Jawoyn Country Bush Blitz

Giyowk Freshwater Fishes

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List of contributors

List of contributors to this report.			
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Cover photos: Leliyn Edith Falls in flood, Nitmiluk National Park (MH25-01) with female (top) and male Barrway's Fish *Hypseleotris barrawayi* from the site. Photos Michael Hammer

Nomenclature and taxonomy used in this report is consistent with:

The Australian Faunal Directory (AFD)

Abstract

A two-week dedicated freshwater fishes sampling trip was undertaken to Jawoyn Country, northeast of Katherine on the Arnhem Land Escarpment in the Northern Territory, in the late wet season of 2025 as part of a larger Bush Blitz survey team. A total of 16 sites were sampled, primarily targeting upland sandstone streams above waterfalls across three major river catchments (Daly, Roper and Mary), using a combination of helicopter and vehicle access and appropriate gear types (i.e. primarily compact gear including backpack electrofishing and seine netting). The survey focus was a baseline assessment of poorly sampled habitats (i.e. remote uplands) and a focus on mapping narrow range endemic species. The objectives were on species discovery, new to science, to provide information for land management, and with a focus being to support taxonomy and the wider picture of northern Australian biodiversity. Fifteen freshwater fishes were recorded (all native), including three narrow range endemic species: Barraway's Fish *Hypseleotris barrawayi*, with a new range confirmation at Leliyn Edith Falls (this species only occurs on Jawoyn Country); Exquisite Rainbowfish *Melanotaenia exquisita*; and the undescribed Sandstone Purplespotted Gudgeon *Mogurnda* sp. (also known only so far from Jawoyn Country). Replicate samples of more widespread species such as Western rainbowfish *Melanotaenia australis* and Northern Purplespotted Gudgeon *Mogurnda mogunda* from different river systems were also made to contribute to future understanding of cryptic species and biogeographic models of fish headwater connectivity in the region. Additional opportunistic data were obtained on decapod crustaceans. Specific region and site-based management recommendations are made along with suggestions to continue to build on survey results in this unique landscape.

1. Introduction

Freshwater fishes are a key part of natural resource management due to their diversity in number and form, intriguing life histories and adaptations, role in human culture and use, links within food-chains, value as bio-indicators, and as icons for aquatic conservation and environmental awareness (Bunn and Arthington 2002; Dudgeon et al. 2006; Lintermans et al. 2020; Tims and Saupe 2023; Sayer and et al. 2025). Fish diversity in Australia increases dramatically in the topical north, and there is still much to be documented in terms of the species baseline. Forms novel to science continue to be recorded from remote regions of Australia, and recent interrogation with genetic techniques suggest that there are likely to be two to three times the number of species actually present than is currently recognised (Adams et al. 2013; Hammer et al. 2013; Adams et al. 2014; Unmack et al. 2022). Hence, detailed surveying and taxonomic review of local fish faunas is likely to provide important and exciting biodiversity updates as the foundation for management and conservation.

The Arnhem Land Escarpment in the Top End of the Northern Territory, is an endemism hot spot for freshwater fishes (Pusey et al. 2017). This rocky upland area is a distinctive and isolated habitat type, as effectively an island in broader vast lowland savannah habitat stretching across northern Australia. The aquatic or hydrological network of the Arnhem Land Escarpment is also complicated, draining a series of major rivers where adjacent headwater streams may drain to different and widely separated river mouths. For example the adjoining headwaters of the Roper and Daly River near Dook Creek, while separated by only a few hundred metres either side of a ridge, drain to opposite sides of the Top End, separated by some 1200 kilometres. From what is known of the fish fauna of the escarpment, species richness is relatively low compared to lowland savannah habitats, but habitat specialisation and endemism is high. Endemic fishes include the Barraway's Fish *Hypseleotris barrawayi*, Midgley's Grunter *Pingalla midgleyi**, Mariana's Hardyhead *Craterocephalus marianae*, Exquisite Rainbowfish *Melanotaenia exquisita**, Upper Katherine Rainbowfish *Melanotaenia splendida* subsp.*, and Sandstone Purplespotted Gudgeon *Mogurnda* sp.* (Cook et al. 2010; Adams et al. 2013; Hammer and Golding 2017) (* indicates species complex still under review by the authors).

