PRELIMINARY SURVEY OF FRESHWATER SAWFISH AND OTHER FISHES OF THE McARTHUR RIVER, NORTHERN TERRITORY

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1.0 INTRODUCTION

As part of the proposed expansion of the McArthur River Mine (MRM), Northern Territory, approximately five kilometres of the main channel of the McArthur River and sections of specific tributaries, i.e. Barney and Surprise creeks, will require permanent realignment to allow access to ore under the river bed. During preparatory works on the Environmental Impact Statement (EIS) for the proposal, a review of existing ichthyological survey data of the McArthur River and opportunistic aquatic fauna sampling was undertaken to compile a fish species list (Midgley 1975, 1982, 1994, Hollingsworth *et al*. 1992, Hanley 1993). This review suggested that the freshwater sawfish *Pristis microdon* had historically been captured from middle and upper reaches of the McArthur River, and more recently (2002) from the lower McArthur River (Thorburn *et al.* 2003).

Of the four *Pristis* species recorded in Australian waters, *P. microdon* is the most commonly encountered in freshwaters (Last and Stevens 1994). It is known to occur throughout the Indo-West Pacific including New Guinea, South-east Asia, India and eastern Africa and within northern Australian rivers it has been recorded some 400 km inland (Morgan *et al*. 2004). Current investigations of *P. microdon* in the Fitzroy River, Western Australia, suggest that juveniles (up to 2.8 m in length) utilise rivers as nurseries for a period of four or five years before migrating into marine waters where they attain maturity (Thorburn *et al.* 2004, submitted). *Pristis microdon* can attain lengths of up to seven metres and is distinguished from other congeners by the combination of the following characteristics: first dorsal fin anterior to the pelvic fins; caudal fin bearing a conspicuous ventral lobe; 18-23 teeth on the rostrum (Last and Stevens 1994, Compagno and Last 1998).

Pristis microdon in Australia is listed as *Vulnerable* under the *Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act 1999*, and internationally as *Endangered* on the IUCN Red List (2006) (Thorburn and Morgan 2005). In light of the paucity of data on this species occurrence in the McArthur River, and that of all other fishes, this preliminary survey aimed to:

- Obtain data on the distribution of *P. microdon* and other fishes within the McArthur River

- Determine if *P. microdon* occurs in the middle and upper reaches of the river, upstream of the proposed diversion area

- Document any broad-scale habitat associations of *P. microdon*

- Identify possible dry season refugia of *P. microdon* and inspect the proposed diversion area in order to identify the significance of the habitat to the species

2.0 METHODS

2.1 Survey Team and Technical Support

The preliminary survey was conducted, and reported, by Dean Thorburn (RPS Bowman Bishaw Gorham) and Dr David Morgan (Centre for Fish and Fisheries Research, Murdoch University). Additional field assistance was provided by Martin Buck (RPS Bowman Bishaw Gorham).

2.2 Site Selection and Timing

A total of 16 sites were sampled for fishes over eight days in May 2006 (Table 1, Figure 1). This period coincided with the end of the monsoonal wet season, however, seasonal rains in the weeks prior to the study led to water levels and flow rates being higher than average for that period and impeded access to parts of the river. Sampling sites were therefore selected on the basis of accessibility and flow rate, but included sites above and below the proposed diversion area, tidal and non-tidally affected waters and permanent waters holes.

2.3 Environmental Variables and Habitat

Salinity (ppt), water temperature (^{o}C), water clarity using a secchi disc (cm), depth (m), estimated flow rate (ms^{-1}) and tidal influence were recorded at each sampling site (Table 2). In addition the immediate habitat was described, including predominant sediment type, density of aquatic vegetation types and detritus, riparian vegetation and snag density.

2.4 Sample Collection and Measurements

Sampling equipment included sinking monofilament gill nets (40 m panel of 75 mm stretched mesh and 20 m panels of 100, 150 and 200 mm stretched mesh) that were generally set in slower flowing waters perpendicular to the river bank (Appendix 1). Gill nets were set during day and night, and checked regularly to ensure that capture, handling and release times were minimised. Gill nets were set for a combined total of

~270 h during the current study. Additional samples were collected with the use of a 26 m seine net, throw net, baited lines and a Smith-Root backpack electrofisher operated from the boat. Visual observations of fishes were also recorded.

