Fishes of the King Edward and Carson Rivers
with their Belaa and Ngarinyin names

By

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Milyengki

Carson Pool

Dolores Cheinmora: **Nyarrinjali, kaawi-lawu yarn' nyerreingkana, Milyengki-ngûndalu. Waj' nyerreingkana, kaawi-ku, kawii amûrike omûrung, yilarra a-mûrike omûrung.**
Agnes Charles: We are here at **Milyengki** looking for fish. He got one barramundi, a small one. **Yilarra** is the barramundi's name.

Dolores Cheinmora: **Wardi-di kala' angbûnkû naa?**
Agnes Charles: Can you see the fish, what sort of fish is that?

Dolores Cheinmora: **Anja kûkûridingei, Kalamburru-ngûndalu.**
Agnes Charles: This fish, the Barred Grunter, lives in the Kalumburu area.

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Photographs on front cover:
Lower King Edward River
Long-nose Grunter (inset).

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Summary

Ichthyological (fish) Survey

During two separate sampling trips, in October to November 2004 and in June to July 2005, 42 sites on the King Edward River and Carson River and their tributaries were sampled for fish. Fish were captured using fine mesh seine nets and gill nets and were observed using mask and snorkel and from visual surveys.

The results of this study have revealed that the number of freshwater fishes (species diversity) of the King Edward River is higher than has previously been recorded for a Western Australian river. Twenty-six freshwater fish species were recorded, which is three species higher than the much larger Fitzroy River in the southern Kimberley. The study also resulted in a number of range extensions, including Butler's Grunter and Silver Cobbler to the west, and the Slender Gudgeon to the north and east. What appears to be an undescribed species of glassfish was captured. It differs morphologically from described species in head spines (or lack of), fin rays, as well as relative body measurements. Similarly, an undescribed ectoparasite, *Argulus* sp. (Crustacea: Branchiura), was found on the caudal (tail) fin lobes of one Black Bream (Jenkin's Grunter) and three Spangled Perch. Interestingly, a considerable proportion of Black Bream, which is widespread throughout the system but essentially restricted to main channel sites, had 'blubber-lips'.

There were significant differences in the prevailing fish fauna of the different reaches of the King Edward River system. Thus fish associations in the upper King Edward River main channel were significantly different to those in the tributaries and the main channel of the Carson River. Similarly, the fauna of the Carson River, which was much more diverse than the King Edward River main channel and tributary sites, was characterised by many species that were not found in other parts of the river. The presence of barriers, in the form of waterfalls which do not permit upstream migrations of fishes are considered to be the main factor in limiting the distribution of many species. For example, many species are restricted to the lower sections of the Carson River, and include Bony Bream, Lesser Salmon Catfish, Silver Cobbler, Black Catfish, False-spined Catfish, Freshwater Longtom, Prince Regent Hardyhead, Mouth Almighty, Barred Grunter and Butler's Grunter. It is hypothesised that these natural barriers were in place long before many of these latter species colonised the King Edward River. Some species tend to only be found within tributary sites, e.g. Kimberley Mogurnda, while others are most abundant in tributaries rather than main channel sites, e.g. Western Rainbowfish and Spangled Perch.

Waterfalls are also seen as limiting the number of migratory marine/estuarine species that enter freshwaters. For example, only three species that require the marine/estuarine environment to complete their life-cycle (i.e. salt water) were captured in the freshwaters of the King Edward River system. This compares to 14 species that utilise the freshwaters of the Fitzroy River.

Aboriginal Traditional Knowledge

Colonisation of the Kimberley by Europeans in the late 1800s disrupted the traditional practices of Aboriginal groups. This disruption had a severe effect on the transmission of traditional

knowledge to the younger generations. Land, Law, Culture, Language are not separable for Aboriginal peoples. For many older Aboriginal people the loss of traditional knowledge includes the loss of aspects of all these areas. Collaborative research such as this project offers an opportunity to explore the depth of Aboriginal knowledge in relation to Western scientific knowledge and to record information from the older generations of Aboriginal people for the future ones.

Western knowledge, especially in academia, operates within systems of classification. It is possible for Western researchers to, for example, target Aboriginal people's 'knowledge of fish' in isolation if they have not been given the information that within Aboriginal knowledge systems fish are not a separate 'item' to be categorised, but have a relationship with all other things. Within a collaborative project, information sharing through Western and Aboriginal perspectives is a very strong outcome – particularly for the people involved in the field research. By outlining for future researchers a methodology for documenting Aboriginal knowledge, it is hoped that collaborative research will become standard practice and the resources to make such collaboration effective will become more readily available.

The term 'endangered' is often used to refer to traditional Aboriginal languages which are not being acquired by children as a first language. For the Western mind it is possible to dissociate language from other aspects of life – particularly in the English speaking parts of the world. As a global language with myriad different varieties English no longer pertains to one place and one culture. The languages of the Kimberley are at the other extreme. Each language links specifically to areas of 'country' and contains all the knowledge for the natural world. Therefore an 'endangered language' actually refers to an 'endangered knowledge system'.

An holistic approach to Western scientific fieldwork that incorporates cultural values and knowledge from the Aboriginal custodians of the land is discussed in this report. The focus of much of the knowledge documentation in this project was fish names in Belaa and Ngarinyin – some 40 names were recorded and reproduced in fish posters (see Appendix 4). However, during the field trips several hours of Belaa language were recorded on Kwini country. Due to time constraints and the absence of field support to record stories and information, the two field trips on Ngarinyin country were not able to yield similar recordings.

While there was not time nor resources to fully explore the content of the Belaa stories in relation to the ichthyological survey described in this report, this secondary outcome of recording traditional stories and knowledge in a severely endangered language (Belaa) is an important aspect of carrying out fieldwork with elderly Aboriginal languages speakers.

A species synopsis is provided in the results and where possible it provides details of the Belaa and Ngarinyin names for the fish. While many of the Ngarinyin names for fish of the Fitzroy River are reported in Morgan *et al*. (2004), the two river systems do not share all of the species. During this project, Pansy Nulgit provided names of fish not previously recorded, e.g. **Mangena** for the Barnett River Gudgeon, **Emana** for the Long-nose Grunter and Long-nose Sooty Grunter and **Arurl** for the eel (Indian Short-finned eel). Pansy also called cherabin **Narli**, and provided some alternative names to those previously recorded. For example, Pansy referred to the Lesser Salmon Catfish as **Yawarl ngarri**, the Freshwater Longtom as **Garnburu** and the Barramundi as **Jongarri emana**.

Belaa is a language characterised by an intricate semantic system of noun classes that classify all aspects of the natural world, including humans, into five different groups. In the list of Belaa names for fish found in the methodology section of this report the words **manya, ninya** or **minya** follow the name of each fish. The names of 16 freshwater fishes and two marine fishes were identified in the Belaa language and classified according to noun class. Ten freshwater and two marine fishes belonged to the same class that includes most mammals and meat. The Black Catfish, Hyrtl's Tandan, False-spine Catfish, Rendahl's Catfish and Freshwater Longtom belonged to another noun class, and the Flathead Goby was exceptional in that it belonged to a different noun class from all other fish identified. Further study should now be done to explore the semantic basis of the classification of both freshwater and saltwater fish species and other marine animals within the Belaa noun class system, to see if there is any correlation between scientific classification of fish and semantic criteria for classifying fish within the noun class system of the Belaa language and other Worrorran languages.

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Introduction

Ichthyological (fish) surveys in the Kimberley

The Kimberley region of Western Australia was one of the very last areas of Australia to be colonised by Europeans – gold prospecting and cattle being the main reasons for settlement. As a result it is often regarded by non-Aboriginal people as one of Australia's "last frontiers" - which has also applied to Western scientific research. The rugged terrain, extended wet season and lack of sealed roads render much of the region inaccessible to visitors.

The isolation and remoteness of the Kimberley also delayed ichthyological surveys, with the majority commencing from the 1970s onwards. The region has a comparatively high diversity of fishes and inevitably, many of the original examinations of the region's freshwater fishes revealed species that were new to science (see Allen 1975, 1978, Hutchins 1977, 1981, Vari 1978, Hoese & Allen 1983, Allen & Feinberg 1998, Morgan *et al*. 2004). Many of these newly discovered species are endemic to the Kimberley which has 17 endemic freshwater fishes and two endemic genera (see above and Allen *et al*. 2002), a fact that highlights the importance of the region to Australia's aquatic biodiversity.

Recently, ichthyological studies of the Kimberley have acknowledged the necessity of involving the traditional custodians of the land, the Aboriginal elders. One such study of this type was the collaborative Murdoch University, Kimberley Land Council and Kimberley Language Resource Centre project (by Morgan, Allen, Bedford and Horstman (2004)) which detailed the fishes of the Fitzroy River and documented the Bunuba, Gooniyandi, Ngarinyin, Nyikina and Walmajarri language names from elders for the Fitzroy River's fishes. Prior to that study the Fitzroy River had only been surveyed for fish in a few accessible locations and there were limited documentations of the traditional names for the fish and understanding of traditional Aboriginal knowledge. That study has led to the possibility of ongoing research in the region with traditional owners and language speakers.

The waters of the King Edward and Carson Rivers converge approximately 15 km north of the Aboriginal community of Kalumburu in the northern Kimberley, before entering Napier Broome Bay (see Figure 1). Previous published ichthyological surveys of the catchment are restricted to those by Hutchins (1977) and Allen and Leggett (1990). The sites sampled by Hutchins (1977) were all within the Drysdale National Park and included 5 sites on the Carson River, 4 sites on Palmoondoora Creek and 3 sites on Orchid Creek. Allen and Leggett (1990) sampled 1 site on the King Edward River, 3 sites on the Carson River and 1 site each on the Morgan River and Monger Creek. Hutchins (1977) reported 18 species from the Carson River within the Drysdale River National Park, while Hutchins (1981) tabulated a total of 11 species of freshwater fishes from the King Edward River and 20 species from the Carson River.

From the above it is evident that the previous ichthyological surveys of the King Edward and Carson rivers were not comprehensive but instead were limited to a small number of sites in specific areas (e.g. Drysdale River National Park). The first aim of the current study was to provide a broader examination of the catchment by examining the fishes of both the King Edward and Carson rivers and their tributaries. A secondary aim to this part of the project was to compare the fish faunal associations between the two major systems (i.e. King Edward River and Carson River) and their tributaries.

The second main aim was to provide an opportunity for discussions regarding the cultural significance, including language names, of the fishes to the Aboriginal people of the catchment.

Kimberley languages

Despite the devastating effects of colonisation and the dominance of the English language on Aboriginal languages and cultures, there are some 28 languages still being spoken in the Kimberley. This reflects the linguistic diversity of the Kimberley, which parallels the biological diversity. Kimberley cultures were traditionally multilingual societies, and many elders still speak a number of languages. The threats to the diversity of language have also been mirrored by environmental degradation and threats to the diversity of plants, animals and fish species.

Kimberley languages are still under threat with decreasing numbers of fluent speakers in the younger generations. The loss of language also means the loss of intricate cultural and biological knowledge encoded within the languages. There are many community driven language maintenance and revival projects taking place throughout the region, many of which are supported and/or resourced by the Kimberley Language Resource Centre (KLRC). The KLRC was set up to respond to community requests to maintain, revive and document Kimberley languages and is directed by an Executive Committee comprising language representatives from 13 Kimberley languages. The KLRC promotes community ownership and control of language activities.

Languages of the area of study

This study took place on country belonging to the, Ngarinyin, Gaambera, Wunambal and Kwini peoples (see Figure 2). [Note: Belaa is the name of the language spoken by the Kwini people]. There are both cultural and linguistic links between these Aboriginal groups. The languages are of varying 'strengths' - a term often used to identify language fluency through the generations. A 'weak' language is said to be one with a few elderly speakers and only passive knowledge through the generations, a 'strong' language is one where children are growing up speaking the language. The languages of the Kimberley region reflect a spectrum between weak and strong. None of the languages of the area in this study are strong, but each of the language groups has language knowledge used by younger generations, if not fluently. Culturally all four

groups have strong connections to their traditional lands and each other and language is often strongest when connected to cultural and traditional practices.

Speakers of an Aboriginal language have criteria to distinguish one language from another, incorporating the importance of land, cultural values and practices, and cultural identity as distinct from other language groups with differing cultural practices and connections to land. Identity and connection to traditional lands are very clear cut for Aboriginal peoples whether they are fluent speakers of a language or not. Factors such as intermarriage and the influx of language speakers from other areas of the Kimberley and wider, mean that identity based on language use alone is not clear cut from a Western perspective. It is important to respect people's 'heritage' language whether they speak it fluently or not because that connection reflects their cultural connections. The area of this study is even more linguistically complex because of the presence of Kriol and Aboriginal English dialects – both of which incorporate grammatical structures and words from the traditional languages and serve as linguistic identity markers.

As will be discussed throughout the report, field trips required for scientific fieldwork can have a role in supporting the cultural and language maintenance practices of the communities involved.

Methodology

Study area

The catchment of the King Edward and Carson rivers, in the Kimberley Basin, flow in a northerly direction and encompass approximately 10000 km^2 (see Figure 1). The headwaters of the King Edward River arise near the Gardner Plateau (King Leopold Sandstone) to the west of the Foster Range. Minor tributaries of the King Edward River include Noolawayoo Creek, Cole Creek, Mongonai Creek and Coondillah Creek. The Carson River has its headwaters in the Foster Range and the main channel follows the Carson Escarpment. The major tributaries of the Carson River incorporate the Morgan River and tributaries including Loonjool Creek and Palmoondoora Creek.

The climate of the region is monsoonal and has a hot wet summer that is followed by an extended warm dry season with little precipitation occurring between April and October (Vigilante *et al*. 2004). Rainfall in the region varies substantially from year to year and is often influenced by tropical cyclones. The mean annual rainfall is >1200 mm at Kalumburu, near the mouth of the river, while Doongan Station in the headwaters receives, on average, ~1100 mm (see results and Vigilante *et al*. 2004).

Fish sampling

During two separate sampling trips, in October and November 2004 and in June and July 2005, 42 sites on the King Edward River and Carson River and their tributaries were sampled for fish (Figure 1, Table 1). This included one site on Dominic Creek that flows into Mission Cove in Napier Broome Bay and is not connected by freshwater to the King Edward River. Fish were captured using a variety of fine mesh seine nets and gill nets and line fishing and were observed using mask and snorkel, and from visual surveys along the bank or from the bow of a boat. The longitude and latitude were recorded at each site sampled. The maps of the sample sites and species distributions were created using the above GPS data and the program MapInfo. Replicate water temperature and conductivity were measured on each sampling occasion. Rainfall and temperature data were sourced from the Bureau of Meteorology.

Fish identification and systematics

On capture, fish were identified and the majority released immediately. Occasionally it was necessary to preserve specimens for formal identifications. This was the case for a number of the ambassids (glassfish) and eleotrids (gudgeons) captured. Fish were also kept for live photography.

In this report the species phylogenetic order follows Nelson (1994). For the glassfish we refer to them as Ambassidae rather than Chandidae (c.f. Allen & Burgess 1990, Pusey *et al*. 2004) since Eschmeyer (2004) notes that the former has precedence over the latter, i.e. Kluzinger (1870) was the first to use the name Ambassidae c.f. Fowler (1905) who was

the first to use Chandidae. In some cases there was a need to verify species identifications from the field. The Ambassidae collected, where possible, were identified from Allen & Burgess (1990), *Mogurnda* sp. from Allen & Jenkins (1996), *Hypseleotris* sp. from Hoese & Allen (1983), Melanotaeniidae sp. from Allen (1978) and Terapontidae sp. from Vari (1978).

For the purpose of this report, freshwater species are considered to be those that are either obligate freshwater fishes or are capable of completing their life within the freshwater environment. Marine species are deemed those that must complete part of their life-cycle within the marine environment but may spend much of their life in freshwater, e.g. Barramundi (*Lates calcarifer*) breed in the estuary but may spend extended periods in freshwater habitats. Species such as the Lesser Salmon Catfish (*Arius graeffei*) and Flathead Goby (*Glossogobius giurus*) are capable of breeding in both fresh and salt water (see Morgan *et al*. 2004) and for the purpose of this report are thus considered freshwater species.

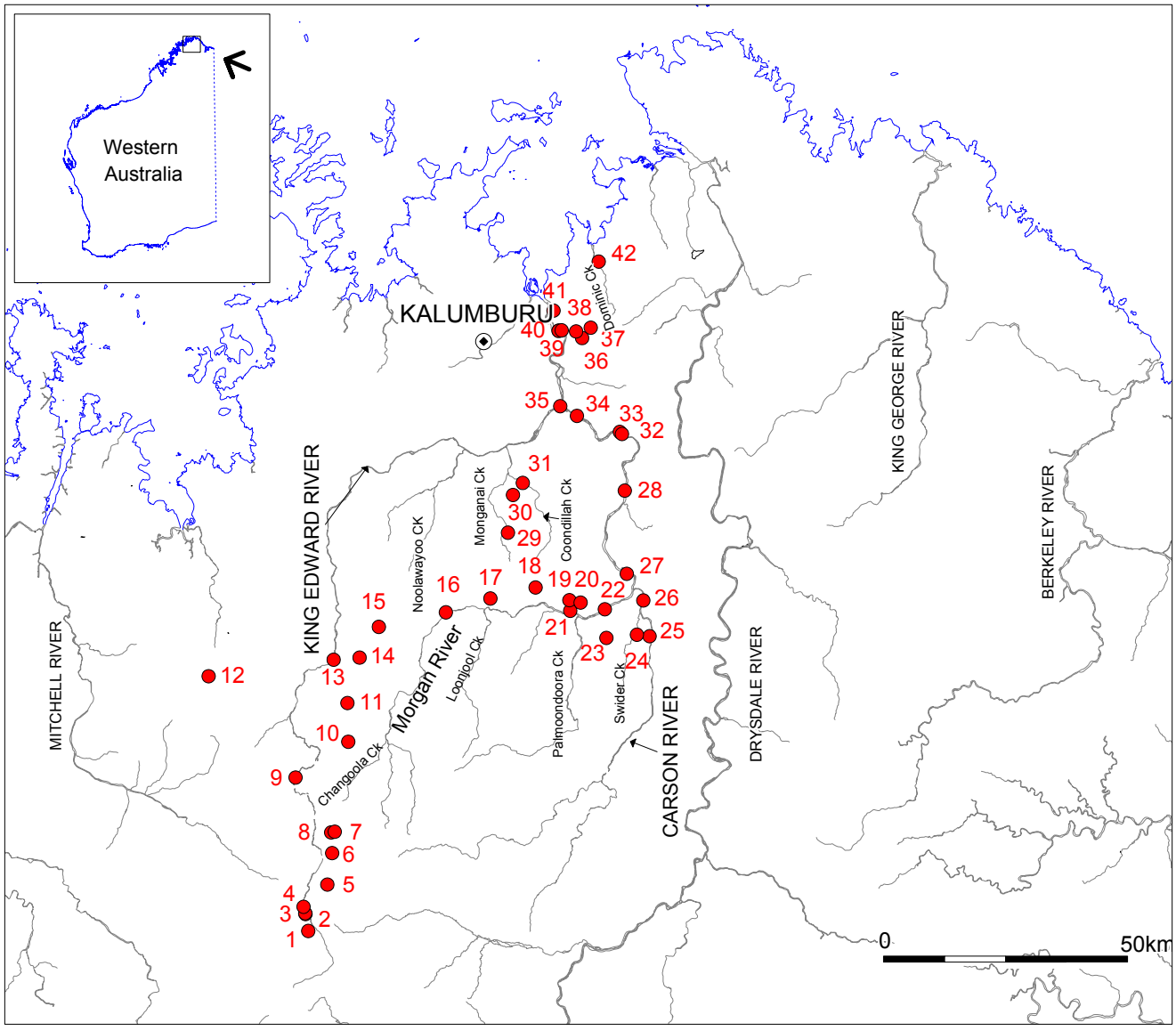


Figure 1 The sites sampled for fish in the King Edward and Carson River systems.