The southern and western side of the Arnhem Land Escarpment is Jawoyn Country (Figure 1), including the Nitmiluk National Park and Jawoyn Land Trust areas (as well as the south-eastern corner of Kakadu National Park, not a focus of the current study). The rugged and remote area is still relatively poorly sampled to science for freshwater fishes with some large gaps in coverage, and other areas where important ecological assets are known for more specific mapping. For example the Nitmiluk National Park has not been previously surveyed for fishes, other than at the main publicly accessible location of Leliyn Edith Falls. This is the type locality of the Exquisite Rainbowfish collected in 1978 (Allen 1978). The popular Jatbula Trail crosses east-west across the park, with recreational camping sites all based near permanent water pools, and sampling would thus provide important baseline data and accessible information to support tourism and monitoring. On the distribution mapping front, Barraway's Fish is a small narrow range endemic species so far known only from the middle Katherine River and its tributaries, named to science after work around the Jeyunay Sleisbech area in the 1990s including the Nibuldakya Aquatic Survey (Wedd 1997; Larson 2007), and the Sandstone Purplespotted Gudgeon was identified in molecular studies following the Northern Australian Fish Survey (NAF) which included a few sites in Jawoyn Country (Burrows et al. 2008; Cook et al. 2010; Pusey et al. 2017). An additional source of fish data for Jawoyn Country includes rainbowfish taxonomy sampling in 2016 at the upper Katherine River, Jeyunay Sleisbech and lower Dook Creek, a partnership between MAGNT and Jawoyn Rangers (Hammer and Golding 2017).

This report summarises the results of a two-week survey of fishes in Jawoyn Country in April 2025. This provided the opportunity to include fishes in broader property management and Healthy Country Plan, to obtain valuable information on range restricted species, partner and undertake two-way learning with traditional owners and rangers, and collect genetic samples with associated vouchers for broader reviews of the Australian freshwater fish fauna. The current study also builds on fish data and research from a series of previous Bush Blitz surveys across northern Australia, namely Fish River Station, Wongalara Sanctuary, East Kimberley, Olkola, Judbarra National Park, Bradshaw Field Training Area, Groote Eylandt IPA and West Kimberley. Decapod crustaceans were opportunistically sampled as part of freshwater fishes site sampling. Jawoyn language names for animals alongside photos are included for those that are publicly available in the fauna and flora knowledge book of Wiynjorrotj et al. (2005) or the Jawoyn-English dictionary app (android 2022 version).

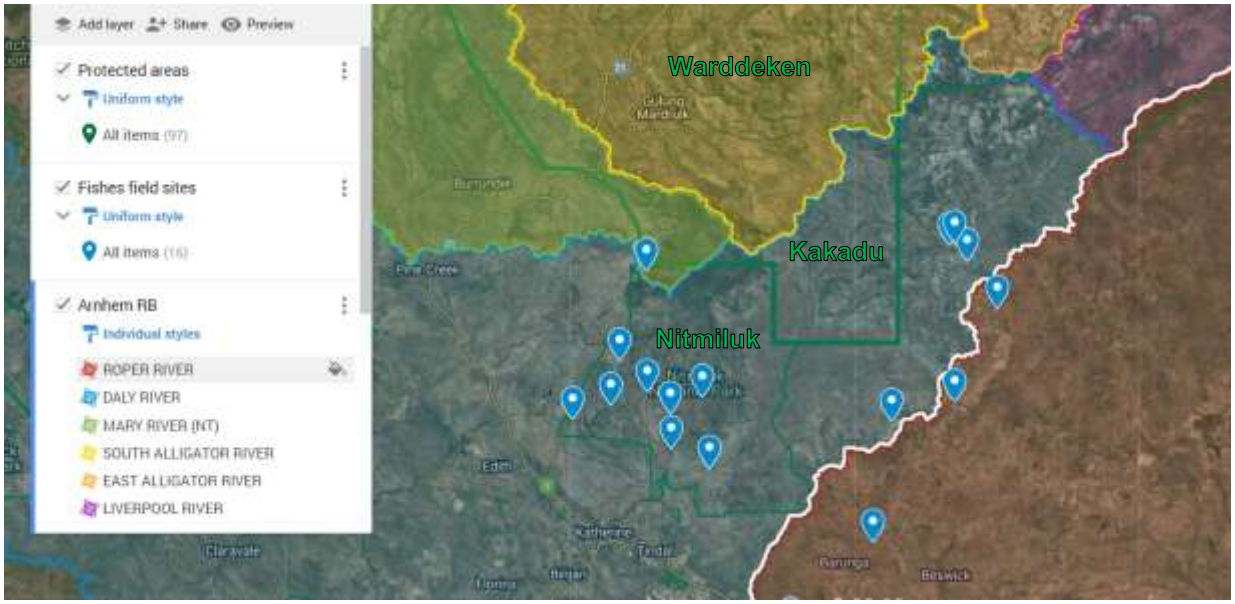


Figure 1. Google map image of Jawoyn Country Bush Blitz 2025 survey sites (blue icons) relative to the different major river basins in the study region and showing green outlies of different protected areas (Terrametrics 2025).

