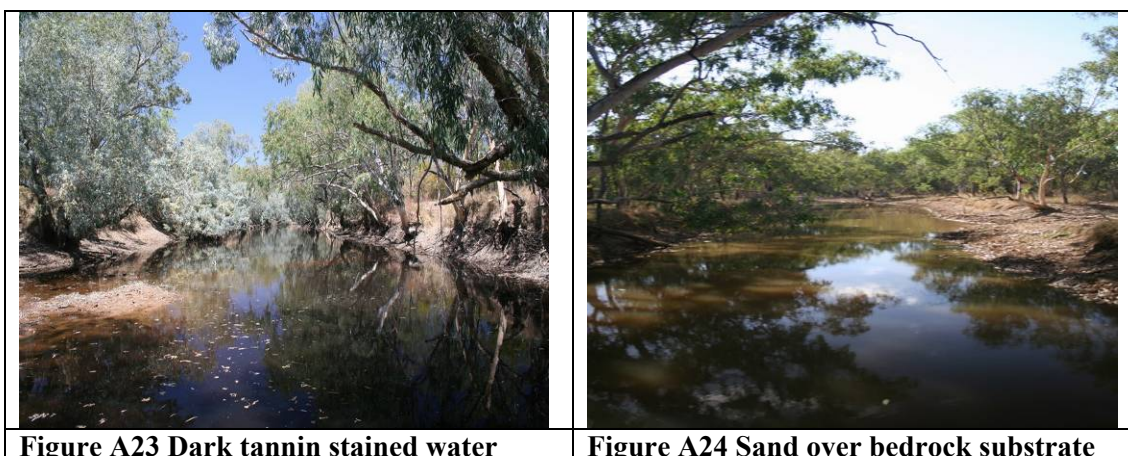


Figure A23 Dark tannin stained water

Figure A24 Sand over bedrock substrate

Table A13. Fish Species Recorded at Cremeries Waterhole

Common name	Scientific name	Total caught
Spangled perch	<i>Leiopotherapon unicolor</i>	104
Chequered rainbowfish	<i>Melanotaenia splendida inornata</i>	50
Bony bream	<i>Nematalosa erebi</i>	42
Giant gudgeon	<i>Oxyeleotris selheimi</i>	7
Gulf grunter	<i>Scortum ogilbyi</i>	2
Hyrtil's tandan	<i>Neosilurus hyrtlilii</i>	2
Toothless catfish	<i>Anodontoglanis dahli</i>	1
Barred grunter	<i>Amniataba percoides</i>	1
Carpentaria catfish	<i>Ariopsis paucus</i>	1
Sooty grunter	<i>Hephaestus fuliginosus</i>	0

*=landholder records but not recorded in survey

This site had only moderate cattle traffic with no erosion noted. The riparian trees were melaleuca with low recruitment. The trees provided good shade as well as overhanging habitat. Snag piles were also present. Overall the disturbance at this site was low.

N12 Wallabadah Waterhole, Carron River

This site was a turbid (secchi depth 0.35m) off-channel lagoon in the Carron River. It is a shallow floodplain depression waterhole with bedrock substrate. The average depth was one metre with a maximum of two metres. There was low macrophyte cover and the dominant macrophytes were lily and naidoo. The site flows from a small catchment most years and flushes in only the larger floods. Flows only persist for one to two weeks in average years. The water clears briefly after wet season flows but becomes turbid and remains turbid for the remainder of the year.

We conducted 10 shots to record 12 species of fish (Table A14). Records from the Queensland Museum (Table 4 in the main text) record the silver tandan (*Porochilus argenteus*) from this site. This species is only known from the central Australia and Lake Eyre drainages such as Cooper Creek (Allen *et al.* 2002). Thus, we consider this to be highly unlikely, though it would be a significant new range extension if it was true. Fish catches from the site as reported by the landholder are dominated by gulf grunter and fork-tailed catfish.

Table A14. Fish Species Recorded at Wallabadah Waterhole

Common name	Scientific name	Total caught
Bony bream	<i>Nematalosa erebi</i>	238
Chequered rainbowfish	<i>Melanotaenia splendida inornata</i>	108
Macleay's glassfish	<i>Ambassis macleayi</i>	44
Spangled perch	<i>Leiopotherapon unicolor</i>	12
Fly-specked hardyhead	<i>Craterocephalus stercusmuscarum</i>	7
Flathead goby	<i>Glossogobius giuris</i>	5
Giant gudgeon	<i>Oxyeleotris selheimi</i>	4
Mouth almighty	<i>Glossamia aprion</i>	4
Gulf grunter	<i>Scortum ogilbyi</i>	3
Carpentaria catfish	<i>Ariopsis paucus</i>	2
Toothless catfish	<i>Anodontoglanis dahli</i>	2
Seven-spot archer fish	<i>Toxotes chatareus</i>	1
Silver tandan*	<i>Porochilus argenteus</i>	

*=Queensland Museum records (this is questionable as the species is a central Australian drainage species).