Anecdotal accounts of the occurrence of sawfish in freshwaters of the McArthur River and tributaries were collected from people residing in the township of Borroloola.

A number of fishes were retained for identification purposes (e.g. Ambassidae, Eleotridae, Plotosidae) and were preserved whole in 100% ethanol or frozen. All fishes were identified to species with the use of either the 'FAO Species Identification Guide for Fishery Purposes' (ref), Allen *et al.* (2002), Pusey *et al*. (2004), Vari (1978), Allen and Burgess (1990). These specimens will ultimately be lodged in fish collections of the Museum and Art Galleries of the Northern Territory.

The total length (TL) (mm) of the majority of fish captured was recorded prior to release. For *P. microdon*, the sex, clasper length and stage of calcification in males, rostrum length (RL) (mm) (measured from the tip to where the head begins to broaden), and number of teeth on each side of the rostrum were also recorded.

Species distribution data collected during sampling in the lower McArthur River during 2002 by the senior author (Thorburn *et al.* 2003, unpublished data) has been included in Table 3 and Figure 1.

3.0 RESULTS

3.1 Species Diversity and Distribution

A total of 949 fishes from 29 species were captured during the current study (Tables 3 and 4, Figure 2). An additional nine species were captured with the use of gill nets from the lower McArthur River during sampling in 2002 by Thorburn *et al.* (2003, unpublished data) and a further five species (*Arius berneyi*, *Arius leptaspis*, *Craterocephalus stercusmuscarum*, *Mogurnda mogurnda* and *Brachirus selheimi*) have previously been recorded from freshwaters of the McArthur River (URS 2005). *Melanotaenia splendida inornata* was the most abundant species captured, followed by *Ambassis muelleri*, *Arius graeffei* and *Toxotes chatareus*. An undescribed species of eleotrid (gudgeon) (*Oxyeleotris* sp.) was also recorded from site 1 (see Allen *et al*. 2002).

3.2 Freshwater Sawfish *Pristis microdon*

A single male *P. microdon* (998 mm TL) was collected from the uppermost sampling site in 8 Mile Waterhole (Site 15; Figures 1 and 3). The rostrum length was 248 mm and possessed 21 right and 22 left rostral teeth. The claspers were small (30 mm) and uncalcified, indicating that this individual was immature.

The site of capture was in the main channel adjacent to the mouth of a small feeder creek. Flow rates at the site were negligible and depth was approximately five metres. Substrates at this site were dominated by sand and silt. Although moderate levels of detritus were present, only low levels of root mats and large woody debris existed. Water conductivity at this locality was ~535 µs/cm (0.35 ppt) and water temperature was ~23 ^{o}C.

Sampling in the McArthur River during 2002 also resulted in the capture of a single 1745 mm TL female *P. microdon* from the nine sites sampled. The conductivity at that lower sample site was much higher than the site of capture during the current study, being ~19930 µs/cm (13.1 ppt).

Several anecdotal accounts of the occurrence (and capture) of sawfish in freshwaters were recorded during the current study, including recent captures at Ryans Bend Waterhole (Batten Creek) and directly below the Burketown Crossing, Borroloola (see Figure 1). Anecdotal accounts of past captures included 8 Mile Waterhole, and from as far inland as Top Crossing and waters accessible from Balbarrini Station.

4.0 DISCUSSION

4.1 Distributions and Range Extensions

The results of this study provided new information on the fishes present (and their distributions) in the fresh and tidally influenced waters of the McArthur River. In light of the few ichthyological surveys that have been conducted in rivers of northern Australia, this data is not only important in the context of the proposed channel realignment, but additionally in a regional context.

Sampling of freshwaters during the current study, estuarine waters by Thorburn *et al.* (2003, unpublished data) and by previous authors (Midgley 1975, 1982, 1994, Hanley 19943, Hollingsworth Dames and Moore 1992) indicate that at least 43 species of fish occur in fresh and upper estuarine waters the McArthur River. Of these, at least 24 species are able to live and breed in upper freshwaters and would be considered obligate freshwater species. A further seven species, including *P. microdon*, are also expected to occur in upper freshwater reaches but are more accurately described as marine/estuarine species, freshwater opportunists or those that fulfil some part of their life-cycle within the freshwater environment. Thus, a total of 31 species will, or are expected to, traverse the section of the river proposed for realignment.