2. Methods

2.1 Site selection

Sites were selected to provide even spatial coverage and representation of different river systems within the study region, with a primary focus on upland stream habitats and especially looking for major waterfall barriers i.e. isolated habitats of the Stone Country. This included a focus on sampling along the Jatbula Trail through Nitmiluk National Park to feed into tourist information. Sites were directed also at broader taxonomic research and of conservation/management interest as viewed from a review of museum specimens and historical data. Different teams collaborated on fish sampling concurrently with other target groups (e.g. odonates/lepidoptera, botanical). Sixteen sites were visited between 31 March and 10 April 2025 (Figure 1; Table 1). Sampling occurred during the late Wet Season, in what was a poor-modest rainfall season but with a late burst just before and during the start of the trip. Most sites were thus in flood or flowing strongly with low water visibility (high turbidity) at the time, which made sampling challenging but still achievable given the focus on smaller upland streams.

2.2 Survey techniques

Sampling employed a rapid assessment design to cover as wide a spatial distribution and variety of habitats/environmental conditions as possible, and maximise efficiency with regard to the time window for helicopter access into remote and difficult to access areas:

1) **Backpack electrofishing** using a Smith-Root model LR-20B with voltage and frequency adjusted according to water conductivity. Electrofishing temporarily shocks fish, and allows capture of target fish species, with remaining fish quick to recover once electrofishing is ceased. This was the primary survey technique, employed at wadeable sites especially smaller streams or runs between larger pools. Standardised sampling targeted 1000 seconds of electrofishing on time, being less in some smaller habitats, or increased proportionally for different major habitat sections (i.e. above and below waterfalls; large rocky runs and pools).
2) **Seine netting** with dimensions 4 m x 1.2 m net with 6 mm mesh, hauled by two people over a distance of around 10 meters, with sometimes a third person used to herd mobile fish like rainbowfish into the net; seine nets are an active survey technique involving sections of nets lined with floats on the top and leads on the bottom, with the net hauled through pools to scoop up fish; this technique is most effective in water depth less than 1.5 metres, and was used to supplement electrofishing at larger pools that were safe to access (i.e. above waterfalls).
3) **Bait traps** are collapsible mesh nets with conical openings on each end (45 x 25 x 25 cm coming in multiple colours) that were set on strings amongst vegetation cover, flat on the bottom, for 1-2 daylight hours and baited with fish flavoured dry cat food. This passive survey technique was used to supplement electrofishing or in supplementary sampling by other teams at some sites.
4) **Dip netting** was employed opportunistically at flooded edge habitat sites where electrofishing was not possible along shallows and edge habitats for 15 minutes; dip netting is an active gear type involving a net on a handle with fine mesh (0.5 m diameter, 4 mm mesh); this is quick and effective for scooping amongst vegetation and leaf litter, a preferred habitat of small fishes.

The methods employed at each site are shown in Table 2. As with many northern Australian waterways, danger from Saltwater Crocodiles was carefully considered in survey design and implementation (e.g. active sampling techniques such as backpack electrofishing and seine

netting were restricted to sites above waterfalls; distance from water maintained and observers used in larger pools).

Environmental data including physical characteristics, habitat components and water quality was recorded for each site (Table 2). Samples of larger crustaceans caught opportunistically as part of fish sampling were also made for future processing and investigation.

Sampling was conducted under NT Fisheries Permit S17/3418, National Parks and Wildlife Permit 74788 and Northern Land Council Permit 171864, in accordance with Charles Darwin University Animal Ethic Committee approval A24023.

Sampling was undertaken in partnership with Jawoyn Rangers, Nitmiluk National Park staff and Warddeken Rangers as part of ranger exchange, with assistance of teachers and Bush Blitz staff.