The site is a major watering point for cattle and the traffic has impacted riparian tree recruitment. The dominant trees were red gum and melaleuca. The site is also a disused outstation.

APPENDIX 2

List of Specimens Recorded from the Norman River Catchment Held by the Queensland Museum

Family	Species	Location Collected	Lat	Long	Date Collected
Soleidae	<i>Brachirus selheimi</i>	Cardon River near Croydon (presumably Carron River)	17.49	141.44	25/08/1954
Synbranchidae	<i>Ophisternon bengalense</i>	Carl Creek, Normanton	17.40	141.04	-0-
Gobiidae	<i>Chlamydogobius ranunculus</i>	Carron R, Oakland Park Xing, Norman R system	17.59	142.09	2/09/1998
Plotosidae	<i>Neosilurus hyrtlilii</i>	Carron R, Oakland Park Xing, Norman R system	17.59	142.09	2/09/1998
Gobiidae	<i>Glossogobius aureus</i>	Carron River, E of Blackbull	17.55	142.02	31/08/1999
Plotosidae	<i>Porochilus rendahli</i>	Carron River, E of Blackbull	17.55	142.02	31/08/1999
Ambassidae	<i>Ambassis agrammus</i>	Carron River, trib Norman River, Mayvale Stn	17.48	141.42	31/08/1999
Ariidae	<i>Arius graeffei</i>	Carron River, trib Norman River, Mayvale Stn	17.48	141.42	31/08/1999
Apogonidae	<i>Glossamia aprion</i>	Carron River, trib Norman River, Mayvale Stn	17.48	141.42	31/08/1999
Gobiidae	<i>Glossogobius</i> sp.	Carron River, trib Norman River, Mayvale Stn	17.48	141.42	31/08/1999
Eleotrididae	<i>Oxyeleotris lineolatus</i>	Carron River, trib Norman River, Mayvale Stn	17.48	141.42	31/08/1999
Eleotrididae	<i>Oxyeleotris selheimi</i> (x2)	Carron River, trib Norman River, Mayvale Stn	17.48	141.42	31/08/1999
Terapontidae	<i>Scortum ogilbyi</i>	Carron River, trib Norman River, Mayvale Stn	17.48	141.42	31/08/1999
Ambassidae	<i>Ambassis macleayi</i>	Carron River, Wallabadah Stn, Norman R system	17.58	142.19	1/09/1998
Atherinidae	<i>Craterocephalus stercusmuscarum</i>	Carron River, Wallabadah Stn, Norman R system	17.58	142.19	1/09/1998
Eleotrididae	<i>Oxyeleotris selheimi</i>	Carron River, Wallabadah Stn, Norman R system	17.58	142.19	1/09/1998
Plotosidae	<i>Porochilus argenteus</i> *	Carron River, Wallabadah Stn, Norman R system	17.58	142.19	1/09/1998
Ambassidae	<i>Ambassis agrammus</i>	Carron River, trib Norman R, Edmonsons Waterhole	18.05	142.23	30/08/1999
Ambassidae	<i>Ambassis elongatus</i>	Carron River, trib Norman R, Edmonsons Waterhole	18.05	142.23	1/09/1998
Terapontidae	<i>Amniataba percoides</i>	Carron River, trib Norman R, Edmonsons Waterhole	18.05	142.23	30/08/1999
Gobiidae	<i>Glossogobius</i> sp.	Carron River, trib Norman R, Edmonsons Waterhole	18.05	142.23	1/09/1998
Plotosidae	<i>Neosilurus hyrtlilii</i>	Carron River, trib Norman R, Edmonsons Waterhole	18.05	142.23	1/09/1998
Plotosidae	<i>Neosilurus hyrtlilii</i>	Carron River, trib Norman R, Edmonsons Waterhole	18.05	142.23	30/08/1999
Eleotrididae	<i>Oxyeleotris selheimi</i>	Carron River, trib Norman R, Edmonsons Waterhole	18.05	142.23	5/05/1998
Plotosidae	<i>Porochilus rendahli</i>	Carron River, trib Norman R, Edmonsons Waterhole	18.05	142.23	5/05/1998
Plotosidae	<i>Porochilus rendahli</i>	Carron River, trib Norman R, Edmonsons Waterhole	18.05	142.23	30/08/1999
Ambassidae	<i>Ambassis elongatus</i>	Glenore, Norman River	17.51	141.08	-0-
Mugilidae	<i>Liza alata</i> (x2)	Glenore, Norman River	17.51	141.08	24/09/1953
Mugilidae	<i>Liza</i> sp.	Glenore, Norman River	17.51	141.08	-0-
Gobiidae	<i>Glossogobius aureus</i>	Norman Ck, via Normanton	17.40	141.04	-0-
Melanotaeniidae	<i>Melanotaenia</i> sp.	Norman Ck, via Normanton	17.40	141.04	28050
Ambassidae	<i>Ambassis macleayi</i>	Norman River	17.29	140.50	-0-
Cyprinidae	<i>Carassius auratus</i> **	Norman River	17.29	140.50	-0-
Apogonidae	<i>Glossamia aprion</i>	Norman River	17.29	140.50	-0-
Terapontidae	<i>Leiopotherapon unicolor</i>	Norman River	17.29	140.50	-0-
Clupeidae	<i>Nematalosa erebi</i>	Norman River	17.29	140.50	-0-
Teraponidae	<i>Scortum ogilbyi</i> (x2)	Norman River	17.29	140.50	-0-
Eleotrididae	<i>Oxyeleotris lineolatus</i>	Norman River, Glenore Storage, 25 km SE Normanton	17.53	141.07	1/08/1985
Ambassidae	<i>Ambassis elongatus</i>	Walkers Ck, Norman R, Karumba -	17.29	141.10	3/08/1991