Classifying the different regions of the King Edward River

The presence of waterfalls throughout the main channel of the King Edward River, compared to the Carson River, is likely to influence the recruitment of species by limiting their migratory ability. Morgan *et al*. (2004) found significant differences between the fish fauna in the different habitats and reaches of the Fitzroy River in the southern Kimberley. These differences were largely attributed to either the presence or absence of catadromous fishes such as mullets, Barramundi, Freshwater Sawfish etc., the size of the tributary, or to the higher altitude reaches of the river within the King Leopold Ranges.

In order to determine the difference in fish faunal associations within the King Edward River system, these sample sites, based on fish species abundance at each site, were categorised as either (1) upper main channel King Edward River, (2) main channel Carson River (including lower Morgan River downstream of, but including, site 21), (3) King Edward tributary, (4) Carson River tributary sites (includes tributaries downstream of the confluence with the King Edward River) or (5) Morgan River tributary sites (includes the Morgan River main channel upstream of the waterfall at site 21) (see Figure 1). The King Edward River included sites 1-4, 9, 13; tributaries of the King Edward River included sites 5-8, 12, 14-15, 29-31; the Morgan River included sites 10-11, 16-20, the Carson River included sites 21-22, 25-28, 32-35 and the Carson River tributaries sites were 23-24 and 36-41 (Figure 1, Table 1).

In order to test the hypothesis that the fish faunal composition would vary between these broad habitat types the sample sites were *a priori* allocated to one of these categories and their fish community compared using one-way analysis of similarity (ANOSIM) in PRIMER (Clarke and Gorley 2001). In order to test for differences in community structure, a data set of the abundance of the different species captured in the 41 sites sampled in the catchment was used to construct a similarity matrix employing the Bray-Curtis similarity coefficient in the PRIMER package (Clarke and Gorley 2001). Site 42 (Dominic Creek) was not included in analysis as it is outside of the main catchment.

The abundance data for the individual species captured at the different sample sites were square root transformed, and were used to construct a similarity matrix using the Bray-Curtis similarity coefficient. One-way analysis of similarity (ANOSIM) was used to determine whether differences between the main sample site groups (1-5) (see above) were significant. Analysis of similarity generates an *R*-statistic that is an estimate of the similarity of the replicates within predetermined groups compared to similarities between groups; *R* value of 1 indicates that all replicates within groups are more similar to one another than they are to any replicate in other groups whilst an *R* value of 0 indicates that similarities within and between groups are the same on average. The similarity matrix that was generated was then ordinated and classified using non-metric multi dimensional scaling (MDS) and hierarchical agglomerative cluster analysis in the

PRIMER package (Clarke & Gorley 2001). PRIMER was also used to generate a cumulative species plot of the sites sampled.

Table 1 The site numbers and name of each site sampled for fish on the King Edward and Carson River systems.

Site # on map	Site Name
1	King Edward River (Marunbabidi)
2	King Edward River (Marunbabidi)
3	King Edward River (Marunbabidi)
4	King Edward River (Marunbabidi)
5	Hair Creek
6	unnamed ck ~20km S Old Mitchell Rd
7	Small tributary ~ 19km from Prap Prap turnoff
8	Ck on Kalumburu Rd (~5km S Old Mitchell Rd)
9	King Edward River (Old Mitchell Falls Rd)
10	Tributary of Changoola Ck (Morgan R)
11	Yoolo Ck (Morgan River)
12	small spring
13	King Edward River (Mitchell Falls Rd)
14	Ngoollalah Ck (South Branch)
15	Ngoollalah Ck (North Branch)
16	Morgan River (Kalumburu Rd)
17	Morgan River - upstream of Loonjool Ck junction
18	Tributary of Morgan River
19	Small tributary of Morgan River (near Old Theda)
20	small tributary of Morgan River
21	Morgan River (below waterfall on Theda)
22	Morgan River (Old Theda)
23	Hudson Spring (Morgan River)
24	Swider Creek (Carson River)
25	Carson River (~15km SE Old Theda)
26	Carson River (Theda Station)
27	Boomerang Pool (Carson River)
28	Carson River - Larriman Yard
29	Mongonai Ck (King Edward)
30	Tributary of Coondillah Ck (King Edward)
31	Coondillah Ck (Kalumburu Rd)
32	Carson River (Damaal)
33	Carson River
34	Carson River (Mur Mur or Mool Mool Lagoon)
35	Junction Carson and King Edward Rivers
36	Lowarl Ck (Teachers Pool)
37	Nallawarri (Lowarl Creek)
38	Lowarl Ck
39	Malinjarr - small creek near Kalumburu
40	Lily Pond (near Kalumburu airport)
41	Longini - Turtle Gallery
42	Dominic Ck

It was not identified during these field trips how the Aboriginal people involved see the different regions of the King Edward River system and if they see the river divided into different sections which parallel the Western scientific classifications in this report. Exploring this topic – without intruding on knowledge that is culturally protected - is a precedent for future collaborative research.

Community contact

Community organisations, including the KLRC, were contacted to gain permission to do the work and ascertain what language groups and traditional owners might want to be involved. Field research goals were outlined (including how the research would take place) as were the benefits that the research may have for the community, including the production of fish posters with language names (see Appendix 4).

The Kalumburu Council, Kupungari Aboriginal Corporation and Wunambal-Gaambera Aboriginal Corporation (WGAC) were contacted prior to the commencement of fieldwork in 2004. This survey work involved visiting sites in the King Edward and Carson River catchment areas that lay in Kwini or Ngarinyin country, but it was important to inform the Wunambal and Gaambera people about the project and about the possibility of future fieldtrips in Wunambal and Gaambera country.

Kalumburu Council were told about the field research at a meeting, and informal conversations took place at the WGAC Office, outside the Kwini store and office and in the community. Fish posters from other field trips were presented, language names for fish already recorded were discussed and photographs from fieldwork were shown. Photographic fish posters from prior Murdoch/KLRC/KLC collaborative projects with other language groups in the Fitzroy River area were sent to the organisations. In this way the people could see one tangible outcome of the project that might facilitate the passing on of knowledge about fish species from elders. Procedures for protecting and storing the information to be collected were also discussed. On the basis of this information consent forms were signed by the elders. In future fieldwork it will be necessary to explain the scientific purposes and methodology of surveys (informed and prior consent) in order to create a collaborative framework for eliciting cultural information.

Audiovisual materials (especially photos and video) help make the research process tangible for community members and others who may not be present during field trips. They can provide clear identification of different fish species and their language names and could be used to create language and cultural maintenance resources that can benefit the younger generations. More importantly, they can provide a record of traditional knowledge spoken in traditional languages on traditional country.

Permission was sought from traditional owners to travel in Kwini and Ngarinyin country while documenting the biodiversity of fish species. It is important to identify who can talk for country. Someone from another area will not have those rights. Travel

to new places should always be directed by the custodians of those places, who know the country.

For cultural, linguistic and medical reasons a bilingual adult accompanied the elders on fieldtrips. The Kwini fieldwork involved Dolores Cheinmora and her daughter Agnes Charles (see Figure 2). When in Ngarinyin country the fieldwork involved Pansy Nulgit and Morton Moore. Unfortunately, the equipment required for the fish survey work and the expense and difficulty of finding 4WD vehicles to access remote terrain placed limitations on how many traditional owners could be involved in the project. It also made it impossible to include much younger family members on the trips – an important factor in the transmission of traditional knowledge through language.

It is important to consider medical needs when taking older people into the field and liaise with the local clinic. In remote locations and with unpredictable wet season weather it was essential to let someone in the community know where we were planning to go and for how long. A satellite phone and GPS were available at all times.

The build up of wet season weather created limitations on how far we could travel and for how long, and there was reluctance to camp out while doing fish survey work. It was suggested that future field trips take place earlier in the year when the weather is more predictable. A longer lead-up to the fieldtrips will also allow for collaboration with other organisations to provide extra vehicles and other resources.

Cultural value of places

Access to country can be limited by factors such as transport - few traditional owners have access to a 4WD vehicle that can take them safely to special and remote places. So although the primary research purpose of this fieldwork was to document the biodiversity of fish species in the river system, the opportunity to access country provides traditional owners with many other recording opportunities that will benefit their families and communities, particularly when a language and the knowledge it contains is severely endangered.

A holistic approach to scientific fieldwork that incorporates cultural values of the custodians of the land and includes several generations provides many benefits. Collaborative projects between organisations have the potential to properly resource fieldwork that allows for traditional teaching and learning practices to take place. While such opportunities allow elders to transmit knowledge to the younger generations, the Western researcher may only have access to certain areas of Aboriginal knowledge (issues of Intellectual Property and ownership and control of knowledge are paramount here). This emphasises the need for prior and informed consent so that it is clear to both researcher and Aboriginal elder exactly where their knowledge systems can meet and potentially benefit each other.

The elders in this study were consulted about the best places to conduct the fish surveys. When working with Dolores visitors and newcomers are introduced to the country by sitting and listening to the story for the place, so that everyone shares an understanding of where they are before they start working together. Elders from other Aboriginal groups have similar practices. It can also be perceived as dangerous to access new places when you are a stranger who doesn't know the country or belong to the place, without first consulting traditional owners. As a language and cultural maintenance practice, recording the story (particularly on video) of important places in an Aboriginal language can help ensure that this story will be passed on and documented for future generations.

One of the elders requested that a daughter be present during fieldwork to help translate the Belaa language into English (see p. 2 – Milyengki, Appendix 3 – Mur Mur). In the process, important stories and oral history were being remembered and passed on to the next generation. It is important that a younger member of a language consultants' family be present on fieldtrips whenever possible. The loss of languages and cultural knowledge has its foundations in the break of transmission between generations. The ideal situation would be for young children, particularly of pre-school age, to be with their elders while these stories are told on country. It was not possible to incorporate this practice in this field trip – but for future collaboration, resourcing field trips which involve children and their parents is a concrete way of repaying traditional owners and communities for access to their lands and their knowledge.

The timing of a cultural approach to fieldwork may at times conflict with the time-scale required to conduct a fish survey using scientific methods, and in planning it is important to allow for the time it may take for an elder to introduce newcomers to a new location and record stories about the place if desired and when appropriate. Time also needs to be allowed to explain the scientific methods being used in fish capture and identification to elders, and to explain the purpose of this kind of work, as well as having an opportunity to look closely at the fish caught to explore information in the two different knowledge systems.

Recording traditional Aboriginal language

During most of the field work we were accompanied by Ngarinyin or Belaa people. who provided language names for the fish. When fish were captured they were presented to the language specialists who identified them. Language names were recorded on tape and later transcribed. Other stories were recorded at special places. Place names in language were also recorded, linked to a GPS location and transcribed.

During the follow up trip fish posters documenting Belaa names for fish found in the King Edward and Carson Rivers were distributed and copies of posters were given out (see Appendix 4). Copies of the final report will be sent to those involved in the project and the Kalumburu Corporation.

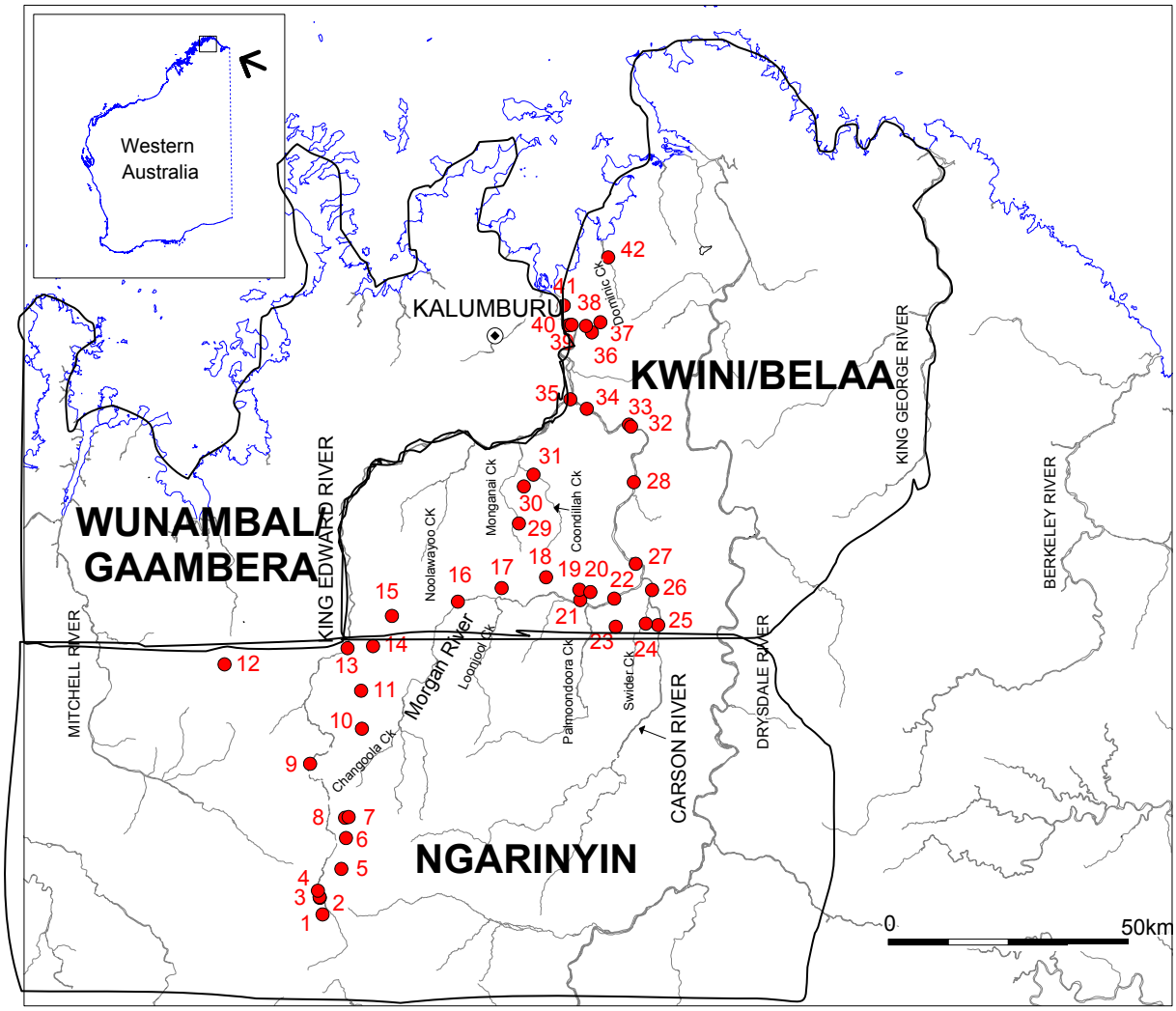


Figure 2 Very approximate traditional land/language boundaries for the Belaa, Ngarinyin and Wunambal/Gaambera people within the King Edward and Carson River systems. N.B. Based on our discussions while conducting the research and not to be reproduced for any other purpose.

Results

The environment of the King Edward River

The King Edward River and its tributaries are exposed to high temperatures for most of the year with the mean monthly temperature for both Kalumburu and Doongan Station (near the source of the King Edward River) being, on average, >30^{o}C (Figure 3). The hottest months, September to November, are immediately prior to the onset of the wet season where mean temperature is ~36^{o}C (Figures 3 and 4). The wet season extends from December to March with mean monthly rainfall being greatest in these months (Figure 4). On average, ~80% of the annual rainfall for Doongan Station (annual mean rainfall = 1106.6 mm) and Kalumburu (annual mean rainfall = 1217.3 mm) falls during this period. Conversely, between April and October the region receives little rainfall, with a combined average of less than 1.7 rainy days in each month during this period (data obtained from the Bureau of Meteorology).

Water temperatures at the sites sampled directly corresponded to the temperature regime to which they were exposed, with higher temperatures recorded in sites sampled during October and November as opposed to those sampled in June and July (see Figures 3 and 5). Mean water temperatures ranged from ~28-32^{o}C in the October-November sampling period and from ~23-27^{o}C in the cooler June-July period. The highest mean water temperatures were recorded from the Carson River sites, with the highest mean water temperature for one Carson River site being 33.8^{o}C.

Conductivities of all sites sampled were generally very low; with the upper King Edward River main channel sites having a mean conductivity of only 57.6 μScm^{-1} (Figure 5). Conductivities were generally highest in the tributary sites sampled. In terms of changes in conductivity during the different seasons, they were marginally higher in the October-November period, presumably as a result of a longer exposure to evaporation (Figure 5).

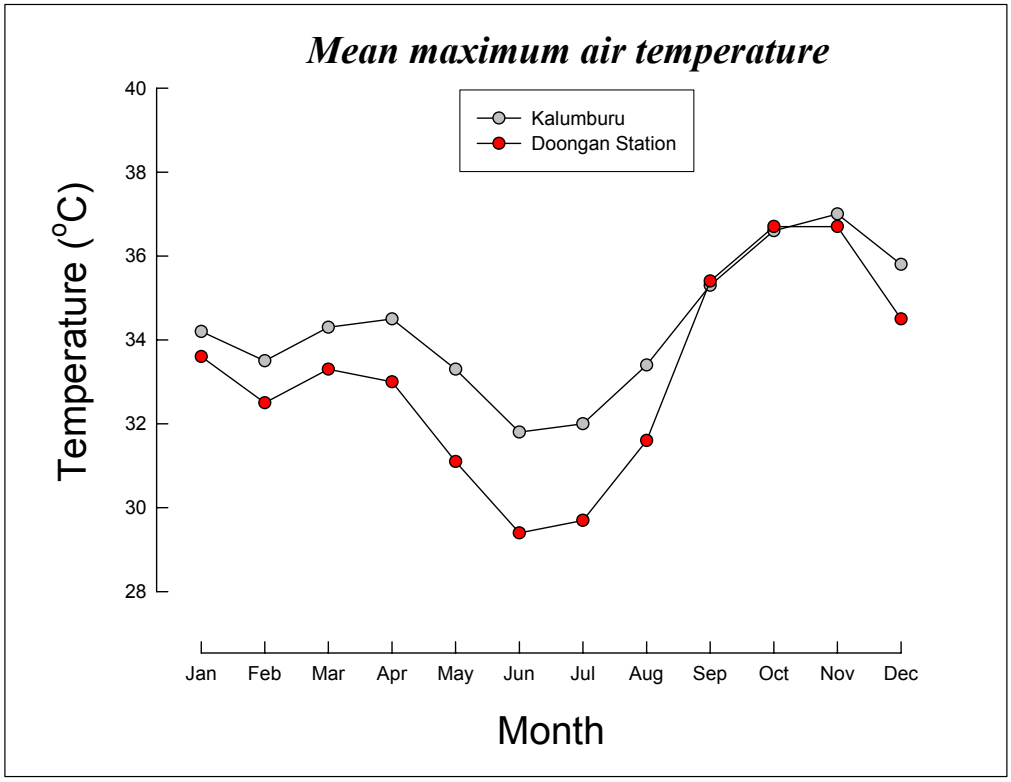


Figure 3 Mean monthly maximum air temperatures for Kalumburu (1941-2004) and Doongan Station (1988-2004). Derived from the Bureau of Meteorology.