2.2.1 Methods used at standard survey sites

The Leliyn Edith Falls fish site MH25-01 site was adjacent to the Standard Survey II site but could only be sampled opportunistically due to flood and Saltwater Crocodile danger.

2.3 Identifying the collections

Captured fishes were sorted to species on site with the majority returned to the point of capture. Representative subsamples retained as vouchers were held in a bucket with aeration and transported back to the field laboratory. Retained fish were ultimately euthanased using AQUI-S, and vouchers were either (a) fixed in 10% formalin solution with a matching genetic tissue sample preserved in 80% analytical grade (AR) ethanol or (b) for smaller specimens fixed whole in 80% AR grade ethanol. On return to MAGNT, all material was sorted and re-examined to provide final confirmation of identifications after Shelley et al. (2018) and Allen et al. (2002), and primary literature keys where applicable (e.g. Hammer et al. 2021). Specimens are permanently accessioned in the MAGNT fishes collection (registration series S.18991 to S.19006) and will ultimately be available on the Atlas of Living Australia.



Typical freshwater fish survey kit for remote sites in upland sandstone escarpment country, backpack electrofisher and accessories



Top – Aquatic survey team remote drop-off point Eva Creek tributary swamp (MH25-06), and Lower – Seine net sampling in flooded 17 Mile Creek above falls (MH25-10)



Top – Aquatic survey team after returning from remote site and with Warddeken Rangers exchange partnership, and Lower – sampling site at Douglas Springs, Mary River (MH25-14)

Table 1. Details of fish sampling sites from the Jawoyn Country Bush Blitz (GDA94)
* indicates sites in Nitmiluk National Park, ds = downstream, us= upstream

Station	Date	River system	Waterway	Specific locality	Longitude	Latitude
MH25-01	31/03/2025	Daly	Edith River	Leliyn Edith Falls, plunge pool*	132.18935	-14.18108
MH25-02	1/04/2025	Roper	Waterhouse River	Small waterfall	133.23890	-13.91460
MH25-03	1/04/2025	Daly	Katherine River trib.	Above series of falls	133.16474	-13.80101
MH25-04	2/04/2025	Daly	Crystal Falls Creek	Campground*	132.43147	-14.16815
MH25-05	2/04/2025	Daly	Katherine River trib.	Off Katherine Gorge*	132.52684	-14.29782
MH25-06	3/04/2025	Daly	Eva Creek trib.	Stream through swamp	132.97754	-14.18338
MH25-07	3/04/2025	Roper	Waterhouse River	Headwaters	133.13601	-14.13893
MH25-08	4/04/2025	Daly	Edith River	Sandy Camp*	132.28299	-14.14662
MH25-09	6/04/2025	Daly	Ferguson River	Upper catchment, us falls*	132.30667	-14.04056
MH25-10	6/04/2025	Daly	17 Mile Creek	Above falls*	132.37427	-14.11604
MH25-11	7/04/2025	Daly	17 Mile Creek trib.	Biddlecombe Cascades*	132.43550	-14.25127
MH25-12	7/04/2025	Daly	Katherine River trib.	ds Nibuldakya Centipede Dreaming	133.12013	-13.76433
MH25-13	8/04/2025	Daly	Crystal Falls Creek	Headwater swamp*	132.51296	-14.12760
MH25-14	8/04/2025	Mary	Mary River trib.	Douglas Springs, south branch*	132.37117	-13.82534
MH25-15	9/04/2025	Daly	Katherine River trib.	Nibuldakya Centipede Dreaming	133.13396	-13.75712
MH25-16	10/04/2025	Roper	Dook Creek	Headwaters	132.93056	-14.47588

Table 2. Details of sampling method and environmental data at fish survey sites
EF = backpack electrofishing