Sampling during the current study resulted in the collection of new distributional records for the Fly River Garfish *Zenarchopterus novaeguineae* (previously only known from the Wenlock and Mitchell Rivers, Queensland) being collected (Allen *et al.* 2002). Furthermore, an undescribed gudgeon (*Oxyeleotris* sp.) was collected from freshwaters below the Burketown Crossing, Borroloola.

4.2 Ecology of *P. microdon* in the McArthur River and Significance of Upstream Habitats

Despite the wide distribution of *P. microdon* throughout northern Australia, the species is generally only encountered in low abundance within each system (Thorburn *et al.* 2003). Unlike bony fishes which may produce large numbers of eggs and develop rapidly, elasmobranchs are generally slow to grow and mature, and only produce low numbers of well-developed offspring. Historically, abundances of sawfish in waters of the Gulf of Carpentaria have been declining (Peverell 2005), and it is feasible to attribute

at least some of this decline to commercial fishing practices and in particular gill netting (Simpendorfer 2000). While commercial fishing within Gulf rivers has now ceased, near-shore activities have not. Assuming that adult *P. microdon* reside in marine waters, give birth in inshore/estuarine waters near to a rivers mouth with the juveniles utilising the freshwaters of rivers as a nursery for up to five years (Thorburn *et al*. 2004, submitted); rivers of the Gulf of Carpentaria represent important refuge habitat for the species in that region.

Results of ichthyological surveys of northern Australian rivers suggest that those which contain permanent deeper waters, attributable to a large catchment area or spring/groundwater feeding etc., and which have fewer instream barriers and maintain a some level of interconnectedness between dry season pools for much of the year, may contain higher numbers of sawfishes than those systems that have limited permanent waters or disjunct pools (Thorburn *et al*. 2004, submitted). While still representing important habitat for *P. microdon*, in a regional perspective and from survey results, the upper reaches of the McArthur River may be described as marginal habitat of *P. microdon* in comparison to other Gulf rivers including, for example, the Roper River.

Length versus age data for *P. microdon* by Thorburn *et al*. (2004, submitted) suggests that the 998 mm TL *P. microdon* captured during the current study is in its first year of life. The upstream distance of the site of capture (8 Mile Waterhole) supports the theory that juveniles migrate (as far as possible) upstream during the beginning of the wet season. This capture also highlights the importance of upstream refuge pools such as 8 Mile Waterhole and the obvious migration through the section of the McArthur River to be realigned.

Observation and captures of *P. microdon* throughout northern Australia by the authors suggest that the species will generally remain in larger waterholes that offer permanent deep waters (over five metres), such as 8 Mile Waterhole. In contrast, although a permanent waterhole exists close to the proposed development area, Jirinmini Waterhole, its shallow depth and limited size suggests that it is unlikely to represent an important refuge for *P. microdon* throughout the dry season. This fact, however, does not negate the importance of Jirinmini Waterhole as a resting pool for migrating *P. microdon*, nor as a dry season refuge for smaller teleost (prey) fishes. At the time of the survey rock bars were exposed at both ends of the Jirinmini Waterhole and athough these would have been navigatible by smaller fishes, we consider that *P. microdon* would only be able to progress upstream of this point during the wet. However, the significance of this pool in terms of offering dry season refuge needs to be confirmed by subsequent sampling during the dry season and throughout the realignment program.

A visual habitat assessment of the section of the McArthur River proposed for realignment indicated some degree of homogeneity in the channel, with consistently shallow depth (and high flow rate), absence of deeper and wider sections and lack of bank undercutting. These characters, in conjunction with a lack of permanent water within this section, suggests that it is unlikely to represent significant refuge (or resting) habitat for *P. microdon* in the McArthur River, but is important in providing a transitory route to upstream waters.

4.3 Conclusions and Future Works

The captured of *P. microdon* from 8 Mile Waterhole indicates the passage of individuals through the section of river designated for realignment. As few large permanent waters exist on the McArthur River, waterholes such as 8 Mile, and to a lesser extent Jirinmini, will represent important refuge habitat for fishes during the dry season. Subsequent dry season sampling will therefore confirm the significance of these pools and that of any waters remaining. Surveying of significant feeders, including the Glyde River and Batten Creek, and estuarine waters will provide further insight into the abundance and distribution of *P. microdon* in the McArthur River system.