		Normanton Rd ford			
Apogonidae	<i>Glossamia aprion</i>	Walkers Ck, Norman R, Karumba - Normanton Rd ford	17.29	141.10	3/08/1991
Terapontidae	<i>Leiopotherapon unicolor</i>	Walkers Ck, Norman R, Karumba - Normanton Rd ford	17.29	141.10	3/08/1991
Mugilidae	<i>Liza alata</i>	Walkers Ck, Norman R, Karumba - Normanton Rd ford	17.29	141.10	3/08/1991
Mugilidae	<i>Liza subviridis</i>	Walkers Ck, Norman R, Karumba - Normanton Rd ford	17.29	141.10	3/08/1991
Melanotaeniidae	<i>Melanotaenia splendida inornata</i>	Walkers Ck, Norman R, Karumba - Normanton Rd ford	17.29	141.10	3/08/1991
Eleotrididae	<i>Oxyeleotris lineolatus</i>	Walkers Ck, Norman R, Karumba - Normanton Rd ford	17.29	141.10	3/08/1991
Eleotrididae	<i>Oxyeleotris selheimi</i>	Walkers Ck, Norman R, Karumba - Normanton Rd ford	17.29	141.10	3/08/1991
Terapontidae	<i>Scortum ogilbyi</i>	Walkers Ck, Norman R, Karumba - Normanton Rd ford	17.29	141.10	3/08/1991
Plotosidae	<i>Anodontiglanis dahlia</i>	Walkers Ck, trib Norman River	17.30	141.05	31/07/1991
Ariidae	<i>Arius leptaspis</i>	Walkers Ck, trib Norman River	17.30	141.05	31/07/1991
Clupeidae	<i>Nematalosa erebi</i>	Walkers Ck, trib Norman River	17.30	141.05	31/07/1991
Belonidae	<i>Strongylura krefftii</i> (x2)	Walkers Ck, trib Norman River	17.30	141.05	31/07/1991
Ambassidae	<i>Ambassis macleayi</i> (x2)	Walkers Creek, Norman River	17.29	141.10	-0-
Terapontidae	<i>Amniataba percooides</i> (x2)	Walkers Creek, Norman River	17.29	141.10	-0-
Atherinidae	<i>Craterocephalus</i> sp.	Walkers Creek, Norman River	17.29	141.10	24/09/1953
Apogonidae	<i>Glossamia aprion</i>	Walkers Creek, Norman River	17.29	141.10	-0-
Terapontidae	<i>Hephaestus fuliginosus</i>	Walkers Creek, Norman River	17.29	141.10	-0-
Melanotaeniidae	<i>Melanotaenia splendida inornata</i> (x2)	Walkers Creek, Norman River	17.29	141.10	-0-
Plotosidae	<i>Neosilurus hyrtlui</i>	Walkers Creek, Norman River	17.29	141.10	24/09/1953
Plotosidae	<i>Neosilurus</i> sp.	Walkers Creek, Norman River	17.29	141.10	-0-
Ambassidae	<i>Parambassis gulliveri</i> (x2)	Walkers Creek, Norman River	17.29	141.10	-0-
Terapontidae	<i>Scortum ogilbyi</i> (x2)	Walkers Creek, Norman River	17.29	141.10	24/09/1953

* doubtful record, probably a misidentification

** alien species (goldfish) which has not established a population