Station	Method	Note	Habitat	Flow	uScm^{-1}	ºC	pH	gH	kH
MH25-01	Dip, trap	In flood	Littoral edges of large pool	Very high	18	28.9	6.5	0	0
MH25-02	EF, seine	In flood	Small rocky and sandy stream	Very high	15	27.6	6.5	0	0
MH25-03	EF, seine	In flood	Medium rocky stream	Very high	13	29.3	6.5	0	0
MH25-04	EF, seine	In flood	Small rocky stream	Very high	9	28.5	6.5	0	0
MH25-05	EF, seine	High level	Small sandy stream	High	8	30.4	6.5	0	0
MH25-06	EF, dip net	Shallows only	Spring fed swamp and stream	Medium	9	30.5	6.5	0	0
MH25-07	EF, seine	High flow	Small sandy stream	High	9	31.1	6.5	0	0
MH25-08	EF, seine	Deep	Large stream with deep pools	High	16	28.8	6.5	0	0
MH25-09	EF, seine	Fish dilute	Small rocky stream	Medium	17	29.5	6.5	0	0
MH25-10	EF, seine	In flood	Small rocky stream	High	19	30.8	6.5	0	0
MH25-11	EF	Deep at edge	Small rocky stream	Medium	21	28.3	6.0	0	0
MH25-12	EF, seine	Flood receding	Small stream/river junction	Medium	11	30.0	6.5	0	0
MH25-13	EF	In flood	Swamp and incised channel	High	29	29.0	6.0	0	0
MH25-14	EF	Dense vegetation	Spring fed stream channels	Medium	17	29.6	6.5	0	0
MH25-15	EF	Good sampling	Small rocky stream	Medium	26	29.8	6.5	0	0
MH25-16	EF, seine	Dirty/flooded	Small sandy stream	Medium	37	29.4	6.5	0	0

3. Results and Discussion

Appendix 1 lists all giyowk freshwater fishes recorded during the Bush Blitz, which includes 15 different species; relative abundance of species by site is shown in Appendix 2. Collections made during this Bush Blitz will result in 52 specimen lots being added to public collections and an additional 16 site-based species occurrence records (observations) being added to publicly accessible databases. Water quality data for sites is shown in Table 2, with water conductivity (salinity) notably very fresh (<30 $uScm^{-1}$) and soft (no detectable water hardness), with typically hot wet season water temperatures (~30°C).

3.1 Un-named or not formalised taxa

Freshwater glassfishes *Ambassis* in Australia represent a species complex of distinct candidate species with some hybrid zones, with patterns still not fully resolved in northern Australia (Unmack et al. 2025). A putative widespread species in the region known as Northwest Glassfish was left without a formal scientific name in a previous reassessment (Allen and Burgess 1990; Allen et al. 2002).

Purplespotted Gudgeons of the genus *Mogurnda* have been highlighted to be taxonomically problematic including high rates of cryptic species (Cook et al. 2010; Adams et al. 2013). Several distinct lineages are known in the Northern Purplespotted Gudgeon *Mogurnda mogurnda* including a species new to science recorded only from Jawoyn Country above major waterfalls (primarily upper Katherine River and connected habitats). Bush Blitz material collected will aid a broader revision in the genus including mapping the range of this narrow range endemic species. At this stage until more detailed morphological studies can be undertaken, genetic methods are the primary form of identification. However, samples from the previous MAGNT-Jawoyn survey in the upper Katherine River (Hammer and Golding 2017) indicated that some males of the new species possess distinct tiger like stripes; and this matching pattern was observed distinctly on one fish at site MH25-12 just below Nibuldakya Centipede Dreaming; other less obvious individuals at this and other sites may have been recorded but will require future genetic screening.

Table 3. Putatively un-named or not formalised taxa

Taxon	Comment
Northwest Glassfish *Ambassis* sp. NW	Distinctive species (not formalised) previously known as *Ambassis muelleri* requiring a new name after nomenclature review
Sandstone Purplespotted Gudgeon *Mogurnda* sp. sandstone	A candidate species identified previously with molecular data

3.2 Species new to science

In this report, ‘species new to science’ means species that were not recognised by Western science before this Bush Blitz. No new fishes have so far been identified, however genetic research continues on samples collected from the survey.

3.3 Introduced species

No alien or translocated native fish species were recorded. Obvious signs of Buffalo and or Cattle impact were observed at several locations, especially Crystal Falls Creek (MH25-13) headwaters, Douglas Springs (MH25-14) and Dook Creek (MH25-16). Cane Toads were widespread.

3.4 Threatened species

No species sampled in the survey are listed as threatened. Barraway's Fish is recognised as Near Threatened on the IUCN Red List of Threatened Species (Hammer and Kennard 2019). It was recorded in two main subpopulations (Edith River and middle Katherine River) represented by three locations in low to medium abundance. This narrow range endemic species is only known to occur on Jawoyn Country. Note previous correspondence with traditional owners indicated that Barraway's Fish was the more appropriate common name to any previous combinations including the word 'gudgeon' (Hammer and Golding 2017).