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TABLES

Table 1
Sites sampled for fishes on the McArthur River during May 2006

Site #	Location	Latitude	Longitude
1	Below Burketown Crossing	16.077	136.313
2	Below Burketown Crossing	16.081	136.314
3	Above Burketown Crossing	16.108	136.342
4	Near Scrubby Creek	16.109	136.340
5	Okey Creek Mouth	16.133	136.316
6	Above Okey Creek	16.136	136.313
7	Jirinmini Pool	16.456	136.082
8	Above Merlin Crossing	16.503	136.044
9	Above Merlin Crossing	16.505	136.043
10	8 Mile	16.516	136.033
11	8 Mile	16.508	136.040
12	8 Mile	16.512	136.036
13	8 Mile	16.519	136.030
14	8 Mile	16.532	136.022
15	8 Mile	16.544	136.019
16	Bessie Springs????	16.667	135.850

Table 2
Physico-chemical properties of sites sampled for fishes on the McArthur River during May 2006

Site #	Secchi (cm)	Temp. (^{o}C)	Cond. (µs/cm)	DO (ppm)	pH	Depth (m)	Velocity (ms^{-1})	Tidal
1	628 ± 2	24.6 ± 0.0	355.3 ± 0.4	7.95 ± 0.01	7.45 ± 0.00	3.0	0.4	out
2	682 ± 5	24.6 ± 0.0	355.3 ± 0.4	7.95 ± 0.01	7.45 ± 0.00	3.0	0.4	out
3	74 ± 1	25.6 ± 1.2	423.3 ± 2.3	8.18 ± 0.11	7.66 ± 0.00	2.0	0	non
4	74 ± 1	25.6 ± 1.2	423.3 ± 2.3	8.18 ± 0.11	7.66 ± 0.00	7.0	0	non
5	72 ± 1	24.5 ± 0.0	434.3 ± 0.4	7.63 ± 0.01	7.53 ± 0.00	3.5	0.1	non
6	72 ± 1	24.5 ± 0.0	434.3 ± 0.4	7.63 ± 0.01	7.53 ± 0.00	3.0	0.2	non
7	95 ± 1	24.2 ± 0.2	608.3 ± 1.1	7.65 ± 0.01	8.06 ± 0.00	2.5	0.2	non
8	89 ± 1	23.7 ± 0.2	533.3 ± 1.1	7.96 ± 0.18	8.05 ± 0.02	5.0	0.1	non
9	89 ± 1	23.7 ± 0.2	533.3 ± 1.1	7.96 ± 0.18	8.05 ± 0.02	4.0	0.5	non
10	125 ± 3	23.3 ± 0.0	544.3 ± 0.4	7.94 ± 0.03	8.12 ± 0.00	6.0	0	non
11	125 ± 3	23.3 ± 0.0	544.3 ± 0.4	7.94 ± 0.03	8.12 ± 0.00	3.3	0.1	non
12	100 ± 2	23.7 ± 0.2	534.3 ± 0.4	8.31 ± 0.02	8.13 ± 0.00	2.2	0.75	non
13	107 ± 3	23.4 ± 0.2	534.7 ± 2.3	8.21 ± 0.05	8.17 ± 0.00	3.0	0	non
14	82 ± 1	23.4 ± 0.2	534.7 ± 2.3	8.21 ± 0.05	8.17 ± 0.00	7.0	0	non
15	82 ± 1	23.4 ± 0.2	534.7 ± 2.3	8.21 ± 0.05	8.17 ± 0.00	5.0	0	non
16	120 ± 11	23.4 ± 0.0	41.6 ± 0.0	8.35 ± 0.01	6.29 ± 0.04	1-8	0	non

Table 3

Species captured at sampling locations on the McArthur River during the current study and 2002 (Thorburn *et al.* 2003, unpublished data)