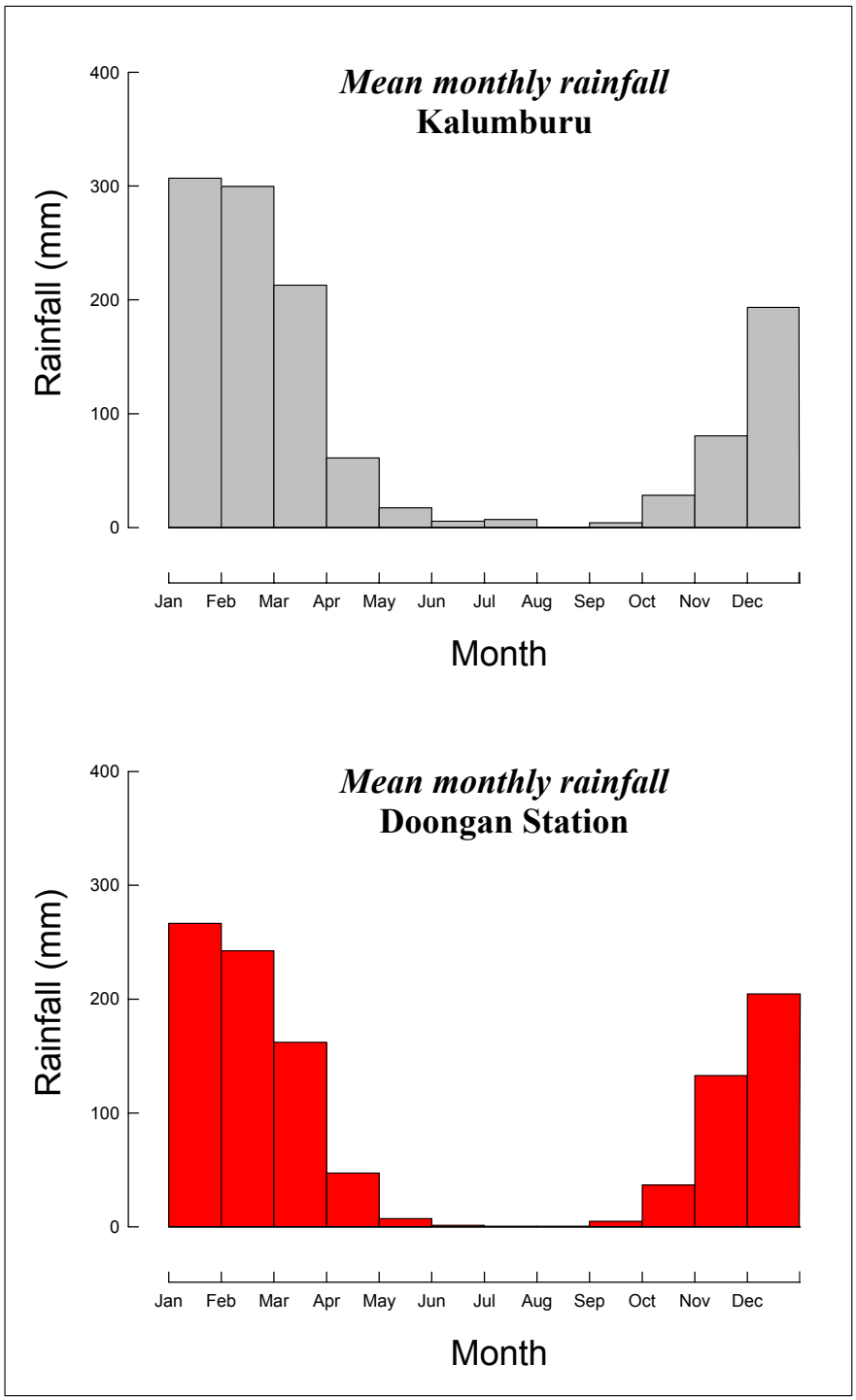
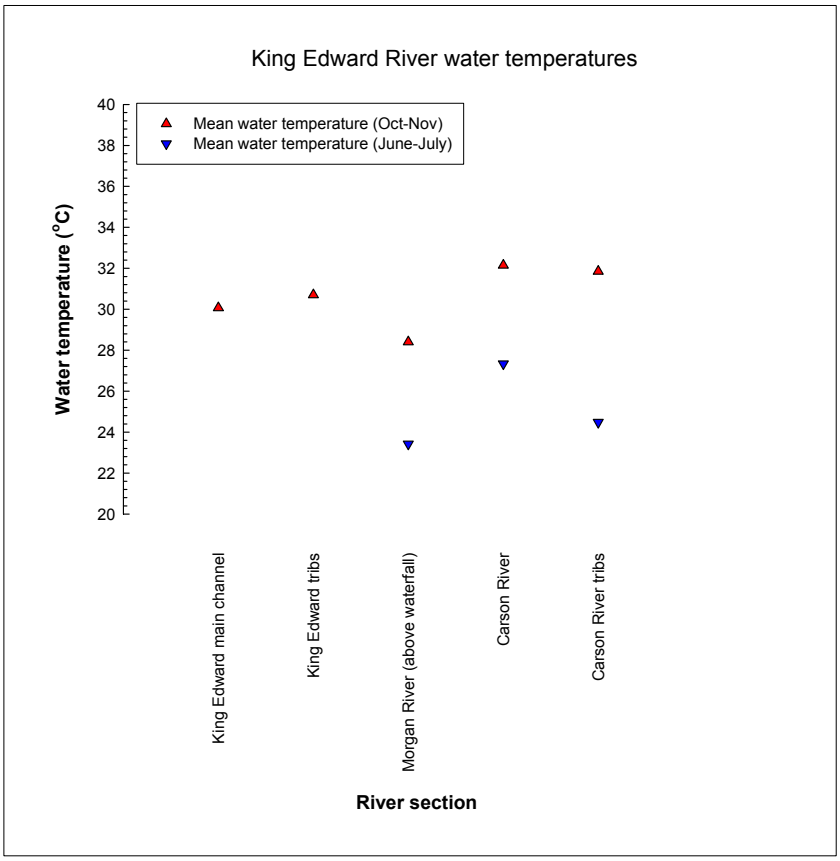


Figure 4 Mean monthly rainfall for Kalumburu (1941-2004) and Doongan Station (1988-2004). Derived from the Bureau of Meteorology.



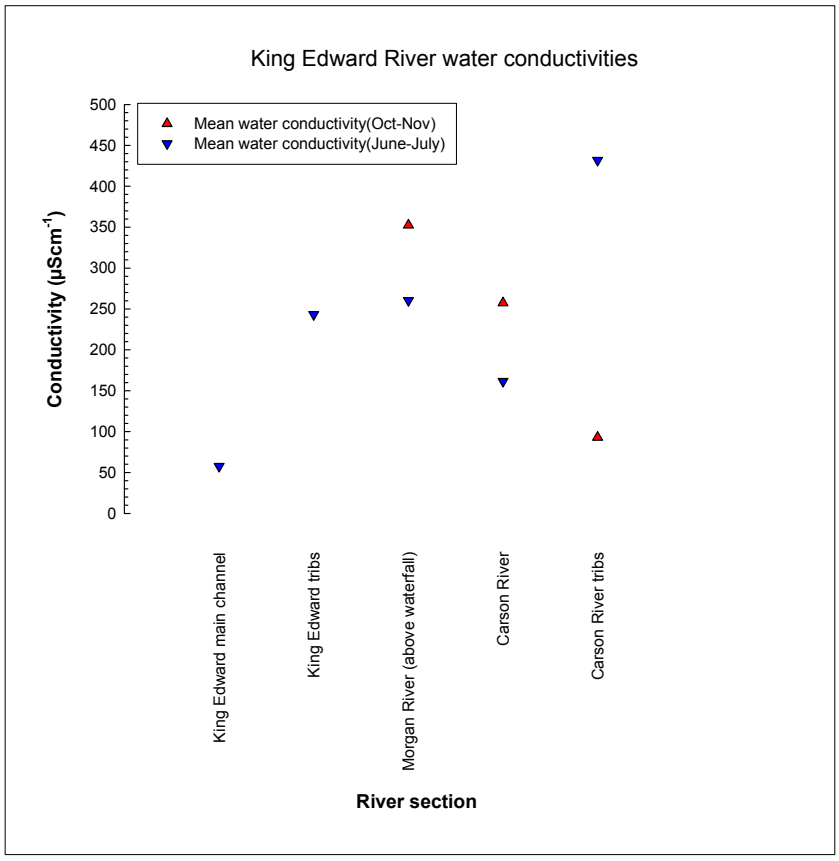


Figure 5 Mean water temperatures and conductivities for the sites sampled in the King Edward River main channel, the Carson River, the Morgan River (upstream of site 21) and the main tributaries in October-November 2004 and June-July 2005 (see methods and Figure 1). N.B. The King Edward River main channel and its tributaries were only sampled in 2004.

Fish species captured

A total of 14304 fish from 29 fish species were captured or observed in the freshwaters of the King Edward River system during this study, including two species only recorded from Dominic Creek (site 42) (see Figure 1, Table 2). A further two species were reported by Hutchins (1977). Of the total of 31 species, 28 were considered to be freshwater species, while the remaining three species, i.e. Barramundi (*Lates calcarifer*), Ox-eye Herring (*Megalops cyprinoides*) and Milkfish (*Chanos chanos*) are estuarine or marine species that may spend part of their life in freshwater. The marine species contributed to less than 0.15% (21 individuals) of the total catch and were only recorded from the main channel of the Carson River and from the Morgan River below the waterfall at site 21 (see Figures 1 and 6). This includes, however, a single Milkfish that was recorded from Dominic Creek (site 42) that is not part of the King Edward River system (see Figures 1 and 6).

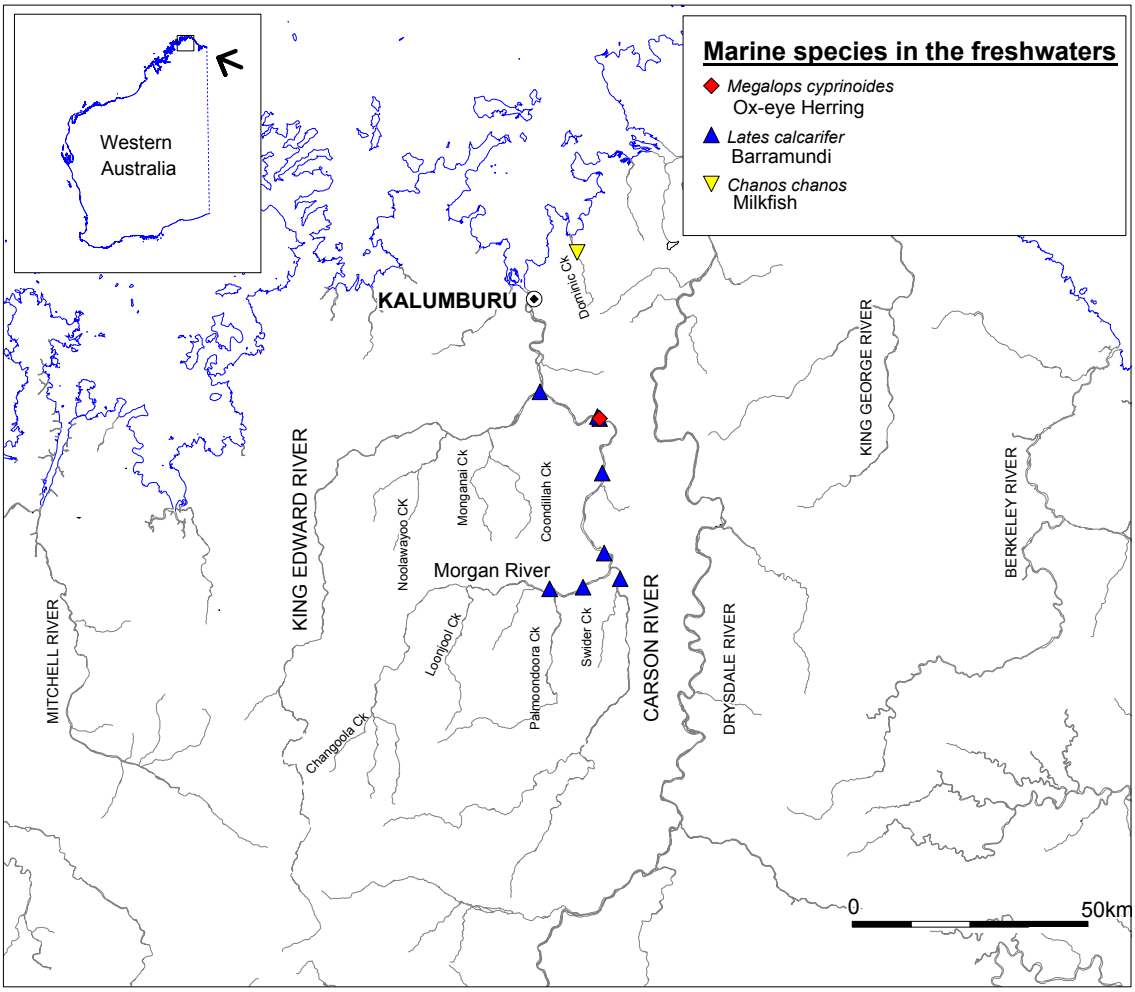


Figure 6 Locations of the marine/estuarine species that were captured in the freshwaters of the King Edward River system during this study.

Table 2 The sites at which the different freshwater fish species were captured in the King Edward River and its tributaries and in the Carson River and tributaries including the Morgan River (see Figure 1 for site localities). †denotes that the species was reported by Hutchins (1977), ‡ by Allen & Leggett (1990) and D represents the species being only found in Dominic Creek (site 42).

Fish species captured	King Edward River sites	Carson River sites	Total (KE,CR)
Freshwater fishes			
Bony Bream (*Nematalosa erebi*)		21,25-26,28,32-35,40†	0,9
Lesser Salmon Catfish (*Arius graeffei*)		21,25-26,28,32-35†	0,8
Silver Cobbler (*Arius midgleyi*)		21-22,26-28,32,35	0,7
Black Catfish (*Neosilurus ater*)		21,28,32,34,35†	0,5
Hyrtl's Tandan (*Neosilurus hyrtlii*)	1-3,13,7-8,14-15	10-11,17,26,28,32,34-35†	8,8
False-spined Catfish (*Neosilurus pseudospinosus*)		28†	0,1
Rendahl's Catfish (*Porochilus rendahli*)	1	40	1,1
Freshwater Longtom (*Strongylura krefftii*)		21,25-32,34-35†	0,11
Western Rainbowfish (*Melanotaenia australis*)	1-9,13-15,29-31‡	10-11,16-17,19-20,21-26, 28, 32,34-35,38-41†‡	15,20
Slender Rainbowfish (*Melanotaenia gracilis*)		18†	0,1
Black-banded Rainbowfish (*Melanotaenia nigrans*)D			D
Prince Regent Hardyhead (*Craterocephalus lentiginosus*)		21-22,28,32-35,38,40‡	0,9
Macleay's Glassfish (*Ambassis macleayi*)		26,28,32-34†‡	0,5
Ambassis sp.1	1-6,9,13-14	11,17,34,23,38,40	9,6
Mouth Almighty (*Glossamia aprion*)		32,34,38,40‡	0,4
Seven-spot Archerfish (*Toxotes chatareus*)		21-22,25-28,32-35,38†	0,11
Barred Grunter (*Amniataba percoides*)		19, 21-22,24-28,32-35,38,40†‡	0,14
Long-nose Sooty Grunter (*Hephaestus epirrhinos*)		†	0
Black Bream (*Hephaestus jenkinsi*)	1-4,9,13,31	16-17,19,21-22,25-28,32-35†‡	7,13
Spangled Perch (*Leiopotherapon unicolor*)	1-9,13-15,29-31‡	10,16-20,21-26,28,32-36,38, 40†‡	15,20
Butler's Grunter (*Syncomistes butleri*)		21-22,28,32,35	0,5
Long-nose Grunter (*Syncomistes trigonicus*)	3,9,13	16-17,33†	4,3
Empire Gudgeon (*Hypseleotris compressa*)		41	0,1
Slender Gudgeon (*Hypseleotris ejucinda*)		32,34	0,2
Kimberley Mogurnda (*Mogurnda oligolepis*)	7-8,14-15,29-30	10,17,24,38	6,4
Northern Trout Gudgeon (*Mogurnda mogurnda*)		†‡	0
Giant Gudgeon (*Oxyeleotris selheimi*)		24†‡	0,1
Flathead Goby (*Glossogobius giurus*)	3	21,26,28,32-35†‡	1,7
Marine fishes in the freshwaters			
Ox-eye Herring (*Megalops cyprinoides*)		32	0,1
Milkfish (*Chanos chanos*)D			D
Barramundi (*Lates calcarifer*)		21-22,26-28,32-33,35	0,8

In contrast to the low diversity of marine/estuarine fishes captured in the freshwaters of the King Edward River system, the freshwater species diversity was high (Table 2). The Western Rainbowfish (*Melanotaenia australis*) accounted for over two-thirds of all fish captured and was found in 35 of the 42 sites sampled. The next most abundant species, the Spangled Perch (*Leiopotherapon unicolor*), was also encountered at 35 sites and contributed to ~5.9% (828 individuals) of the total captures. The other freshwater species captured included some species not previously recorded from the river, i.e. Slender Gudgeon, Kimberley Mogurnda, Silver Cobbler, Rendahl's Catfish and Butler's Grunter and potentially a new species of glassfish (*Ambassis* sp. 1). The different habitat associations of the fish fauna associated with the King Edward River system are discussed below; followed by specific accounts of each of the freshwater fish species captured, their distributions and their Belaa and Ngarinyin names.

Habitat associations of the fishes in the King Edward River system

There were considerable differences in the fish fauna associated with the various sections of the King Edward River system. For example, the diversity of fishes captured in the upper King Edward River main channel was low (average of 5.5 species captured/site) compared to the Carson River main channel sites (an average of 12.4 species captured/site) (Figure 7). Similarly, within the Morgan River upstream of site 21, the King Edward River tributaries and the Carson River tributaries, the diversity of fishes was comparatively low, with an average of 3.2, 3.7 and 3.6 species recorded, respectively (Figure 7).

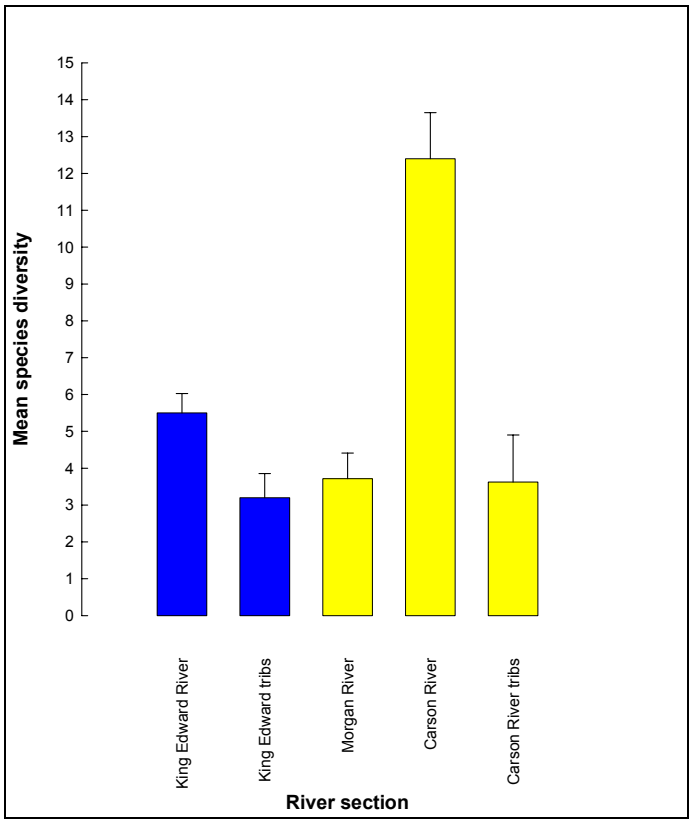


Figure 7 Mean number of fish species captured (±1SE) in the different regions of the King Edward River system (see also Figure 1).

The differences between the fishes in the different sections of the catchment can not only be measured in terms of species diversity, but also in the species associations within the various riverine sections. For example, the sites sampled in the King Edward River main channel were dominated by Western Rainbowfish (84.4% of all fish), *Ambassis* sp. (6.1%), Long-nose Grunter (4.3%), Spangled Perch (2.8%), Hyrtl's Tandan (1.2%) and Black Bream (Jenkin's Grunter) (1%), with one Rendahl's Catfish and four Flathead Goby captured at one site (Figure 8). In contrast, within the tributary sites of the King Edward River there were higher relative abundances of the Spangled Perch (10.8% cf. 2.8%) and Hyrtl's Tandan (5.6% cf. 1.2%) , but far fewer Black Bream (2 individuals cf. 62) and no Long-nose Grunter or Flathead Goby were captured (Figure 8). The Kimberley Mogurnda, while absent from the main channel King Edward sites, was found in six King Edward River tributary sites and contributed to 1.2% of captures.