3.5 Range extensions

Barraway's Fish was recorded from flooded edge habitat at Leliyn Edith Falls (MH25-01). There are previous anecdotal reports of the species present there (Larson 2007; Pusey et al. 2017), and now verified images, specimens and thus spatial records are available. This represents a second isolated sub-population for the species, Edith River and mid-Katherine River, adding to conservation security. Given the lack of previous sampling, several additional sites were located for Exquisite Rainbowfish on small streams above waterfalls. An outlying population of Flyspecked Hardyhead *Craterocephalus stercusmuscarum* was also recorded in the upper Edith River above the Leliyn Edith Falls physical barrier.

Table 4. Range extensions or significant infill in distribution records for species

Species	Location sighted/observed	Distance from nearest known record (km)	Comments
Barraway's Fish *Hypseleotris barrawayi*	Leliyn Edith Falls	~50 km straight line, or ~200 km river distance	Physical confirmation of previous anecdotal reports
Exquisite Rainbowfish *Melanotaenia exquisita*	Nitmiluk National Park waterfalls, multiple additional stream tributaries of the Katherine River	5 km	No previous survey data was available for the park
Flyspecked Hardyhead *Craterocephalus stercusmuscarum*	Sandy Camp, Edith River, Nitmiluk National Park	5 km	Isolated population above waterfall

3.6 Genetic information

Matching tissue voucher specimens were taken for most species on the trip, with a focus on the upland endemics and Purple-spotted Gudgeons. Future screening with nuclear genetic markers (SNPs) will be required to verify the identity of the two Purple-spotted Gudgeon species and any hybrids at survey sites (Adams et al. 2013; Amini et al. 2025).

Replicate samples of more widespread species such as Western Rainbowfish *Melanotaenia australis* and Northern Purplespotted Gudgeon from different river systems were also made to contribute to future understanding of cryptic species and biogeographic models of fish headwater connectivity in the region (i.e. along the headwater divide of the adjacent upper Roper and Daly rivers: see Figure 1).

Broader taxonomic revision is also underway on Exquisite Rainbowfish that indicates that although there are populations currently identified as this species further west in the Kimberley (Victoria, Pentecost, King George and King Edward river basins), they represent a group of distinct undescribed species, such that the true Exquisite Rainbowfish is endemic to the Arnhem Land Plateau plus one small outlier in Litchfield National Park (Hammer, Moore et al. in prep.).



Katherine River tributary waterfall, habitat of Barraway's Fish (sampling site was a way upstream of the falls = MH25-03)

4. Information on species lists

To complete the species list of fishes known from upland escarpment areas on Jawoyn Country, the following sources were consulted: (a) Midgely's Grunter *Pingalla midgleyi* and Black Catfish *Neosilurus ater* were sampled previously by MAGNT in partnership with Jawoyn Rangers within the study region at Jeyunay Sleisbech (Hammer and Golding 2017), (b) Upper Katherine River Rainbowfish are known above Nibuldakya Centipede Dreaming waterfalls (Hammer and Golding 2017; Pusey et al. 2017) and (c) Falsespine Catfish *Neosilurus pseudospinosus* specimen records held at MAGNT from mid-Katherine River originally collected as part of the Nibuldakya Aquatic Survey in 1997 from Gimbat Creek (Wedd 1997).

A pictorial summary of upland sandstone fishes from the Jawoyn study region are shown below including with available language names sourced from the Jawoyn dictionary and web application and other personal communication.

Rainbowfishes (Melanotaeniidae)



Weredj
Exquisite or Waterfall Rainbowfish (upper catchment areas)
Melanotaenia exquisita



Weredj
Western or Redtail Rainbowfish (Katherine and Edith rivers, upper Dook Creek)
Melanotaenia australis



Weredj
Chequered or Yellowtail Rainbowfish (on Jawoyn Country only from Mary River)
Melanotaenia splendida inornata



Weredj
Upper Katherine Rainbowfish (Upper Katherine River above Centipede Dreaming only)
Melanotaenia splendida subsp.