Species name	Common name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	a	b	c	d	e	f	g	h	i
Pristis microdon	Freshwater Sawfish															•					•					
Carcharhinus leucas	Bull Shark																		•							
Ambassis maclaeyi	Macleay's Glassfish													•			•									
Ambassis muelleri	North West Glassfish	•	•			•											•									
Amniataba percoides	Barred Grunter	•				•			•								•									
Arius argypleuron	Long-snouted Catfish																		•						•	
Arius graeffei	Lesser Salmon Catfish	•						•	•	•	•			•		•	•						•		•	
Arius hainesi	Ridged Catfish																								•	
Arius paucus	Gulf Shovel-nosed Catfish								•	•				•	•	•	•									
Arius sp.		•								•	•					•										
Arrhamphus sclerolepis	Snub-nosed Garfish	•	•																							
Chanos chanos	Milkfish																							•		
Glossamia aprion	Mouth Almighty	•															•									
Glossogobius giurus	Flathead Goby					•		•	•																	
Hephaestus fuliginosus	Sooty Grunter	•	•					•	•	•																
Lates calcarifer	Barramundi	•		•		•				•			•	•	•		•				•					
Leiopotherapon unicolor	Barred Grunter	•	•			•		•	•								•									
Liza alata	Diamond Mullet	•																								
Liza vaigiensis	Square-tail Mullet																		•							
Liza sp.			•																							
Megalops cypinoides	Oxeye Herring																•									
Melanotaenia splendida inornata	Chequered Rainbowfish	•				•		•	•	•				•			•									
Nematalosa erebi	Bony Bream	•	•	•		•			•	•	•						•		•		•			•	•	
Neosilurus ater	Black Catfish																•									
Neosilurus hyrtlii	Hyrtl's Tandan																•									
Oxyeleotris selheimi	Giant Gudgeon	•				•		•	•					•			•									
Oxyeleotris sp.		•																								
Pomadasys kaakan	Javelin Fish																		•							
Polydactylus macrochir	Blue-nosed Salmon																								•	
Porochilus rendahli	Rendahl's Catfish																•									
Scatophargus argus	Spotted Scat		•																							
Scomberoides commersonnianus	Talang Queenfish																	•	•		•			•		
Scomberoides tala	Barred Queenfish																	•	•							
Scortum ogilbyi	Gulf Grunter										•															
Selenotoca mutlifasciata	Banded Scat	•																								
Strongylura kreffti	Freshwater Longtom					•			•	•							•									
Toxotes chatareus	Seven-spot Archerfish	•	•			•		•	•					•			•									
Zenarchopterus novaeguineae	Fly River Garfish	•																								

Table 4
Composition of fishes captured from the McArthur River during sampling in May 2006

Species name	Common name	n	% Composition
Pristis microdon	Freshwater Sawfish	1	0.11
Ambassis maclaeyi	Macleay's Glassfish	16	1.69
Ambassis muelleri	North West Glassfish	92	9.69
Amniataba percoides	Barred Grunter	51	5.37
Arius graeffei	Lesser Salmon Catfish	88	9.27
Arius midgleyi	Gulf Shovel-nosed Catfish	21	2.21
Arius sp.		8	0.84
Arrhamphus sclerolepis	Snub-nosed Garfish	61	6.43
Glossamia aprion	Mouth Almighty	6	0.63
Glossogobius giurus	Flathead Goby	49	5.16
Hephaestus fuliginosus	Sooty Grunter	13	1.37
Lates calcarifer	Barramundi	34	3.58
Leiopotherapon unicolor	Spangled Perch	20	2.11
Liza alata	Diamond Mullet	2	0.21
Megalops cypinoides	Oxeye Herring	1	0.11
Melanotaenia splendida inornata	Chequered Rainbowfish	272	28.66
Nematalosa erebi	Bony Bream	39	4.11
Neosilurus ater	Black Catfish	2	0.21
Neosilurus hyrtlii	Hyrtl's Tandan	4	0.42
Oxyeleotris sp.		5	0.53
Oxyeleotris selheimi	Giant Gudgeon	39	4.11
Porochilus rendahli	Rendahl's Catfish	2	0.21
Scatophargus argus	Spotted Scat	23	2.42
Selenotoca mutlifasciata	Gulf Grunter	11	1.16
Scortum ogiliby	Banded Scat	1	0.11
Strongylura kreffti	Freshwater Longtom	3	0.32
Toxotes chatareus	Seven-spot Archerfish	83	8.75
Zenarchopterus novaeguineae	Fly River Garfish	2	0.21
Total number of individuals		**949**	