The sites sampled in the Carson River and lower Morgan River had far more diverse fish faunas than the upper King Edward River, with not only many of the above species captured, but species recorded also included Barramundi, Silver Cobbler, Lesser Salmon Catfish, Black Catfish, False-spined Catfish, Macleay's Glassfish, Prince Regent Hardyhead, Ox-eye Herring, Seven-spot Archerfish, Flathead Goby, Bony Bream, Butler's Grunter, Barred Grunter, Mouth Almighty, Freshwater Longtom and a restricted species of gudgeon (Slender Gudgeon) (Figure 9). Within these sites the relative contribution of Western Rainbowfish (20.7%), Ambassis sp. (<1%), Hyrtl's Tandan (<1%) and Spangled Perch (1.8%) were noticeably lower than within the King Edward River and its tributaries and no Kimberley Mogurnda and only one Long-nose Grunter were recorded there. Within the Morgan River and its tributaries upstream of site 21, apart from the Slender Rainbowfish which was recorded at only one site and was found nowhere else during the study, these sites were characterised by a similar suite of species to the King Edward tributaries (Figure 9). The tributaries of the Carson River, which were dominated by Western Rainbowfish (77.2% of all fish) and Spangled Perch (13.8%), were differentiated from other tributary sites by containing a number of species that are restricted to either these sites or the Carson River main channel (Figure 9).

The above striking differences in fishes associated with the different regions of the King Edward River system are further highlighted when examining these data using PRIMER. These relationships are illustrated graphically in Figures 10 and 11. Both MDS and ordination of these data clearly demonstrate similarities (and differences) between the different regions. Both methods separate the Carson River sites (group 2) from the tributary sites and the King Edward River main channel (group 3) (Figure 11). The outlying sites in both Figures 10 and 11 are separated on the basis of each site containing a species that was captured nowhere else in the catchment, i.e. Slender Rainbowfish in the Morgan River tributary (site 18) and the Empire Gudgeon in a Carson River tributary site (site 41).

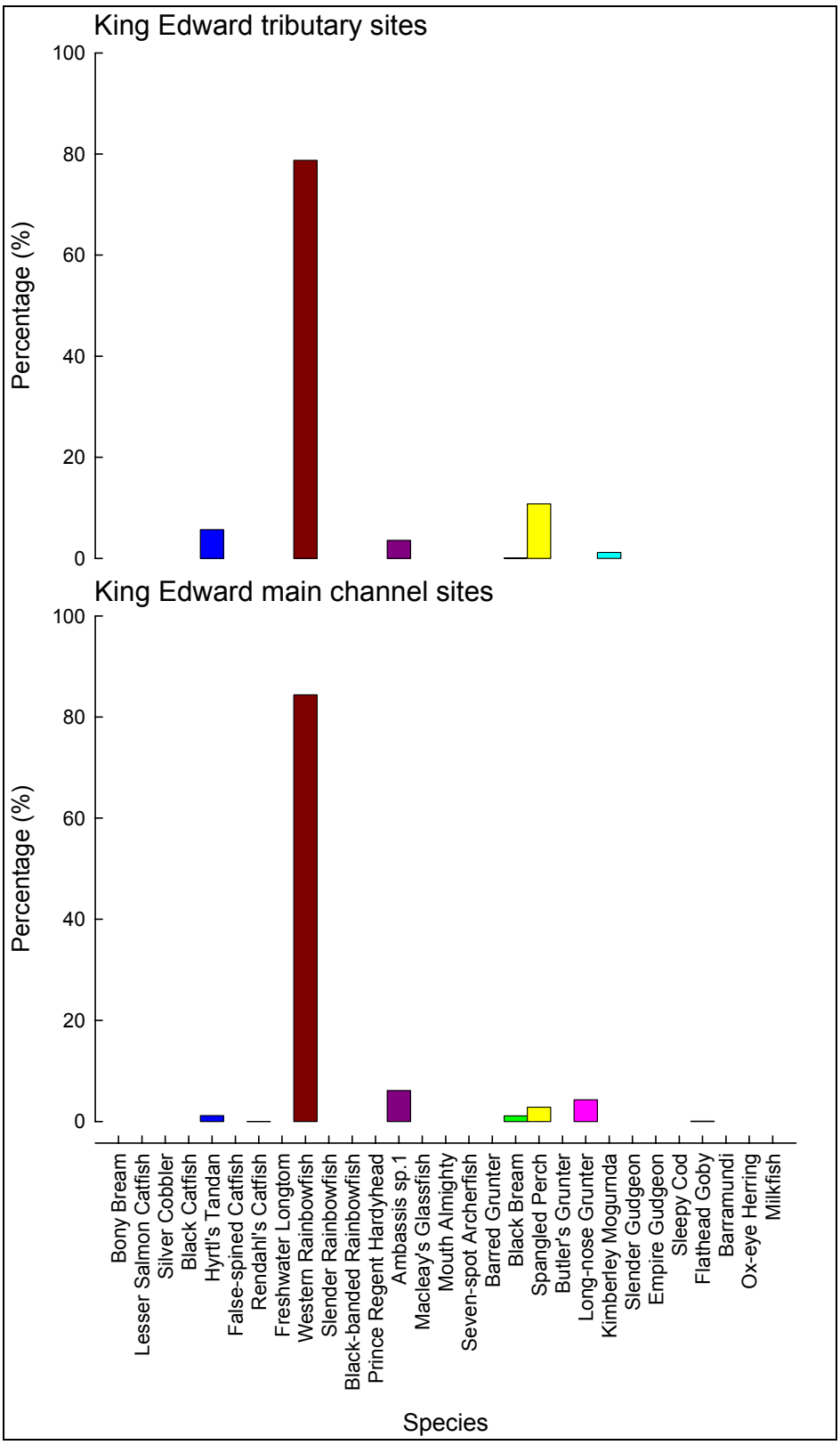


Figure 8 Percentage contributions to the total catch of the different species in the upper King Edward River main channel compared to tributary sites.

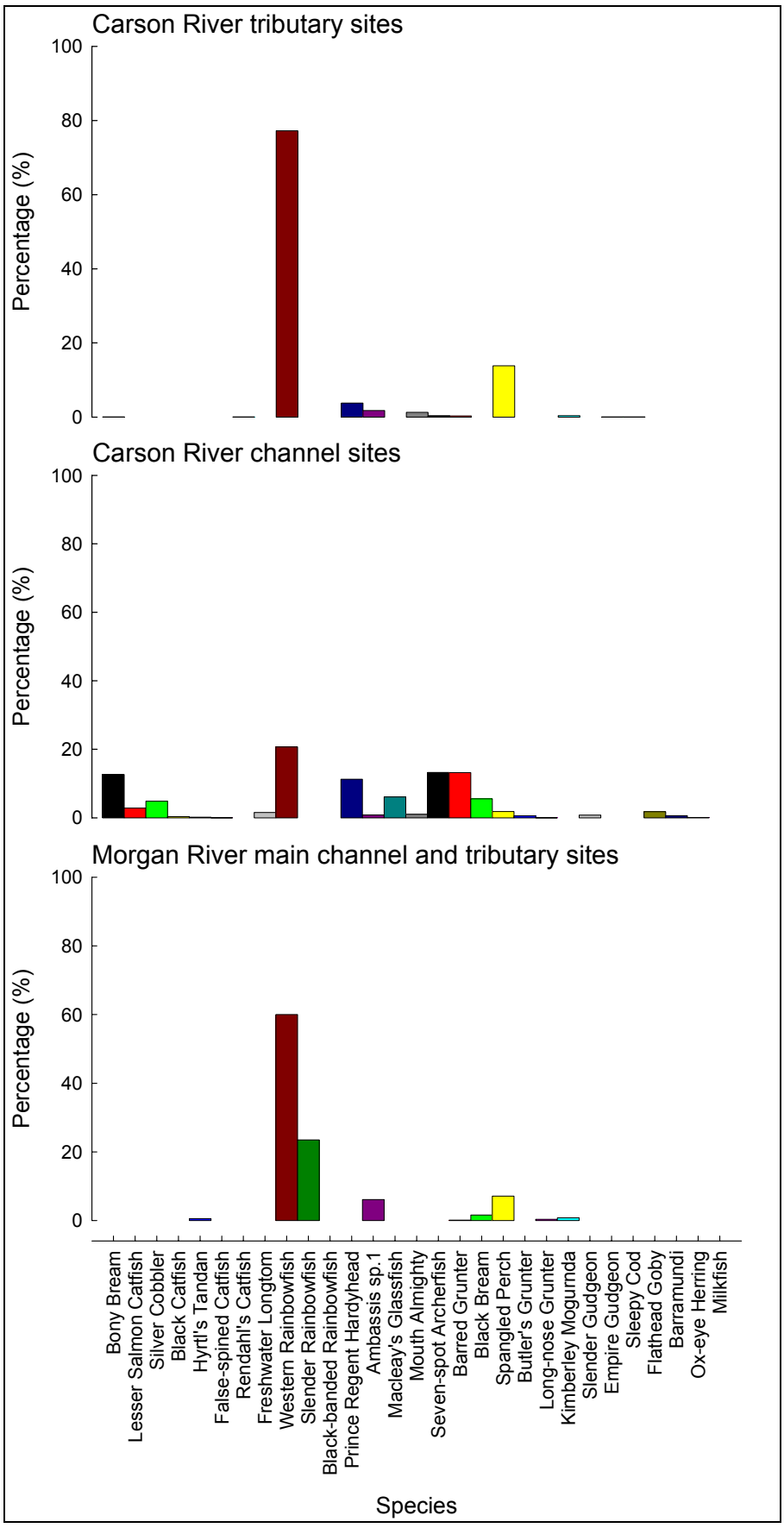


Figure 9 Percentage contributions to the total catch of the different species in the Carson River tributaries, main channel, and the Morgan River main channel and tributaries (upstream of site 21).

Analysis of Similarity (ANOSIM) suggested that these major differences in species occurrences throughout the catchment were, in most cases, highly significant ($p<0.01$) (Table 3). The instance where two regions were considered not to differ in terms of prevailing fish fauna was between the Morgan River and the tributaries of the Carson River. The Carson River main channel however was found to have highly significant differences ($p\leq0.001$) to all other regions sampled (Table 3). The cumulative species plot further highlights the sharp increase in species diversity once the species counts for the Carson River and lower Morgan River sites are included; see species 'jump' in Figure 12, site 20-21.

Table 3 R-stat values for ANOSIM pairwise comparisons of the fish fauna associated with the different regions of the King Edward River system. N.B. Significantly different faunal relationships are represented by: *$p\leq0.5$, **$p\leq0.01$ and ***$p\leq0.001$.

REGION	King Edward River	King Edward tributary	Morgan River	Carson River
King Edward tributary	0.469**	-	-	-
Morgan River	0.291**	0.140*	-	-
Carson River	0.933***	0.945***	0.750***	-
Carson tributary	0.271*	0.207*	-0.082	0.719***

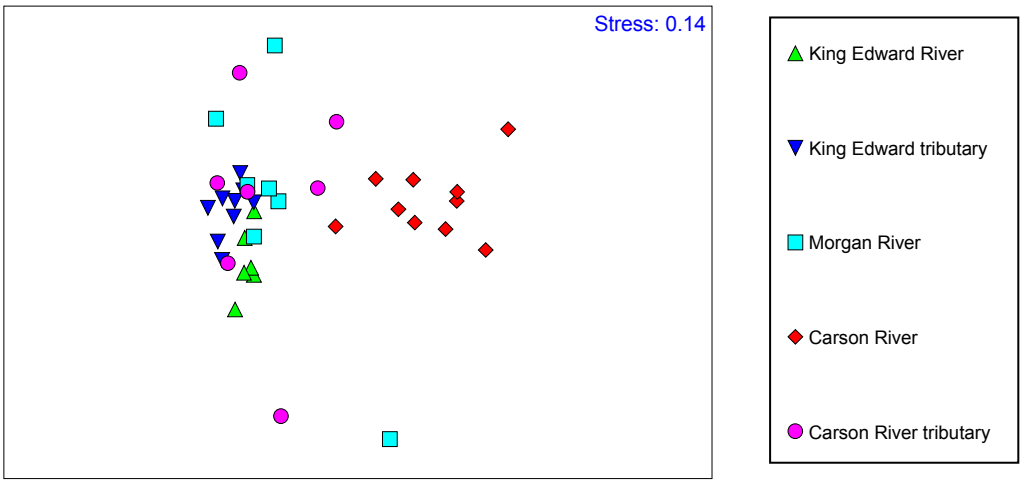


Figure 10 Multidimensional scaling (MDS) plot of the fish species associated with the sites sampled in the King Edward River, the Morgan River and the Carson River and their tributaries (see Figure 1 for site locations).

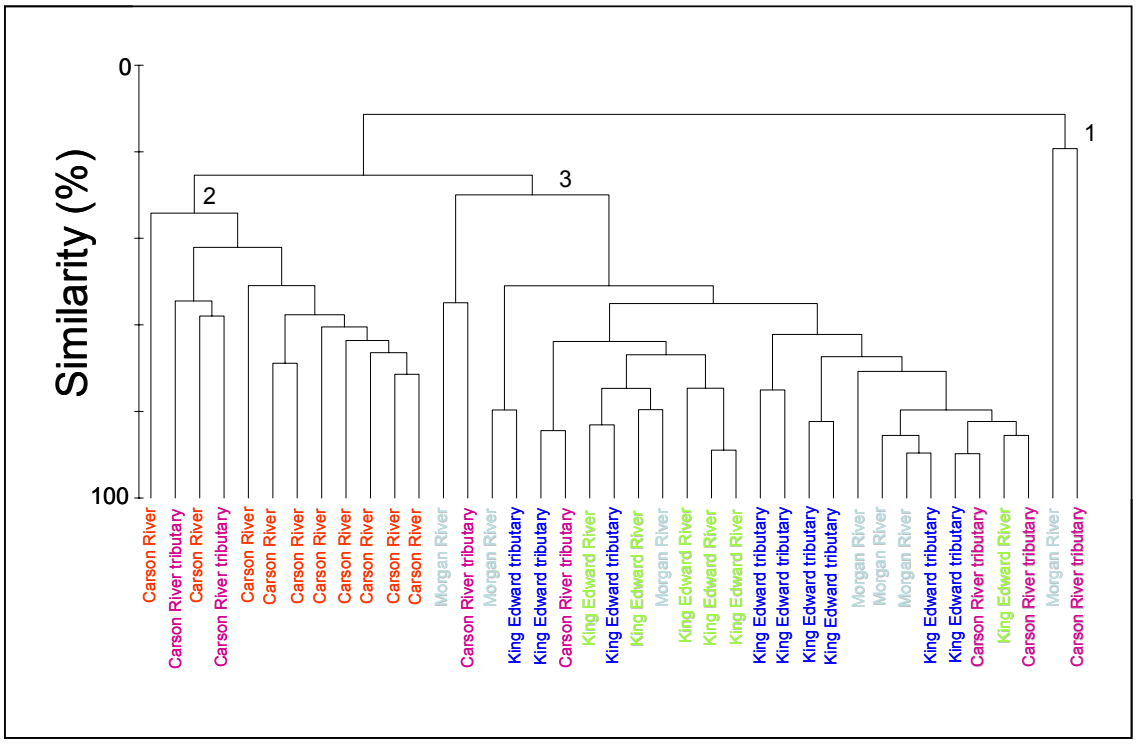


Figure 11 Ordination plot of the fish species associated with the sites sampled in the King Edward River, the Morgan River and the Carson River and their tributaries (see Figure 1 for site locations).

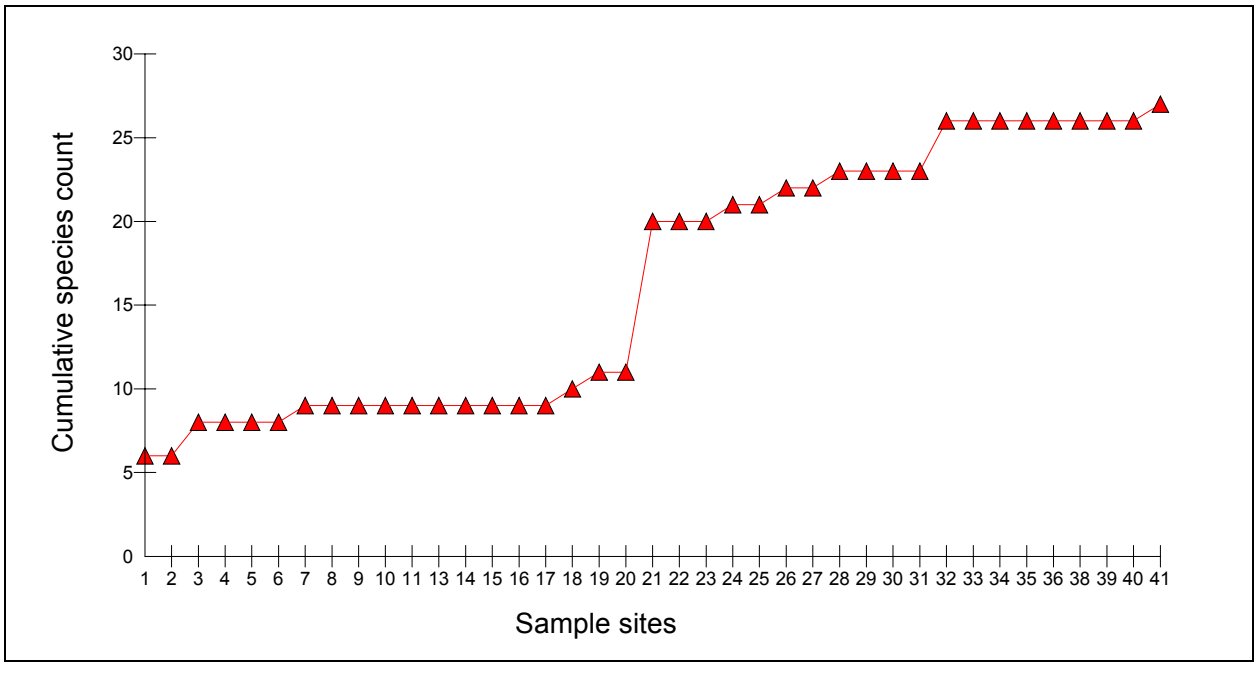


Figure 12 Cumulative species plot of the number of fish species captured in the King Edward River (sites 1-4, 9, 13), tributaries of the King Edward River (sites 5-8, 12, 14-15, 29-31), the Morgan River (sites 10-11, 16-20), the Carson River (sites 21-22, 25-28, 32-35) and the Carson River tributaries (sites 23-24, 36-41). N.B. The substantial increase in species recorded at Carson/lower Morgan River sites (from site 21).

Bony Bream (*Nematalosa erebi*) (CLUPEIDAE)

Gunangurri (*Ngarinyin*)

Capture localities during this study

A total 341 Bony Bream, which is one of Australia's most widespread freshwater species and one of only two Australian freshwater clupeids, was captured at a total of nine sites during this study, all either within the Carson River or below the waterfall on the Morgan River (site 21) (Figure 13). None was captured in the King Edward River upstream of the confluence with the Carson River. Hutchins (1977) recorded five individuals from Palmoondoora Creek and 25 from the Carson River. Not eaten by traditional owners of the region but highly regarded as a bait species.