Weredj
Banded Rainbowfish (on Jawoyn Country, only recorded at Douglas Springs)
Melanotaenia trifasciata

Eeltailed Catfish (Plotosidae)



Wutba
Black Catfish (larger rivers)
Neosilurus ater



Falsespined Catfish (on Jawoyn Country, found in Daly catchment, main rivers)
Neosilurus pseudospinosus



Puwut
Hyrtl's Catfish or Nailfish (widespread)
Neosilurus hyrtlii

Gudgeons (Eleotridae)



Jaworlk
Sandstone Purplespotted Gudgeon **(sandstone escarpment only, Upper Katherine River)**
Mogurnda sp. sandstone (fish shown was sampled during current survey)



Jaworlk
Northern Purplespotted Gudgeon (widespread)
Mogurnda mogurnda



Mik Giyowok
Barraway's Fish **(endemic to middle Katherine River and Edith Falls)**
Hypseleotris barrawayi

Grunters or Breams (Terapontidae)



Nagertmi
Sooty Grunter or Black Bream (widespread in lowlands)
Hephaestus fuliginosus





Juvenile

Najort
Lake Bonaparte Grunter (previously known as Butlers Grunter – larger rivers)
Syncomistes bonapartensis (recently split from *Syncomistes butleri*)



Barred Grunter
Amniataba percoides



Danbukkarr
Spangled Grunter or Spangled Perch
Leiopotherapon unicolor



Midgley's Grunter (like Spangled Perch but small mouth and sandy colour)
Pingalla midgleyi



Coal Grunter (only Mary River, Douglas Springs in Jawoyn Country)
Hephaestus carbo

Other fish families



Northwest Glassfish (rare above waterfalls)
Ambassis sp. NW



Flyspecked Hardyhead (found at Sandy Camp and middle Katherine River)
Craterocephalus stercusmuscarum

Decapod crustaceans



Yarr Freshwater Prawn *Macrobrachium bullatum*



Redclaw Crayfish *Cherax quadricarinatus*



Martdarr Freshwater Crab *Austrothelphusa transversa*

5. Information for land managers

Jawoyn Country is remote with unregulated stream catchments, an important landscape feature when considering development elsewhere in Australia. Numerous waterfalls and the Katherine Gorge act as natural barriers that filter out most lowland fishes, leaving habitat and core refuge to a specialised upland assemblage. Accordingly upland sandstone areas have high conservation value as a stronghold for narrow range endemic species, particularly Barraway's Fish, Sandstone Purple-spotted Gudgeon and Exquisite Rainbowfish. Barraway's Fish is only found on Jawoyn Country, as two sub-populations on the mid-Katherine River and Edith River below the falls, requiring deeper pools with good levels of physical cover like woody debris. Sandstone Purple-spotted Gudgeon is endemic to the more elevated areas of stone country above Nibuldakya Centipede Dreaming where the fractured landscape of deep gorges connects the headwaters of the Katherine River to the South Alligator, East Alligator and Liverpool river headwaters; the exact distribution and habitat of this species thus requires further mapping especially in Warddeken Country with the adjoining East Alligator River Basin having extensive sandstone uplands yet to be surveyed. The Exquisite Rainbowfish is also a habitat specialist for upland stream habitats and is relatively widespread above waterfalls.

The assemblage of upland sandstone escarpment fishes are key ecological assets for Jawoyn Country that can be better incorporated as aquatic values in the Jawoyn Healthy Country Plan. Mapping the distribution of freshwater fishes at additional location on Jawoyn Country is a good activity to get rangers and traditional owners on country around waterways, with collapsible bait traps and digital cameras ideal monitoring equipment, and documenting language names for the endemics will help with two-way learning and future studies. While the focus of the current survey was upland areas, other areas and could be sampled to better understand fishes in these areas. For example the section below Katherine Gorge would be important to survey given the strong cultural interest in larger fishes, some of which are still poorly known from a biodiversity perspective in the upper Daly River (e.g. Morroporl forktail catfishes).

Upland sandstone country is very exposed to the elements outside of the wet season, and thus protecting the availability and quality of refuge pools during dry periods is a key management priority. In particular mapping the Sandstone Purple-spotted Gudgeon may identify areas where habitat contracts considerably to key refuges that may be targets for feral animal control, fencing, or proactive fire management control to help maintain water quality and availability and thus habitat, population and species resilience.

Maintaining the pest fish free status of Jawoyn Country is a high management priority. Future watch and proactive preventative management should be maintained for Tilapia *Oreochromis mossambicus* recently established in the Gulf of Carpentaria and Western Australia (Gascoyne), and for other ornamental species sometimes kept in home aquaria/ponds (e.g. Guppies *Poecilia reticulata*) and which could become pests. Recently there has been a large incursion of Siamese Fighting Fish *Beta splendens* onto the Adelaide River floodplain, highlighting the potential for new pest fish threats in the region (Hammer et al. 2019).Education and awareness about the introduced status and potential impacts of species such as Guppies and Cichlids that may be in peoples fish tanks or ponds in townships like Katherine is critical.