FIGURES

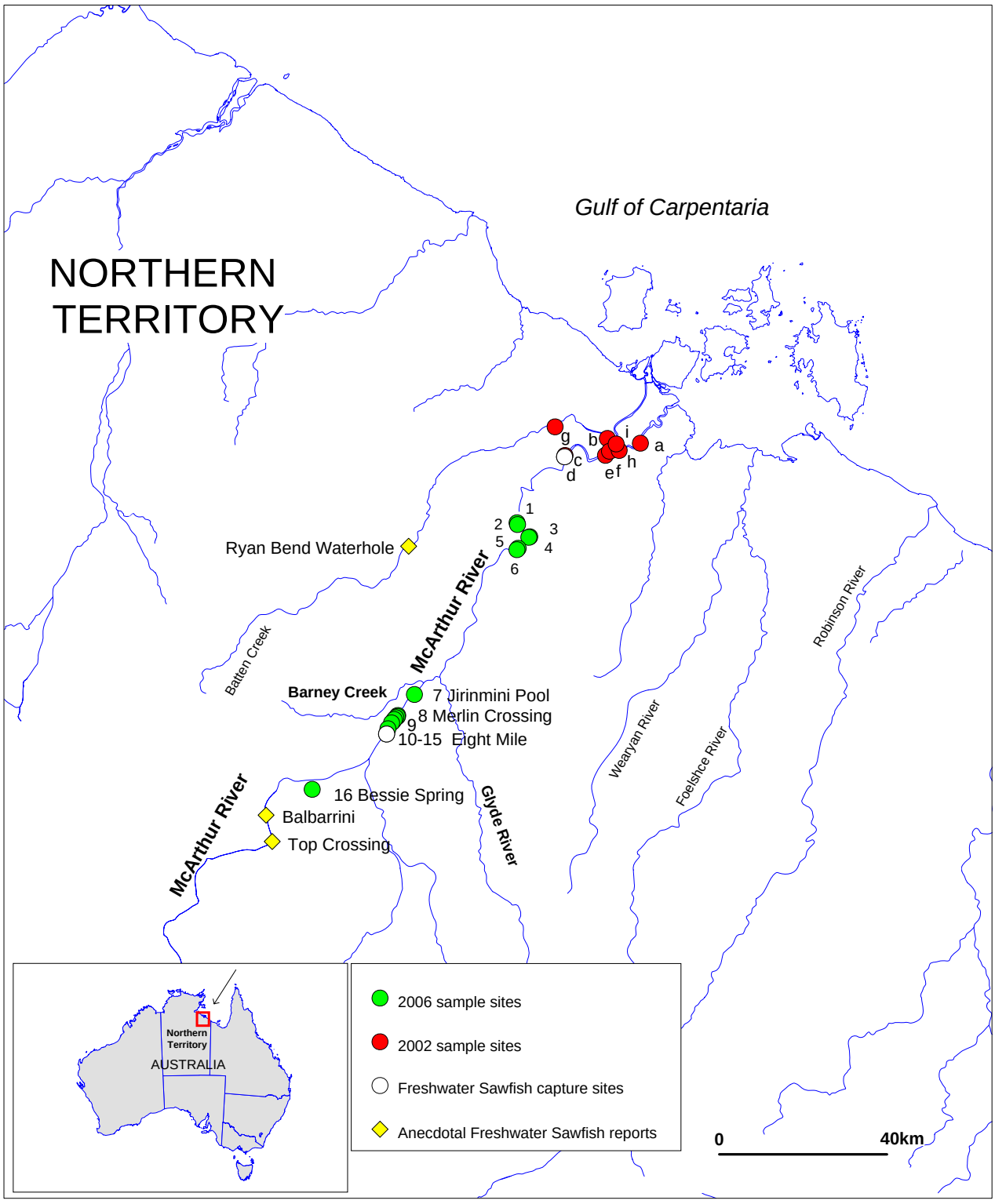

Figure 1
Sites sampled for fishes on the McArthur River, indicating survey capture and anecdotal capture sites of *Pristis microdon*