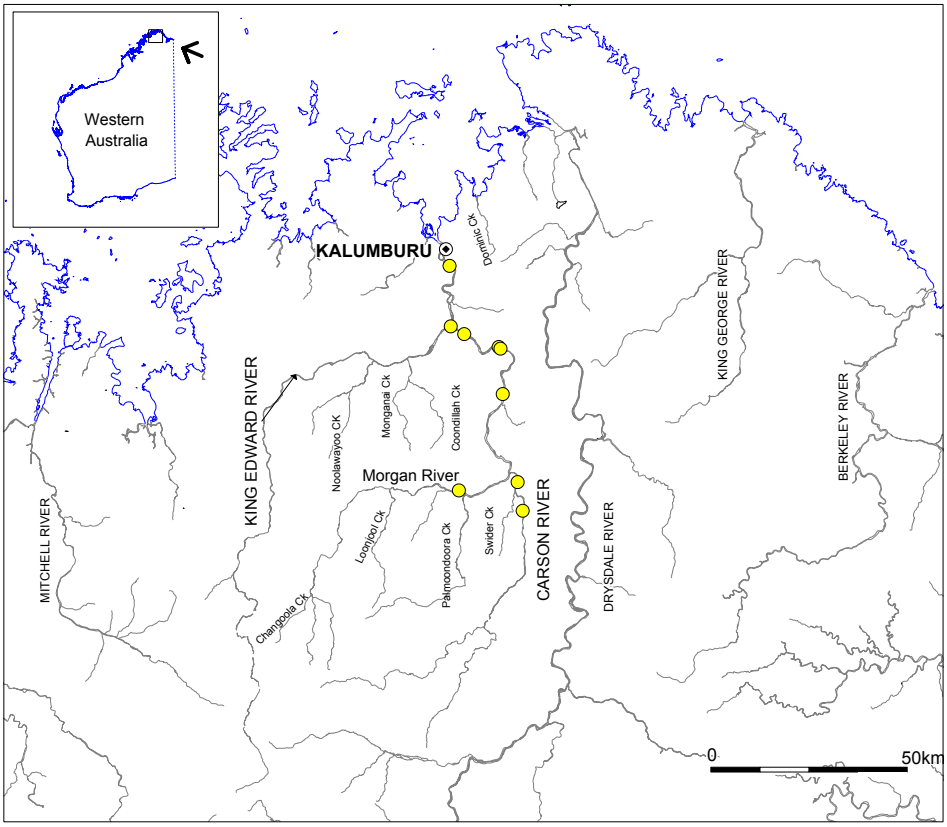


Figure 13 Bony Bream (*Nematalosa erebi*) capture sites in the King Edward and Carson River systems during this study.

Lesser Salmon Catfish (*Arius graeffei*) (ARIIDAE)

Maada-kudengei manya **(*Belaa*)**

Moolirr / Yawarl ngarri (*Ngarinyin*)

Capture localities during this study

A total of 76 Lesser Salmon Catfish were captured during this study at seven sites. All capture sites were within the Carson River main channel or the lower reaches of the Morgan River downstream of site 21 (Figure 14). Hutchins (1977) also reports this species from the Carson River upstream of the Morgan River mouth. It is a species that is considered good eating. Pansy Nulgit provided a second Ngarinyin name **Yawarl ngarri** for the catfish, whereas **Moolirr** was recorded during previous work (see Morgan *et al*. 2004).

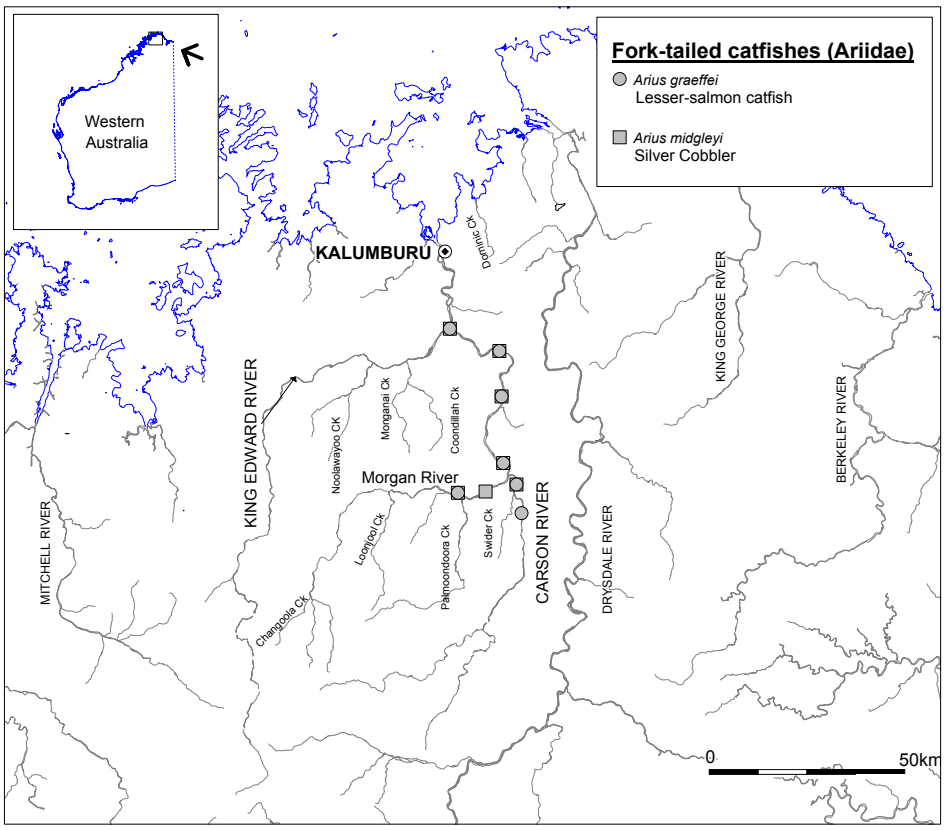


Figure 14 Capture sites of the Lesser-salmon Catfish (*Arius graeffei*) and Silver Cobbler (*Arius midgleyi*) in the King Edward and Carson River systems during this study.

Silver Cobbler (*Arius midgleyi*) (ARIIDAE)

Maada-kudengei manya **(*Belaa*)**

Capture localities during this study

Distinguished from Lesser Salmon Catfish by a more blunt snout when viewed dorsally (see above) and attaining a far greater maximum size (1400 mm total length (TL) cf. 600 mm TL). A total of 131 Silver Cobbler (or Shovel-nosed Catfish) were captured during this study at seven sites (Figure 14). All capture sites were within the Carson River main channel or the lower reaches of the Morgan River downstream of site 21 (see Figure 14) and essentially parallels the distribution of the other fork-tailed catfish (Lesser Salmon Catfish) in the system. There have been no other published reports of this species being found in the catchment. While Allen *et al*. (2002) reports the species to be found in rivers east (and north) of the Fitzroy River in the southern Kimberley, this is erroneous, and it has not been recorded in that river (see Morgan *et al*. 2004). The Western Australian Museum only has specimens from the Ord River system in WA, which is east of the Carson River. Thus, the finding of Silver Cobbler within the Carson River represents a notable range extension to the west. Fish up to 722 mm total length (TL) were captured during this study.

Black Catfish (*Neosilurus ater*) (PLOTOSIDAE)

Dorungai ninya **(*Belaa*)**

Capture localities during this study

Similar to the two fork-tailed catfishes, the eel-tailed Black Catfish was only captured within the Carson River (Figure 15). The Black Catfish was much rarer that the fork-tailed catfishes with only nine individuals recorded at five sites. Highly regarded as a

food fish to the people of Kalumburu, the nine captured during this study ranged in length from 314 to 402 mm TL. Hutchins (1977) also reported a single specimen from the Carson River upstream of the Morgan River mouth.

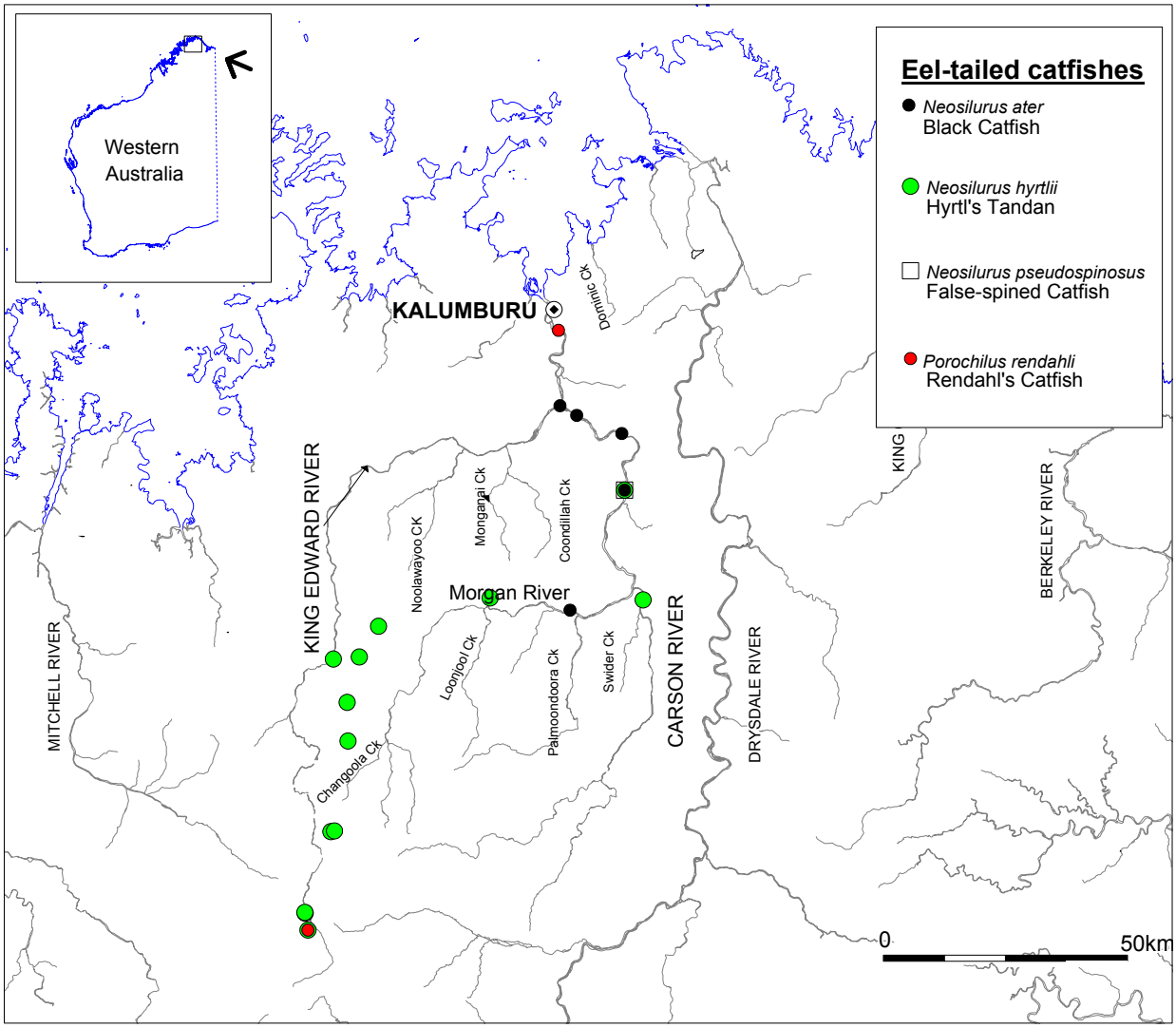


Figure 15 The sites in the King Edward and Carson River systems that the four species of eel-tailed catfishes (Plotosidae) were captured at during this study.

Hyrtl's Tandan (*Neosilurus hyrtlii*) (PLOTOSIDAE)

Dorungai ninya **(*Belaa*)**
Walaman (*Ngarinyin*)

Capture localities during this study

Hyrtl's Tandan is one of Australia's most widely distributed freshwater fishes and it was widely distributed throughout the sites sampled in this study (see Figure 15). However, they were most abundant in the upper King Edward River main channel and its tributaries. For example, 65 individuals were found in four main channel sites and 175 in four tributary sites of the King Edward River. This contrasts the catches in the Carson River and Morgan River where only five and six individuals, respectively, were captured. None was captured in the Carson River tributary sites. They are generally a small species and during this study were rarely found to exceed 150 mm TL.

False-spined Catfish (*Neosilurus pseudospinosus*) (PLOTOSIDAE)

Dorungai ninya **(*Belaa*)**

Capture localities during this study

A single False-spined Catfish (295 mm TL) was captured at site 28 in the Carson River during this study (see Figure 15). While very similar in appearance to the Black Catfish, False-spined Catfish (as the common and scientific names suggest) are readily distinguished by the absence of rigid spines on the dorsal and pectoral fins. Hutchins (1977) reported 16 individuals from the Carson River (74-279 mm SL) and a further five specimens from Palmoondoora Creek (89-147 mm SL).

Rendahl's Catfish (*Neosilurus rendahli*) (PLOTOSIDAE)

Dorungai ninya **(*Belaa*)**
Walaman (*Ngarinyin*)

Capture localities during this study

Rendahl's Catfish has not previously been reported from the King Edward or Carson Rivers. The species has a patchy distribution across northern Australia (Allen *et al*. 2002) and the same may be said within the King Edward River system (see Figure 15) where only two individuals were found at one site in the upper reaches of the King Edward River (site 1) and in one tributary site near the mouth of the river (site 40). Very similar in appearance to Hyrtl's Tandan but is best distinguished by the longer nasal barbels that reach beyond the eye and a head shape that is concave rather than rounded.

Freshwater Longtom (*Strongylura krefftii*) (BELONIDAE)

Wuluwa ninya / **Jaburru** manya **(*Belaa*)**
Biyira / Garnburu (*Ngarinyin*)

Capture localities during this study

A total of 41 Freshwater Longtom were recorded during this study, all of which were found either within the main channel of the Carson River or in the lower Morgan River (Figure 16). None was captured in the King Edward River upstream of the confluence with the Carson River. Hutchins (1977) recorded five individuals (61-329 mm TL) from the Carson River upstream of the junction with Orchid Creek. Pansy Nulgit provided a second Ngarinyin name, **Garnburu** for the longtom, whereas **Biyira** was recorded during previous work (see Morgan *et al*. 2004).

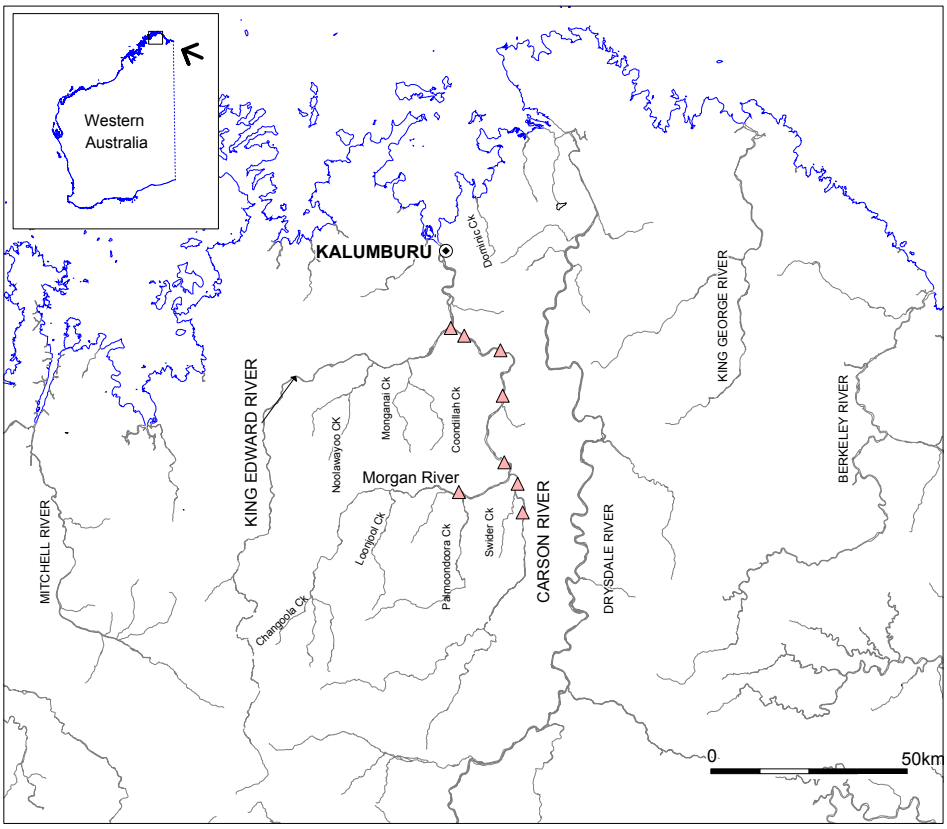


Figure 16 The sites that Freshwater Longtom (*Strongylura krefftii*) was captured at in the King Edward and Carson River systems during this study.

Western Rainbowfish (*Melanotaenia australis*) (MELANOTAENIIDAE)

Gooljirimby (*Ngarinyin*)

Capture localities during this study

The Western Rainbowfish was extremely widespread and abundant (Figure 17). It was captured at all main channel sites in the King Edward River and in all of the King Edward River tributary sites. They were also found within all but one Morgan River site, where they were replaced by the Slender Rainbowfish, and all but two Carson River main channel sites and two Carson River tributary sites. They represented approximately 80% of all captures in the King Edward main channel, King Edward tributaries and Carson tributary sites, but were much less abundant in the Carson River main channel (see Figures 8 and 9).

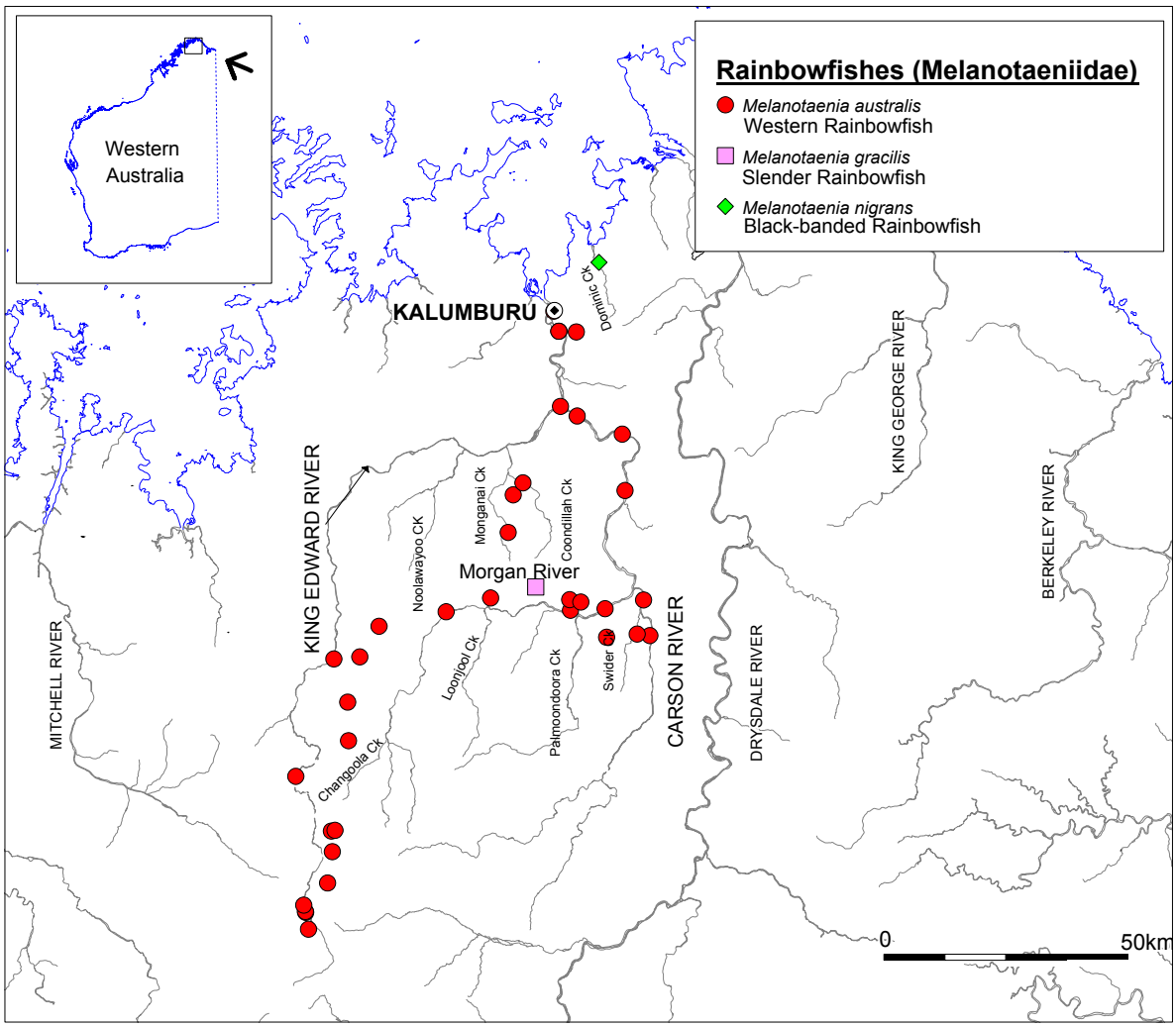


Figure 17 The sites that Western Rainbowfish (*Melanotaenia australis*), Slender Rainbowfish (*Melanotaenia gracilis*) and the Black-banded Rainbowfish (*Melanotaenia nigrans*) were captured at during this study.

Slender Rainbowfish (*Melanotaenia gracilis*) (MELANOTAENIIDAE)

Capture localities during this study

In contrast to the Western Rainbowfish, the Slender Rainbowfish is extremely restricted within the study region (Figure 17). It was only captured at a single tributary site within the Morgan River (site 18). At this site it was however very abundant, with 265 individuals captured. The only co-occurring species at this site was the Spangled Perch.

The overall distribution of the Slender Rainbowfish is highly restricted, with it known only to occur in the King Edward and Drysdale River systems (Allen 1978, Allen *et* al. 2002).

Black-banded Rainbowfish (*Melanotaenia nigrans*) (MELANOTAENIIDAE)

Capture localities during this study

The Black-banded Rainbowfish was not captured within the King Edward River system but it was found at a single site on Dominic Creek (site 42) which is ~15 km to the east of the mouth of the King Edward River (Figure 17). They have previously been reported in Dominic Creek by Allen & Leggett (1990). They can be distinguished from the Slender Rainbowfish by a more defined mid-lateral stripe and by the position of the first dorsal fin which originates in line with the anal fin in Black-banded Rainbowfish rather than originating in line with the 2nd to 4th soft anal ray in the Slender Rainbowfish (Allen 1978).

Prince Regent Hardyhead (*Craterocephalus lentiginosus*) (ATHERINIDAE)

Capture localities during this study

The Prince Regent Hardyhead was absent from our catches in the King Edward River main channel and the tributary sites of the King Edward River and Morgan River

(upstream of site 21) (Figure 18). It was however, relatively abundant in the main channel of the Carson River and lower Morgan River and within two tributaries of the lower main channel (see Figures 8, 9 and 18). A total of 361 individuals were captured, with over 80% of these being found in the Carson River main channel and lower Morgan River. Allen & Leggett (1990) captured eight specimens of this species near Kalumburu.

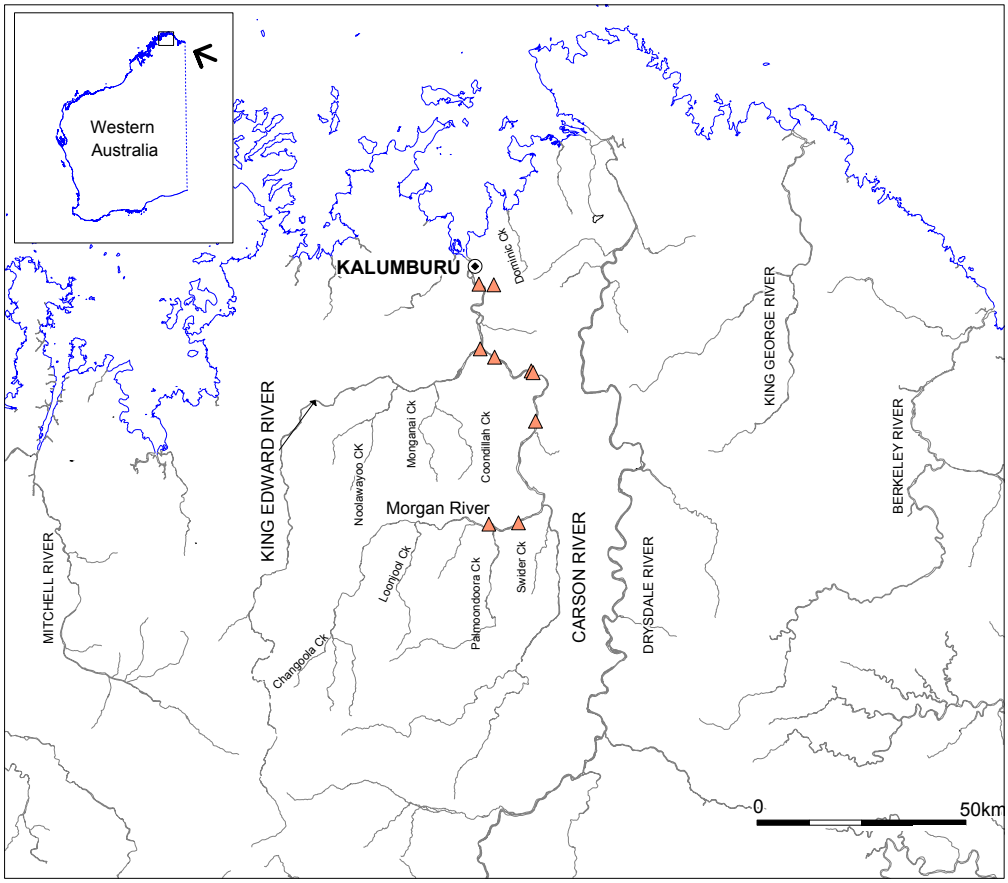


Figure 18 The distribution of the Prince Regent Hardyhead (*Craterocephalus lentiginosus*) in the King Edward River system.

Macleay's Glassfish (*Ambassis macleayi*) (AMBASSIDAE)

Capture localities during this study

Macleay's Glassfish were only captured within main channel sites of the Carson River (Figure 19). A total of 165 individuals were captured within five sites (see Figures 8 and 9). Allen & Leggett (1990) however, reported four individuals (16-26 mm SL) from Monger Creek, ~10 km west of Kalumburu.

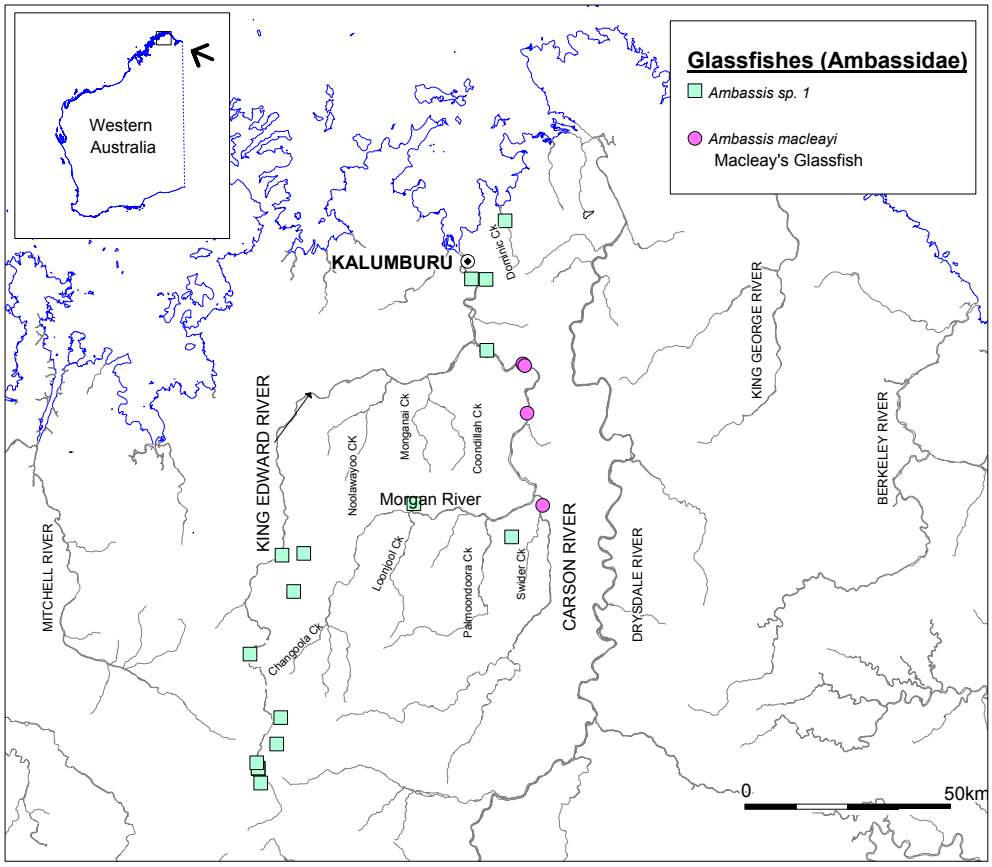


Figure 19 The sites that Macleay's Glassfish (*Ambassis macleayi*), and *Ambassis* sp. 1 were captured during this study.

Ambassis sp. 1 (AMBASSIDAE)

Wolaman (*Ngarinyin*)

Capture localities during this study

An unidentifiable species of glassfish (*Ambassis* sp.) (pictured above) was found to be widespread throughout the King Edward River system (Figure 19). It was particularly abundant in the main channel of the upper King Edward River where it was recorded at all sites (344 individuals). A further 110 individuals were captured within the tributaries of the upper King Edward, while 69, 22 and 57 were recorded form the Morgan River, Carson River and Carson tributaries, respectively. This species was not reported by previous authors from the river. Allen *et al.* (2002) provide a broad Kimberley distribution for the Northwest Glassfish (*Ambassis* sp. (formerly *Ambassis mulleri*)), but based on the description they provide and from that in Allen & Burgess (1990), the King Edward glassfish can be distinguished by a number of characters. For example, from 10 individuals examined (22.5-49.86 mm TL (17.13-36.55 mm SL)), morphological differences such as head spines, fin rays, as well as relative body measurements are different (see Table 4). The suborbital, preorbital ridge and hind margin of the preoperculum are all smooth in the King Edward glassfish but are spinosus on the Northwest Glassfish. Furthermore, there are large differences in proportional body measurements and generally fewer gill rakers and predorsal scales in the King Edward *Ambassis* (Table 4). From the above it appears likely that the King Edward species is new. More counts are required of the species and it requires formal description.

Table 4 Morphological counts for the unidentified glassfish captured in the King Edward River compared to the Northwest Glassfish (*Ambassis* sp. – formerly *Ambassis mulleri*). For an explanation of characters see Allen & Burgess (1990). SL = standard length.

Morphological counts	**Northwest Glassfish** ***Ambassis mulleri***	**King Edward Glassfish** ***Ambassis* sp. 1**
Preorbital ridge	smooth or 1-11 spines	smooth
Suborbital	occasionally smooth or 1-14 spines	smooth
Supraorbital ridge	1 spine	smooth or with 1 spine
Hind margin of preoperculum	1-10 spines	Smooth
Predorsal scales	13-14	9-12
Vertical scale rows	25-26	23-26
1st dorsal spines	7	6-8
2nd dorsal soft rays	8-9	7-9
Pectoral fin rays	11-13	10-12
Snout length (% of SL)	6.3-8.1	6.5-10.3
Body depth (% of SL)	36.4-45	29.1-39.0
Caudal peduncle depth (% of SL)	15.5-17.5	13.2-21.6
1st dorsal height (% of SL)	24-36.8	20.2-27.3
Gill rakers on lower limb of first arch	16-19	15-16

Mouth Almighty (*Glossamia aprion*) (APOGONIDAE)

Damari (*Ngarinyin*)

Capture localities during this study

The Mouth Almighty was only captured at two main channel and two tributary sites of the Carson River (Figure 20). None was captured within the King Edward River. A total of 48 individuals were caught accounting for less than 0.4 % of all fish captured. Allen & Leggett (1990) recorded five individuals from Monger Creek, ~10 km west of Kalumburu, while Hutchins (1977) recorded five from the Carson River upstream of the confluence with the Morgan River.

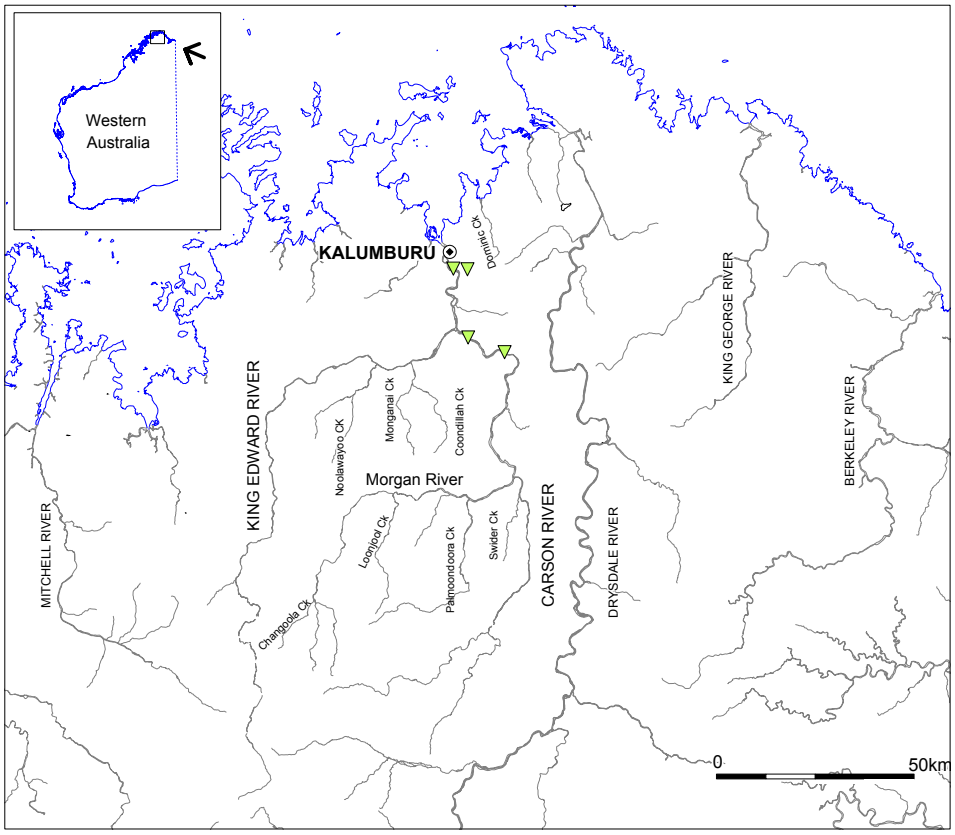


Figure 20 The sites that the Mouth Almighty (*Glossamia aprion*) was captured at during this study.

Seven-spot Archerfish (*Toxotes chatareus*) (TOXOTIDAE)

Wungkalbarr manya **(*Belaa*)**
Nalawarr (*Ngarinyin*)

Capture localities during this study

While Hutchins (1977) captured 12 specimens of the Seven-spot Archerfish in the Carson River above the confluence with the Morgan River, we recorded a total of 363 individuals from all main channel Carson River sites sampled and from one tributary site (Figure 21). It was not captured within the King Edward River upstream of the confluence with the Carson River. They accounted for ~13% of all fish captured in the Carson River main channel but less than 1% of fish captured in the tributaries of the Carson River.

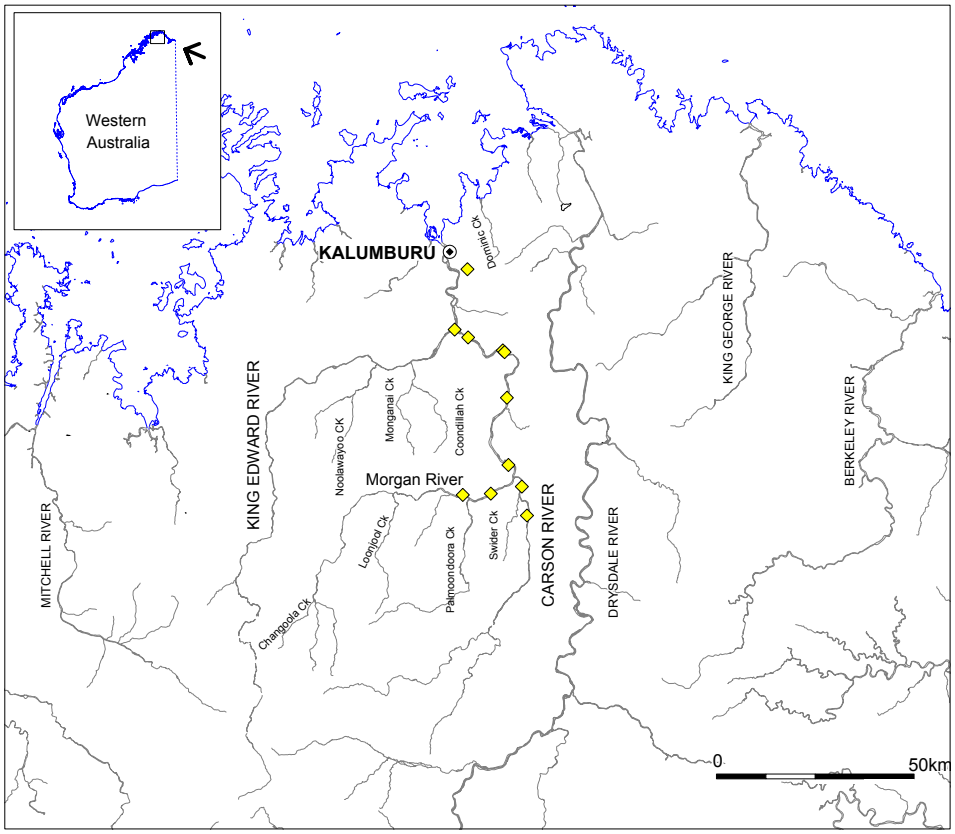


Figure 21 The sites that the Seven-spot Archerfish (*Toxotes chatareus*) was captured at during this study.

Barred Grunter (*Amniataba percoides*) (TERAPONTIDAE)

Kûkûridingei manya **(*Belaa*)**

Birlirndirr (*Ngarinyin*)

Capture localities during this study

The Barred Grunter was extremely common within the Carson River main channel, and with the exception of five individuals captured in the Carson tributaries it was not recorded anywhere else (Figure 22). A total of 360 individuals were recorded and they accounted for approximately 13% of all fish captured in the Carson River main channel. Allen & Leggett (1990) recorded three fish in Monger Creek and a further nine in the lower King Edward River near Monger Creek. Hutchins (1977) recorded a total of 26 individual Barred Grunter in the Carson River upstream of the confluence with the Morgan River and in Palmoondoora Creek below Morgan Falls.

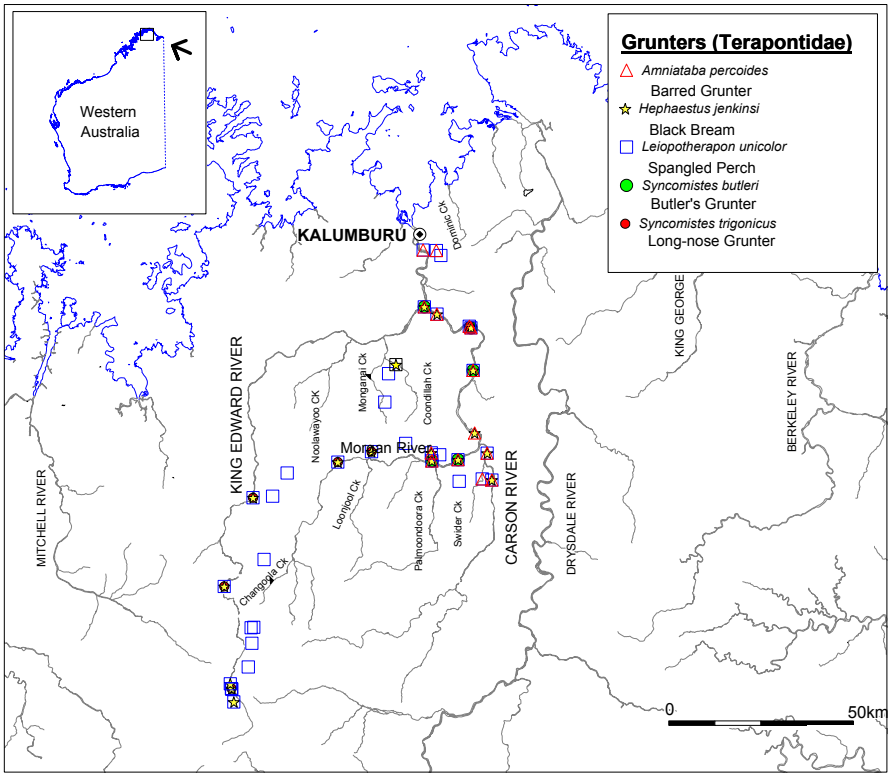


Figure 22 The sites where Barred Grunter (*Amniataba percoides*), Black Bream (*Hephaestus jenkinsi*), Spangled Perch (*Leiopotherapon unicolor*), Butler's Grunter (*Syncomistes butleri*) and Long-nose Grunter (*Syncomistes trigonicus*) were captured at in the King Edward and Carson River systems during this study.