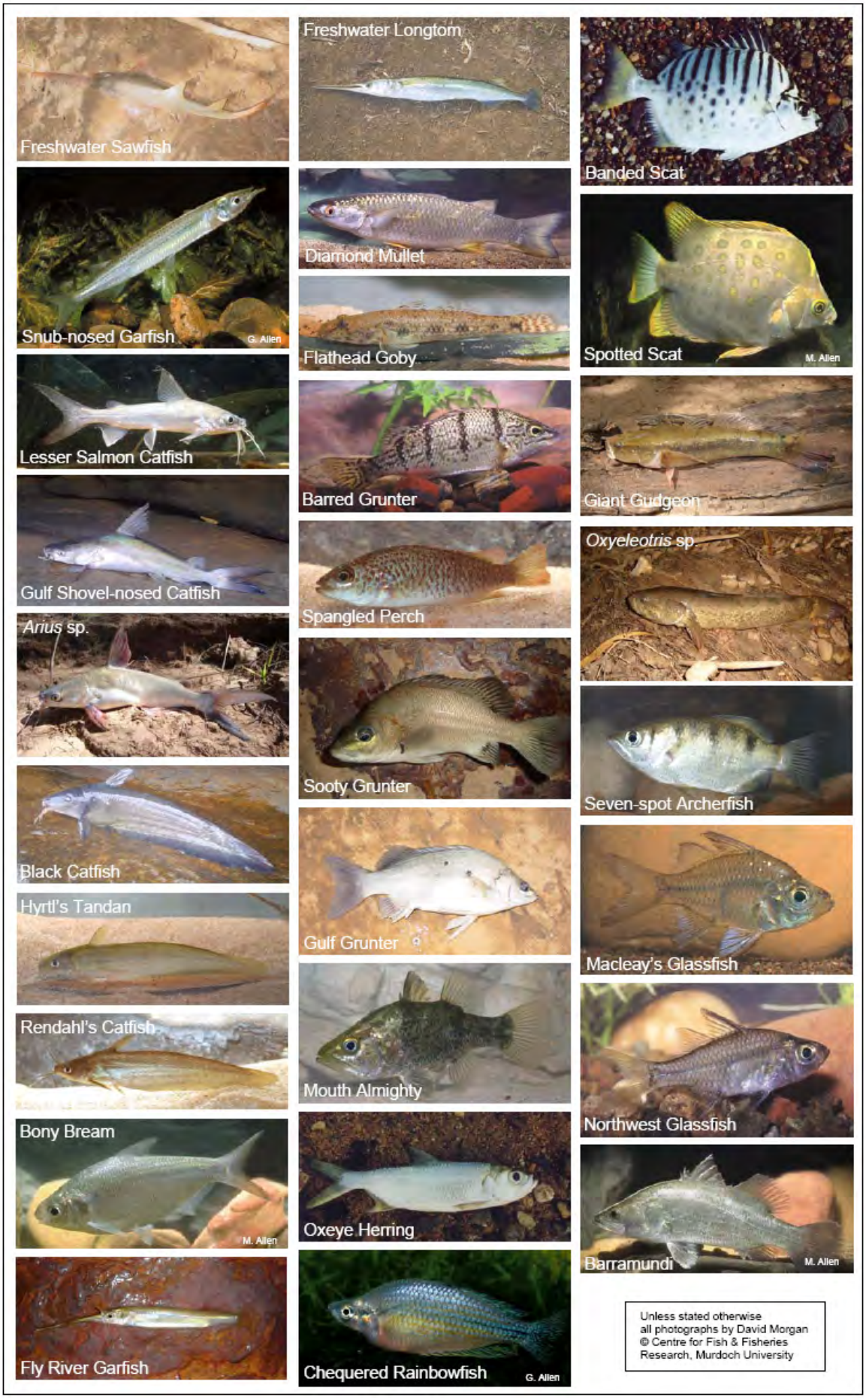

Figure 2
Fishes captured from the McArthur River during May 2006

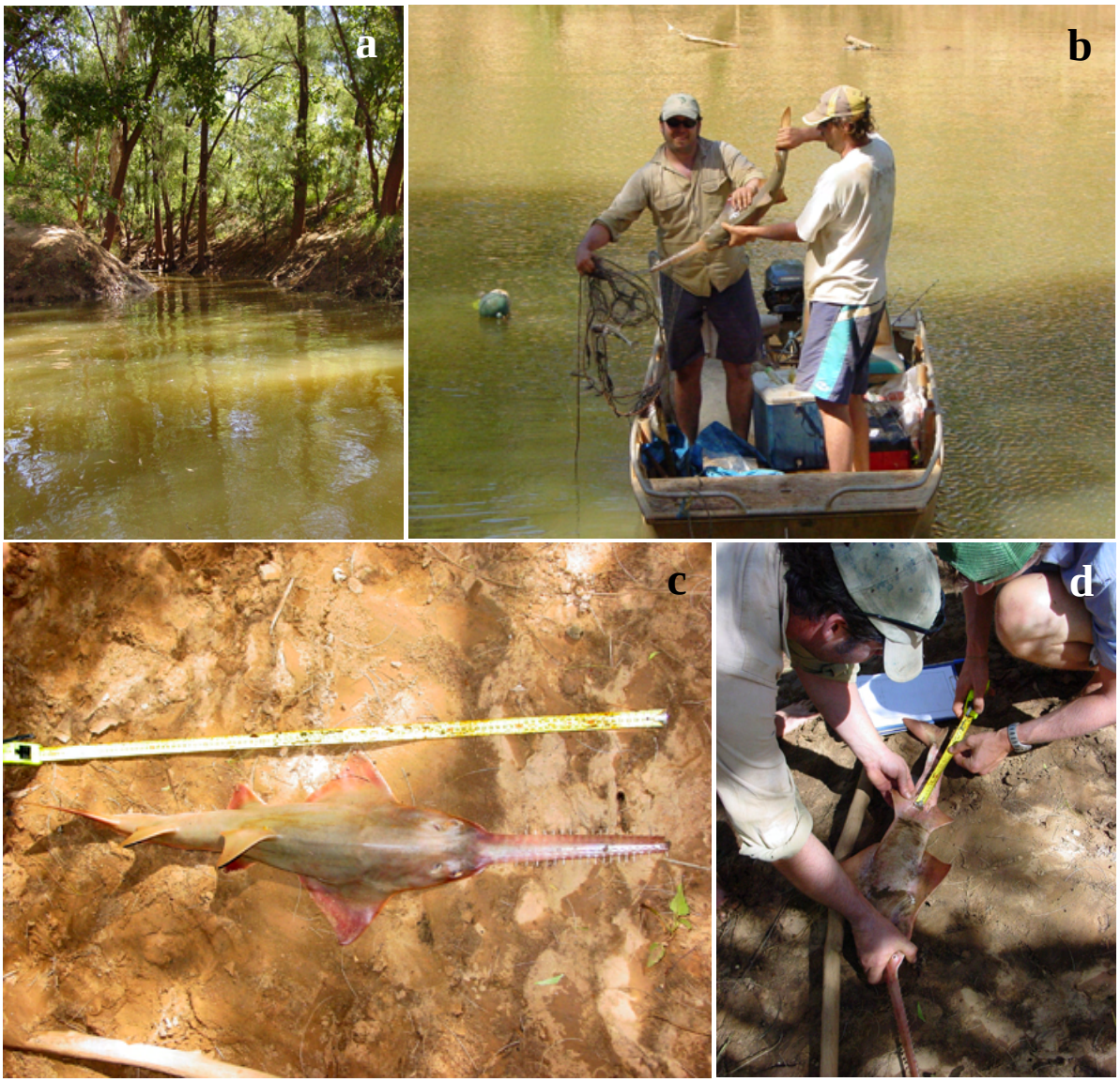

Figure 3
Pristis microdon **captured during the current study; including (a) the site of capture, (b) capture methodology, (c) measurement of total length and (d) measurement of clasper length.**

APPENDIX A

**Sampling Effort at Each Sample Site,
Including the Duration and Type of Gill Nets Used, and Additional
Techniques, Including Baited Line (BL), Throw Net (TN),
Seine Net (SN), Electrofishing (EF) and Visual (V)**

Appendix A

Sampling effort at each sample site, including the duration and type of gill nets used, and additional techniques, including baited line (BL), throw net (TN), seine net (SN), electrofishing (EF) and visual (V).

	Gill net (hours set)				Additional sampling techniques				
Site #	**75 mm**	**100 mm**	**150 mm**	**200 mm**	**BL**	**TN**	**SN**	**EF**	**V**
1	1	3.25	3.25	3.25			•	•	•
2			3.75	3.75				•	
3		2	2	2	•				
4			2	2					
5		2	2	2				•	
6			2	2					
7	1	20.25	20.25	20.25	•			•	
8			18.25	18.25	•			•	
9	2		17.5	17.5					•
10	1								
11			3.5	3.5					
12			16	16					
13			13.5	2.5	•	•			•
14			2.5	2.5					
15	1.5								
16	2.5		15	15	•	•			•
Total	**9**	**27.5**	**121.5**	**110.5**					