Long-nose Sooty Grunter (*Hephaestus epirrhinos*) (TERAPONTIDAE)

Amalarr manya **(*Belaa*)**
Emana (*Ngarinyin*)

Capture localities during this study

The Long-nose Sooty Grunter was not captured during this study but it was recorded by Hutchins (1977) below Morgan Falls on Palmoondoora Creek. Other than that record, the species is only known from the nearby Drysdale River (see Figure 22). It attains a relatively large size in the Drysdale River and is apparently good eating.

Black Bream (*Hephaestus jenkinsi*) (TERAPONTIDAE)

Amalarr manya **(*Belaa*)**
Emana (*Ngarinyin*)

Capture localities during this study

With the exception of two individuals captured in a small tributary of the King Edward River, the Black Bream (otherwise known as Jenkin's Grunter or Western Sooty Grunter) is restricted to main channel sites or larger waterbodies (Figure 22). It is highly regarded as a food for the local people and is the most commonly sought after fish in the area. It appears to obtain a much larger size in the King Edward than the Fitzroy River or it may be that fishing pressure is less in the King Edward. Interestingly, a relatively large proportion in the King Edward River has 'blubber-lips' (pictured above). Of 61 superficially examined in the Carson River, 19 had obvious 'blubber-lips' while two had minor 'blubber-lips'. The condition is probably genetic but may be related to diet. This condition was previously reported for the species in the Carson River by Hutchins (1977).

Ectoparasite of Black Bream and Spangled Perch

Within the Morgan River main channel, an unidentified species of *Argulus* (Crustacea: Branchiura), pictured below, was found on one Black Bream and three Spangled Perch. On each occasion the parasite was found on the caudal (tail) fin lobes. The specimens were photographed and sent to Dr William Polly (Californian Academy of Science) who is currently revising the genus. He indicated that the specimens were from an undescribed species.

Spangled Perch (*Leiopotherapon unicolor*) (TERAPONTIDAE)

Jelenji manya **(*Belaa*)**

Wunggari (*Ngarinyin*)

Capture localities during this study

The Spangled Perch is an extremely successful species which has led to it being the mostly widely distributed freshwater fish in Australia. This species was captured in all but six sites sampled during this study (Figure 22). It was most abundant in the tributary sites and accounted for ~6% of all captures across all sites. In the tributaries of the King Edward, Morgan and Carson Rivers they contributed to 10.8, 7 and 13.8% of the catches, respectively, whereas in the main channel of the upper King Edward and the Carson River they were less abundant contributing to 2.8 and 1.8%, respectively, of the catches in these parts of the catchment (Figures 8 and 9).

Butler's Grunter (*Syncomistes butleri*) (TERAPONTIDAE)

Amalarr manya **(*Belaa*)**

Capture localities during this study

Butler's Grunter was previously only known from rivers east of, and including, the Drysdale River east to the Liverpool River in the Northern Territory (Allen *et al*. 2002). Thus, its capture within the Carson River represents a westerly range extension for the species (Figure 22). A total of 16 individuals were captured at five sites within the Carson River main channel where they were mainly found under shaded deep river banks.

Long-nose Grunter (*Syncomistes trigonicus*) (TERAPONTIDAE)

Kungkumirri manya **(*Belaa*)**

Emana (*Ngarinyin*)

Capture localities during this study

The Long-nose Grunter is relatively common in the main channel of the upper King Edward River where 241 individuals were captured (Figures 8, 9 and 22). While none was recorded in the tributaries of the King Edward or Carson River, they were recorded in the Morgan River (4 individuals) and Carson main channel (1 individual) (Figure 22). They are a schooling species that prefers rocky habitats. The juveniles have more obvious lateral stripes than the adults. Their mouth is probably adapted for scraping algae off rocks which was observed while snorkelling with the species.

Empire Gudgeon (*Hypseleotris compressa*) (ELEOTRIDAE)

Capture localities during this study

A single Empire Gudgeon was recorded in a small tributary near the mouth of the King Edward River (Figure 23). The species had not previously been recorded from this river. While numerous sources consider the species to be a freshwater species, in northern Western Australia it appears to be more often captured in or near the mouth of rivers and rarely penetrates far into freshwaters and should probably be considered an estuarine species (see Morgan & Gill 2004).

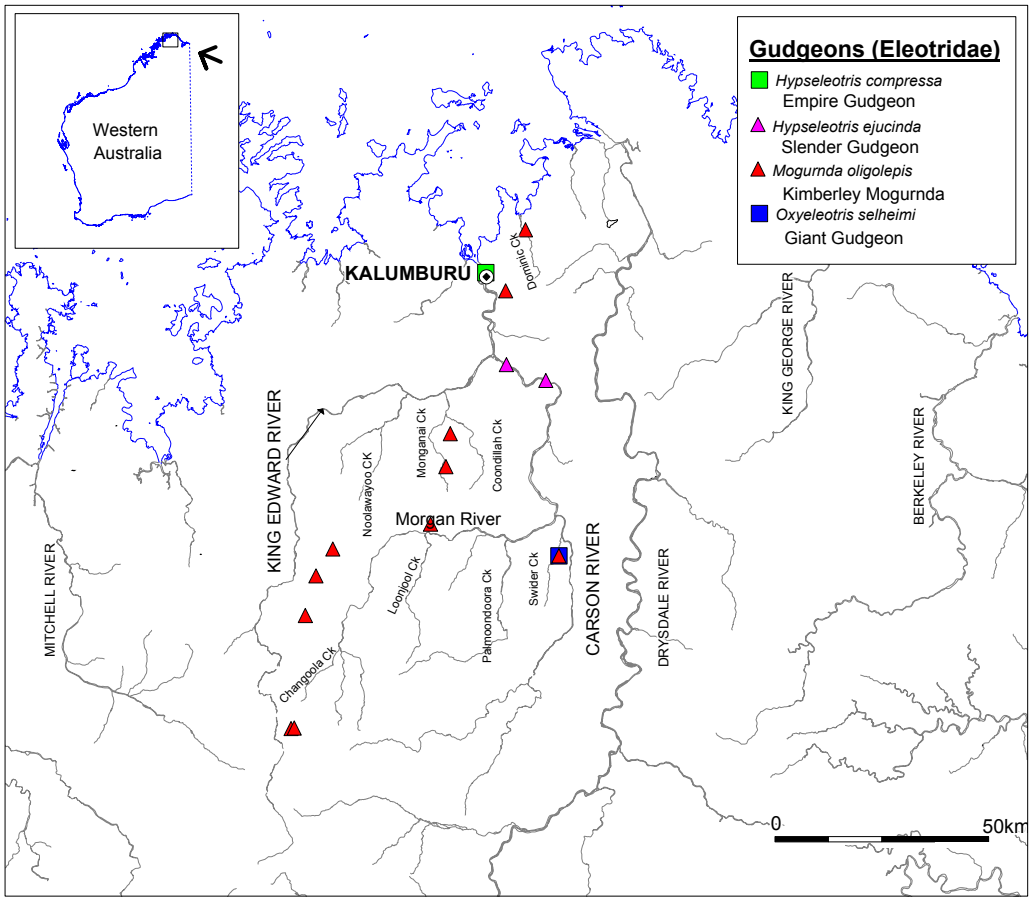


Figure 23 The sites where the Empire Gudgeon (*Hypseleotris compressa*), Slender Gudgeon (*Hypseleotris ejucinda*), Kimberley Mogurnda (*Mogurnda oligolepis*) and Giant Gudgeon (*Oxyeleotris selheimi*) were captured at in the King Edward River system during this study.

Slender Gudgeon (*Hypseleotris ejucinda*) (ELEOTRIDAE)

Mangena (*Ngarinyin*)

Capture localities during this study

The Slender Gudgeon was previously only known from a few specimens from Gundarara Creek in the Prince Regent River, West Kimberley (Hoese & Allen 1983). The 21 individuals captured (Figure 9) in the Carson River main channel (Figure 23) represent an important range extension for the species. At one site all captured using mask and snorkel and a dip net where individuals were observed 'hanging' in the water column amongst fallen leaves and roots of *Pandanus*. The Slender Gudgeon and two related species, all of which are endemic to the Kimberley, were only recently described (1983). The region has fostered the speciation of these fishes. During this study the Ngarinyin name **Mangena** was recorded from Pansy Nulgit for the Barnett River Gudgeon (*Hypseleotris kimberleyensis*), a species that is endemic to the upper Fitzroy River and one which a Ngarinyin name was previously unrecorded (Morgan *et al*. 2004). Due to the similar size and appearance to the Slender Gudgeon, we have adapted this name for the Slender Gudgeon.

Kimberley Mogurnda (*Mogurnda oligolepis*) (ELEOTRIDAE)

Nyagurlman (*Ngarinyin*)

Capture localities during this study

The Kimberley Mogurnda (or False-spotted Gudgeon) was never captured from sites within the main channel of the King Edward or Carson River (Figure 23). It was, however, relatively common in tributary sites, particularly those of the upper King Edward River (Figures 8, 9 and 23). Allen & Leggett (1990) recorded a different

mogurnda, the Northern Trout Gudgeon (*Mogurnda mogurnda*), from Monger Creek near Kalumburu. The specimens are housed in the Queensland Museum. Hutchins (1977) also reported seven Northern Trout Gudgeons from Palmoondoora Creek. It is worth noting that the Kimberley Mogurnda was described by Allen & Jenkins in 1999, after the studies by Allen & Leggett and Hutchins, and they included in their description specimens captured by Hutchins. A number of the *Mogurnda* captured were retained for examination to ascertain which species they represented. While the two species have some differences in coloration, with the Kimberley Mogurnda having fewer, and larger, red spots along the base of the anal fin, preserved specimens are best recognised by the number of lateral line scales. The Kimberley Mogurnda generally has fewer lateral line scales but there is some overlap (31-39 in *M. oligolepis* and 34-47 in *M. mogurnda*) (see Table 5). From the lateral scale counts of 32 of the 51 *Mogurnda* captured during this study, all had fewer than 37 scales, but most had less than 34 lateral scales, indicating that they were all likely to be the Kimberley Mogurnda and not the Northern Trout Gudgeon.

Table 5 Lateral scale counts of the Kimberley Mogurnda (overall and from the King Edward River) and for the Northern Trout Gudgeon. Modified from Allen & Jenkins (1999).

Lateral scale count	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**
Northern Trout Gudgeon					1	5	5	5	2	5	2	2	2	1	1	1	1	2
Kimberley Mogurnda		2	1	9	2	2	9	9	2	1								
King Edward River		3	8	9	4	5	3											

Giant Gudgeon (*Oxyeleotris selheimi*) (ELEOTRIDAE)

Nyagurlman (*Ngarinyin*)

Capture localities during this study

A single large gudgeon that appeared to be either the Giant Gudgeon (*Oxyeleotris selheimi*) or the Sleepy Cod (*Oxyeleotris lineolate*) was found in a tributary of the Carson River (Swider Creek). These species are distinguished by *O. lineolata* lacking dark spots on the anal, pelvic and pectoral fins. While the one captured in the King Edward River was not retained, based on the geographic range given by Allen *et al*. (2002) it was most

likely the former. The Giant Gudgeon, unlike the Sleepy Cod, has a distribution that extends to the western Kimberley. The Sleepy Cod on the other hand has only been recorded from streams east of, and including, the Ord River (Figure 23).

Flathead Goby (*Glossogobius giurus*) (GOBIIDAE)

Wuma minya **(*Belaa*)**
Ngagulnun (*Ngarinyin*)

Capture localities during this study

With the exception of four individuals captured near Prap Prap on the upper King Edward River, Flathead Gobies were only caught in the main channel sites sampled in the Carson River or below the waterfall at site 21 on the lower Morgan River (Figure 24). They appear to prefer flat sandy or rocky regions.

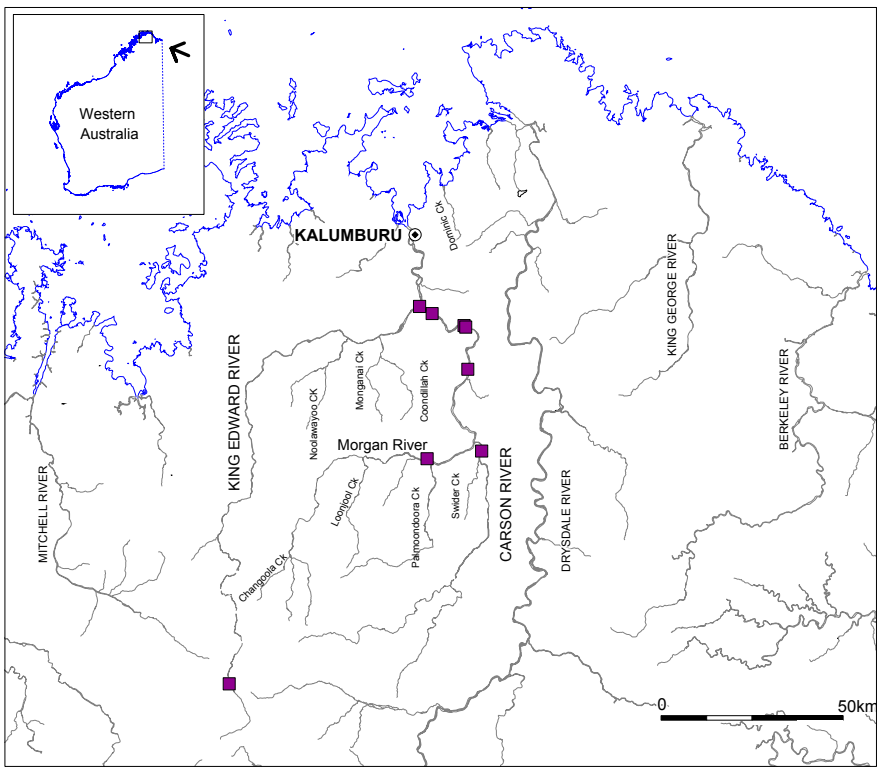


Figure 24 The sites where the Flathead Goby (*Glossogobius giurus*) was captured at during this study.

Aboriginal cultural and linguistic knowledge in relation to location, habitat and traditional uses of fish

Due to time constraints, and difficulties in planning field visits during the build-up to the wet season, the only area of Aboriginal knowledge really accounted for in this study is that of the language names for the fish species. As will be discussed below, the grammatical categorisation of fish names (Belaa data) have a semantic significance which on further investigation may reflect the cultural knowledge of the fish species – whether that be behaviour, location, habitat or uses.

In regard to future research there are many areas of Aboriginal traditional knowledge which could be explored in parallel with the scientific methodology presented here. For example: how people see the habitat associations of the fish species; how the fish species inter-relate to each other, to the rest of the natural world, and to humans; how these data reflect on the locations where they are found; what are the practical uses or cultural significance of the fish and how are those roles dictated. There may even be parallels between the scientific methodology for identifying new species of fish by morphological count (see Table 4) and the traditional Aboriginal uses and physical descriptions of different parts of individual fish species.

None of this knowledge can be collected without the agreement and cooperation of Aboriginal elders. Intellectual Property rights and knowledge protection would apply to the collection of such data. It is therefore imperative that prior and informed consent about the purpose and future use of the research is sought. Outcomes for the community would be strengthened by a holistic approach to the collection of knowledge, as will be discussed in the conclusion.

Linguistic data

The above species synopses provide, where possible, the Belaa and Ngarinyin names for the fish with three references to variance in Aboriginal knowledge.

During the present study, Pansy Nulgit provided Ngarinyin names of fish not previously recorded, e.g. **Mangena** for the Barnett River Gudgeon, **Emana** for the Long-nose Grunter and Long-nose Sooty Grunter and **Arurl** for the eel (Indian Short-finned eel). Pansy also named cherabin **Narli**, and provided some different names to those previously recorded. For example, referring to the Lesser Salmon Catfish as **Yawarl ngarri** and the Barramundi as **Jongarri emana**. The provision of additional and alternative names was not explored in this study. Future research could account for variation and comparison in species naming both between languages and within the same language.

Belaa and Ngarinyin are both grammatically characterised by a semantic system of noun classes that classify all aspects of the natural world, including humans, into

different groups. Noun classes in both languages are also cross-referenced with complex verb structures, so to speak the language fluently it is essential to know what noun class each item belongs to.

For the Belaa fish names in this report the words **manya, ninya** or **minya** follow the name of each fish. Kwini elders and language specialists Mary Pandilo(dec) and Dolores Cheinmora requested that all nouns be listed together with their noun classes in educational resources so that future generations will retain this system of classification. This linguistic methodology was not applied to the Ngarinyin data (a language which has noun classes but different grammatical models to Belaa) so unfortunately there is not an empirical body of data.

Preliminary discussion of Belaa data

The names of 16 freshwater fishes and two marine fishes were identified in the Belaa language in this study and classified according to three different noun classes. There is no clear explanation for this, although fish are a food source and most fish were marked with **manya** (Noun Class A) that also includes most mammals and meat (See Appendix 1). The Flathead Goby was exceptional in that it belonged to a different noun class from all other fish identified.

Further study needs to be done to explore the semantic basis of the classification of both freshwater and saltwater fish species and other marine animals within Belaa noun class systems, to see if there is any correlation between scientific classification of fish and semantic criteria for classifying fish in Belaa, Ngarinyin and other languages of the region which have noun classes such as Wunambal, Gaambera and Worrorra.

Discussion

The King Edward River system in the far north of Western Australia's Kimberley region has not only fostered a distinctive linguistic and cultural diversity, but it is home to a unique array of fishes. The recording of 27 freshwater fish species is the highest recorded for any river system in Western Australia and surpasses the known number of freshwater fish species from other Kimberley Rivers, including the much larger Fitzroy and Ord Rivers (see Morgan *et al*. 2004, Gill *et al*. 2005). This total however, includes two species of *Mogurnda*, one of which was recorded during previous studies. These specimens, which were collected by Allen & Leggett (1990) and are housed in the Queensland Museum require examination for positive identification, but, based on the results of this study are likely to be the Kimberley Mogurnda which was only recently described by Allen & Jenkins in 1999; therefore, after the study by Allen & Leggett (1990). Thus, the King Edward River system is likely to contain at least 26 species of freshwater fish.

The study also resulted in a number of important range extensions. For example, Butler's Grunter was previously only known from rivers east of, and including, the Drysdale River and the finding of Silver Cobbler within the Carson River represents a notable range extension to the west. The extremely cryptic Slender Gudgeon was previously only known from a few specimens from the Prince Regent River and its range has now been extended to the north-east.

Morphological examination of the unidentified glassfish from the King Edward River suggests that is likely to represent an undescribed species. The 10 individuals examined revealed a unique arrangement of head spines, fin rays and relative body measurements (see Table 4). The suborbital, preorbital ridge and hind margin of the preoperculum are all smooth in the King Edward glassfish but are spinosus in the Northwest Glassfish, which is apparently common throughout the Kimberley (Allen *et al*. 2002). Furthermore, there are large differences in proportional body measurements and generally fewer gill rakers and predorsal scales in the King Edward *Ambassis* (Table 4). It is thus likely that the King Edward species is new to science and thus requires formal description.

Similarly, an undescribed ectoparasite, *Argulus* sp. (Crustacea: Branchiura), was found on the caudal (tail) fin lobes of one Black Bream and three Spangled Perch in the Morgan River. A total of five specimens were collected. No *Argulus* have previously been reported from Kimberley freshwater fishes. It is not clear what the effect of this parasite on the host is. Further examination of the range of hosts of this parasite should be conducted and a formal species description is required.

There were significant differences between the fish fauna associated with the various riverine habitats of the King Edward River system. For example, the Carson River main channel was the most diverse in terms of species occurrences, when compared to its tributaries and the tributaries and main channel of the King Edward River. These differences are largely attributed to both the fact that particular species are often associated with either tributaries or larger water bodies and that the upstream migrations of many of the rivers species have been hindered by the presence of natural barriers such as rock bars and waterfalls. Thus, it appears that most of the upper King Edward River has been isolated from other rivers, including the Carson River for a very long time. Species such as Bony Bream, Lesser Salmon Catfish, Silver Cobbler, Black Catfish, False-spined Catfish, Freshwater Longtom, Prince Regent Hardyhead, Macleay's Glassfish, Mouth Almighty, Seven-spot Archerfish, Barred Grunter and Butler's Grunter are essentially restricted to the lower altitude sites on the Carson River (and lower Morgan River and King Edward River) and have never had access to most of the King Edward River. Species such as the Kimberley Mogurnda is mainly restricted to tributary sites while the abundances of Western Rainbowfish and Spangled Perch are much higher in tributaries. Conversely, Black Bream are only associated with main channel sites throughout the catchment.

Waterfalls are also seen as limiting the number of migratory marine/estuarine species that enter freshwaters. For example, only three species that must complete their life-cycle in salt water were captured in the King Edward River system. This compares to 14 marine/estuarine species that utilise the freshwaters of the Fitzroy River (Morgan *et al*. 2004).

It appeared that the Black Bream population within in the King Edward River system were dominated by large fish when compared with the Fitzroy River. Either growth rates are higher due to warmer temperatures experienced in this more northerly river or fishing pressure is far less in the King Edward, or a combination of both. At popular camping areas the maximum size of Black Bream was generally much smaller than in areas that are rarely accessed and thus the species may be susceptible to high fishing pressure. In order to maintain stocks of Black Bream and other species that are important food species to the traditional owners of the Kimberley, biological examinations should commence to determine length at maturity and breeding season of species in the region. Without such knowledge it is difficult to conserve fish stocks and maintain quality fishing opportunities. Interestingly, a relatively large proportion (approximately one-third) of Black Bream in the King Edward River system have 'blubber-lips'. The condition is presumably genetic but may be related to diet. Future research should be directed to explore this unusual phenomenon with perhaps reference to traditional Aboriginal practices for maintaining fish stocks.

Such future research may benefit from traditional Aboriginal knowledge – both perspectives on the river systems and boundaries of country as well as physical descriptions of fish, how they are inter-related to other fish and the rest of the natural world, and traditional explanations for their location and preferred habitat.

During this project, new Ngarinyin names for fish were recorded, e.g. **Mangena** for the Barnett River Gudgeon, **Emana** for the Long-nose Grunter and Long-nose Sooty Grunter and **Arurl** for the eel (Indian Short-finned eel). Some different names to those previously recorded by Morgan *et al*. (2004) were also documented. For example, the Lesser Salmon Catfish was documented as **Yawarl ngarri** (cf. **Moolirr**), the Freshwater Longtom as **Garnburu** (cf. **Biyira**) and the Barramundi as **Jongarri emana** (cf. **Deyo**).

Belaa is a language characterised by an intricate semantic system of noun classes that classify all aspects of the natural world, and humans, into five different groups. In the list of Belaa names for fish found in the methodology section of this report the words **manya, ninya** and **minya** follow the name of each fish. The names of 16 fresh water fishes and two marine fishes were identified in the Belaa language and classified according to noun class. Ten freshwater and two marine fishes belonged to the same class that includes most mammals and meat. The Black Catfish, Hyrtl's Tandan, False-spine Catfish, Rendahl's Catfish and Freshwater Longtom belonged to another noun class, and the Flathead Goby was exceptional in that it belonged to a different noun class from all other fish identified. Further research needs to be done to explore the semantic basis of the classification of both freshwater and saltwater fish species and other marine animals. The linguistic data collection did not include documenting the noun classes of the Ngarinyin words. This needs to be addressed in future research, which may also include other language groups.

Of the nine fish species found in the King Edward River sites, five were also identified in Belaa. Exceptions were the Western Rainbowfish, the unidentified glassfish *Ambassis* sp. 1 and the Kimberley Mogurnda. As the Western Rainbowfish was so prolific, and was given a Ngarinyin name, it was surprising that there was consistently no Belaa name attributed to it. Further research is needed to establish whether the reason is related to traditional use of the fish or simply because the fish was not familiar to Kwini people in the past.

One interesting naming practice observed in Belaa was the naming of fish based on physical features (this analysis was not applied to Ngarinyin in this study). In some instances one Belaa name is used to describe two or more different fish species. For example, both fork-tailed catfishes have the same name, **Maada-kudengei manya**. This name includes a description of a characteristic shared by both species: - **kude** is a postposition meaning 'having' and -**ngei** is a postposition meaning 'characterised by.' Therefore **Maada-kude-ngei** means 'having and characterised by its pin'. All eel-tailed catfishes (Plotosidae) were referred to as **Dorungai ninya**, which means 'beard/whiskers' - meaning characterised by its whiskers (barbels).

In regard to the morphological count used to identify new species of fish, further research could be done to explore the names for parts of fish species, as well as uses of the different parts of the fish, to see if there is any correlation with the scientific approach in identifying the relationships between species.

In one instance two different Belaa names from different noun classes were provided for one fish species. The Freshwater Longtom, found in 11 sites in the Carson River, was named both **Wuluwa ninya** and **Jaburru manya**. As this is unusual it may need to be investigated further to confirm that both of these glosses do in fact refer to the same fish, and to try and ascertain possible cultural or usage reasons why the one fish has been classified in two different ways.

Other traditional Aboriginal knowledge about location, use, habitat and connection to aspects of the natural world were also not documented for the purposes of this research report (apart from the Mur-Mur in Appendix 3). In order to provide a true balance between scientific and Aboriginal traditional knowledge a framework needs to be developed to allow the collection of Aboriginal knowledge in a way which can be appropriately used by Western scientists and *vice versa*.

In order to facilitate the collection of traditional Aboriginal knowledge field work needs to be planned in conjunction with community organisations and, where possible, government organisations working in the same region. This collaboration will provide resources for field trips which include more than one or two elders and which allow the younger generations to be present. It is important, though, that the elders are not required to care for young children – a role which they often have to perform within their communities. The resourcing of field trips should include 'middle' generations whose role may be simply caring for the younger children. Other roles might be cook and someone to maintain the camp.

Approaching field trips in this way has a number of advantages: more people to facilitate the trips, an intergenerational teaching and learning environment and the involvement of middle generations of Aboriginal people in the collection of knowledge for the Western research purposes. This approach to field trips repays the elders for their contribution to Western science and assists them in the transmission of traditional Aboriginal knowledge to the younger generations.

It is likely that in such an environment more knowledge will be made available to the researchers. Methods of data collection and management need to be carefully thought through – as well as the processing of that data after the conclusion of the field trips. Keeping the management and use of that data in the hands of the community is a positive outcome to aim for.

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Appendix 1

Fish by Noun Class in Belaa

A Class Fish

Lesser salmon catfish (*Arius graeffei*)	**Maada-kudengei manya**
Silver Cobbler (*Arius midgleyi*)	**Maada-kudengei manya**
Seven-spot Archerfish (*Toxotes chatareus*)	**Wungkalbarr manya**
Barred Grunter (*Amniataba percoides*)	**Kûkûridi-ngei manya**
Black Bream (*Hephaestus jenkinsi*)	**Amalarr manya**
Spangled Perch (*Leiopotherapon unicolor*)	**Jelenji manya**
Butler's Grunter (*Syncomistes butleri*)	**Amalarr manya**
Long-nose Grunter (*Syncomistes trigonicus*)	**Kungkumirri manya**

A Class Fish (Marine fish found in freshwater)

Ox-eye Herring (*Megalops cyprinoides*)	**Arurl-kudengei manya**
Barramundi (*Lates calcarifer*)	**Yilarra manya**

N Class Fish

Black Catfish (*Neosilurus ater*)	**Dorungai ninya**
Hyrtl's Tandan (*Neosilurus hyrtlii*)	**Dorungai ninya**
False-spine Catfish (*Neosilurus pseudospinosus*)	**Dorungai ninya**
Rendahl's Catfish (*Porochilus rendahli*)	**Dorungai ninya**

A and N Class Fish

Freshwater Longtom (*Strongylura krefftii*)	**Wuluwa ninya/Jaburru manya**

M Class Fish

Flathead Goby (*Glossogobius giurus*)	**Wuma minya**

Belaa and Ngarinyin Orthographies

An orthography is the system matching symbol with sound used to write a language. Aboriginal languages were oral languages until colonisation, and therefore the development of writing systems is a very recent phenomenon. Different Kimberley languages use different orthographies. Some of these are community developed orthographies that are used by language groups, others have orthographies which have been developed by linguists for their research.

At this stage Belaa has no community developed orthography. Literature in Belaa, such as Mary Pandilo's (dec'd) stories published by the KLRC (Pandilo 2003a, b, c), uses an orthography developed by Margaret Sefton. Father Sanz of the Kalumburu Mission

uses a different orthography in his work, and place names in this report, which come from maps and other sources, have been written in other ways.

After several years of discussion Ngarinyin has a community orthography developed at Wanalirri Catholic School (Gibb River) in 1997 for use in their language program. It differs slightly from the linguist orthographies of Coate & Elkin (1974) and Rumsey (1982) (KLRC 2000).

It is important that researchers consult with organisations like the KLRC, or directly with language communities, before writing Kimberley languages down, or publishing names and words in language. This is partly to do with consistency in written materials, and partly to do with community ownership of languages, how they are represented in the written form and what those materials are used for.

Note: In the orthographies, two letters may represent one sound. Some of the sounds in Aboriginal languages are not found in English.

Belaa Orthography (Margaret Sefton)

a	sounds like	**u** in c**u**p, sometimes like **a** in c**a**t
aa		**a** in f**a**ther
i		**i** in p**i**n
ii		**ee** in f**ee**d
e		**e** in p**e**t
ee		**ai** in h**ai**r
û		**i** in horr**i**ble and **u** in 'fish' (New Zealand accent)
o		**o** in h**o**t, sometimes like **ore** in m**ore**
u		**oo** in b**oo**k, sometimes like **oo** in c**oo**l
ai		**ai** in **ai**sle and **y** in m**y**
ei		**ei** in **ei**ght
au		**ow** in h**ow**
ou		**ou** in m**ou**ld and **o** in **o**ld
oi		**oi** in **oi**l
b		**b** in **b**at and **p** in s**p**in
d		**d** in **d**ot and **t** in s**t**un
rd		**rt** in hu**rt** and **rd** in hea**rd** (American accent)
k		**k** in s**k**y and **g** in **g**ot
j		**j** in **j**am and **ch** in **ch**urch
l		**l** in **l**oad
rl		**rl** in cu**rl** (American accent)
m		**m** in **m**at
n		**n** in **n**od
rn		**rn** in ba**rn** (American accent)
ng		**ng** in si**ng**
ny		**ni** in o**ni**on (at the end of a word there is no English equivalent.)
r		**r** in **r**iver
rr		an Italian or Scottish (rolled) '**r**'
w		**w** in **w**et
y		**y** in **y**ellow

Ngarinyin Orthography (Wanalirri Catholic School 1997)

a	**u** in b**u**t
aa	**a** in f**a**ther
i	**i** in p**i**n
ii	**ee** in f**ee**d
e	**e** in p**e**t
ee	**ai** in h**ai**r
o	**o** in h**o**t
oo	**oo** in b**oo**k, sometimes like **oo** in c**oo**l
ay	**ai** in **ai**sle and **y** in m**y**
oy	**oy** in b**oy**
b	**b** in **b**at and **p** in s**p**in
d	**d** in **d**ot and **t** in s**t**un
rd	**rt** in hu**rt** and **rd** in hea**rd** (tongue rolls back)
j	**j** in **j**am and **ch** in **ch**urch
k	**k** in s**k**y and **g** in **g**ot
l	**l** in **l**oad
ly	**ly** like the **lli** in mi**lli**on
rl	**rl** in cu**rl** (tongue rolls back)
m	**m** in **m**at
n	**n** in **n**od
rn	**rn** in ba**rn** (roll tongue back)
ng	**ng** in si**ng**
ny	**ni** in o**ni**on. (at the end of a word there is no English equivalent.)
r	**r** in **r**iver
rr	an Italian or Scottish (rolled) '**r**'
w	**w** in **w**et
y	**y** in **y**ellow

Appendix 2

Fish species found at each site. Ne = Bony Bream, Ag = Lesser Salmon Catfish, Am = Silver Cobbler, Na = Black Catfish, Nh = Hyrtl's Tandan, Np = False-spined Catfish, Pr = Rendahl's Catfish, Sk = Freshwater Longtom, Ma = Western Rainbowfish, Mg = Slender Rainbowfish, Mn = Black-banded Rainbowfish, Cl = Prince Regent Hardyhead, A1 = *Ambassis* sp., Am = Macleay's Glassfish, Ga = Mouth Almighty, Tc = Seven-spot Archerfish, Ap = Barred Grunter, Hj = Black Bream, Lu = Spangled Perch, St = Long-nose Grunter, Mo = Kimberley Mogurnda, Hy = Slender Gudgeon, Hc = Empire Gudgeon, Os = Giant Gudgeon and Gg = Flathead Goby.

Site	Ne	Ag	Am	Na	Nh	Np	Pr	Sk	Ma	Mg	Mn	Cl	A1	Am	Ga	Tc	Ap	Hj	Lu	Sb	St	Mo	Hy	Hc	Ol	Gg
1					x		x		x				x					x	x							
2					x				x				x					x	x							
3					x				x				x					x	x		x					x
4									x				x					x	x							
5									x				x						x							
6									x				x						x							
7					x				x										x			x				
8					x				x										x			x				
9									x				x					x	x		x					
10					x				x										x							
11					x				x				x									x				
12																										
13					x				x				x					x	x		x					
14					x				x				x						x			x				
15					x				x										x			x				
16									x									x	x		x					
17					x				x				x					x	x		x	x				
18										x									x							
19									x								x	x	x							
20									x										x							
21	x	x	x	x				x	x			x				x	x	x	x	x						x
22			x						x			x				x	x	x	x	x						
23									x				x						x							
24									x								x		x			x			x	
25	x	x						x	x							x	x	x	x							
26	x	x	x		x			x	x					x		x	x	x	x							x
27		x	x					x								x	x	x								
28	x	x	x	x	x	x		x	x			x		x		x	x	x	x	x						x
29									x										x			x				
30									x										x			x				
31									x									x	x							
32	x	x	x	x				x	x			x		x	x	x	x	x	x	x			x			x
33	x											x		x	x	x	x	x	x		x					x
34	x			x				x	x			x	x	x	x	x	x	x	x				x			x
35	x	x	x	x				x	x			x				x	x	x	x	x						x
36																			x							
37																										
38									x			x	x		x	x	x		x			x				
39									x																	
40	x						x		x			x	x		x		x		x							
41									x															x		
42											x		x									x				
Total	9	7	7	7	13	1	2	8	35	1	1	9	16	5	4	11	14	20	35	5	6	11	2	1	1	8

Appendix 3

Mur-Mur

Paradise Pool

On 1/11/04 Kwini Elder Dolores Cheinmora took us to an important place called Mur-Mur (on published maps written as Mool Mool), also known as Paradise Pool on the Carson River, and recorded the following story. It is the story of a meteorite falling in the area a long time ago and causing a devastating flood. Everyone was drowned except for one small boy who was rescued by a kangaroo and taken away from the area. The boy grew up and found a wife, and from these beginnings, a new generation emerged, explaining the origins of the Kwini tribe.

Before, Mur-Mur was a seasonal waterhole that dried out in the winter and filled up during the rains of the wet season. Today, there is living water at this place throughout the year, enabling the fish of the area to thrive. It is culturally significant that although the people of this area were all drowned but one, and had to move away from the area, the fish found in these waters survived the flood, from the distant past until today.

At this location (Site 34) 14 fish species were identified, the third most diverse location in terms of species recorded. So Mur-Mur was found to be a place within the catchment area that is rich both in terms of cultural value and in the biodiversity of fish species. It is not clear yet where the cultural explanation and the scientific explanation for the biodiversity of fish may overlap, but, the presence of diverse fish species in this place was of great cultural and scientific value, providing a common research purpose.

[Bold print is Dolores Cheinmora speaking in Belaa. English translation provided by Dolores' daughter Agnes Charles]

Dolores Cheinmora: **Wunjali kûraa, Mur-Mur. Wunungkulei minya, buju' biindi, bûrrûmbal,kaandan minya, barda' mûndi. Enkardi buju' bindi. Winjardi, ngawa aada' wurrangku.**
Agnes Charles: We are here in **Mur-Mur**. A long time ago people were here and the **kaandan**, the meteorite, the star, fell on them and killed them, here in **Mur-Mur.**

Dolores Cheinmora: **Kundili manya, jurdba-jurdba' anguneiyadi. Biyarnda, bûnmûra, kundili. Biyarnda bûnmûrong, marna bûnmûrong. Jalamba-ngûndalu warn' bûndanga, jurdba-jurdba' bûndûnga. Bûnda ngûndi kurrbaku.**

Agnes Charles: And after that meteorite fell and killed everyone. The kangaroo, **kundili,** came and put a little child in his pouch and took the baby away from here.

Dolores Cheinmora: **Enkardi buju' bindi. Kurdi balei durrurruk' burrma.**
Agnes Charles: The ones all left behind all drowned.

Dolores Cheinmora: **Wunungkulei minya, buju' bindi, ngawa enkadi, yorn' bûnmoro-ngai, durrurruk' burrma…. balangkarra.**
Agnes Charles: A long time ago they were all finished, drowned. They all went down, all of them.

Dolores Cheinmora: **Endij Wijalkurr, kwoya aarru wungkaila, enkardi wu-ngu-nei-nga, kwoya-di Winjalkurr-ngûndalu aada' wirr-a-mbu, Wijalkurr, jorru' wu-mba-nû-ngai…**That's the place, **Wijalkurr. Jorru' wumbanûngai** means that the rolling stone went to the place, and it's over there now in that **Wijalkurr.**
Agnes Charles: When the meteorite came, and the sea and the mountains rolled over, everyone was finished, the sea took them away. The flood took them, sea and water all mixed up, it took them. The **kaandan**, it fall down, it makes the flood.

Dolores Cheinmora: **Wunongoi' bindi, namba-ngu mara' andûnûdi.**
Agnes Charles: When he was big he found a wife.

Dolores Cheinmora: **Ngarrinjûnkardi baward' ngûrrmangai, balangkarra.**
Agnes Charles: We are the new generation. We came out from them, all of us, black and white I suppose. The kangaroo came and took the baby away and then he found the wife, that little boy, when he was a big one, and then here we are, we all came out then, new generation…

And that is the story of Mur-Mur. It is called Paradise Pool. When the flood season comes it builds up the waterhole, and there is water. When it comes to the dry season it is really dry and there is no water. But today, in November, the water is still here, and it isn't dry, the water is still here.

Extracted from Tape Transcript K27/04
Recorded at Mur Mur, Paradise Pool (Site 35, Carson River) 1/11/04

Appendix 4

Belaa fish poster

Ngarinyin fish poster