Nitmiluk National Park

While better surveyed for other groups such as terrestrial vertebrates and plants, Nitmiluk National Park has previously had no dedicated science survey effort for fishes other than at Leliyn Edith Falls. As such the Bush Blitz survey provided important baseline data at a range of sites, which can be added to especially along the western side of the park where a series of waterfalls remain to be surveyed (upland assemblage and plunge pool assessment for Barraway's Fish).

A particular focus of survey effort was along the Jatbula Trail walk camp sites to provide information to feed into management and tourism. For example discussion on the unique sandstone upland habitats can now include reference to Exquisite Rainbowfish as a habitat specialist or a particular species list for snorkellers to identify at designated sites (e.g. Sandy Camp).

The verified record of Barraway's Fish at Leliyn Edith Falls is also a good point for strengthening interpretive information at the site and understanding the importance of the region for biodiversity (endemic species).

Douglas Springs was documented to provide important fish habitat which was distinct from other areas of the park owing to being in a different catchment area (Mary River). There were clear signs of the impact of feral grazing animals and severe fire intensity at Douglas Springs which may impact upon the quality of this fish refuge habitat. Likewise, at an interesting perched swamp habitat surveyed in the central park area, representing the headwaters of Crystal Falls Creek (MH25-13); here the seasonality of swamp habitat appeared to be increasing (drying quicker) owing to Buffalo channelling the swamp outlet which now resembled a deeply incised artificial stream allowing water to drain off quickly rather than pool/soak through. Restorative action could include control of feral animals and reinstatement of wetland dynamics through channel works such as sandbagging.



Sampling sites along the Jatbula Trail in Nitmiluk National Park; Top – 17 Mile Creek falls (MH25-10) and Edith River, Sandy Camp (MH25-08)



Erosion head/channelisation facilitated by Buffalo activity at upland swamp in central plateau Nitmiluk National Park as a potential area for restorative action; Crystal Falls Creek, headwater swamp (MH25-13)

6. Other significant findings

Replicate samples of widespread species such as Western Rainbowfish and Northern Purplespotted Gudgeon from different river systems were also made to contribute to future understanding of cryptic species and biogeographic models of fish headwater connectivity in the region, given the presence of significant waterfalls within systems and the very low and relatively flat aquatic drainage divide between the Daly and Roper river headwaters.

The waterfalls at Nibuldakya Centipede Dreaming appear to be a distinct barrier between a mid-Katherine River and upper-Katherine River distribution in two species pairs, with part or occasional overlap from individuals spilling over the falls. The first species pair is the aforementioned Purplespotted Gudgeons, with a narrow range endemic sandstone species occupying the very upper escarpment habitat, and a more widespread species below and in other tributaries with a small area showing some level of hybridisation; although this requires formal publication, precise mapping can be better undertaken after working up samples from this survey in the future.

The second pair is the larger growing Eastern and Western rainbowfish combination, where the red tailed Western Rainbowfish *Melanotaenia australis* is the dominant species throughout the Daly and to systems further west, and the Eastern Rainbowfish *Melanotaenia splendida* occurs in the Roper and further east. There is a natural genetic transition zone between the two species covering the Finniss to Alligator rivers, including the Mary (Unmack et al. in prep.). Above the falls only a local variety of Eastern Rainbowfish occurs, likely a new subspecies owing to distinct colour characteristics that breed true in aquaria (black fins and gold body; see section 4). Below the falls is primarily occupied by Western Rainbowfish, with some mixed schools previously noted on the Nibuldakya Aquatic Survey (Wedd 1997); it is also possible that a low level of hybridisation occurs in the area of overlap, with samples from this Bush Blitz available for future genetic screening.

Eastern Rainbowfish, or specifically the yellow finned Checkered Rainbowfish subspecies *Melanotaenia splendida inornata*, is the dominant rainbowfish through the Roper River around to Cape York (and the most appropriate name for fish from the Mary River site of the current study based on yellow tails). However, at several sites in Roper River headwater tributaries on the current survey the rainbowfish had red tails indicative of Western Rainbowfish, and thus possible headwater connections. Again, this will be an interesting area of future genetic screening to assess movement patterns over time.

7. Conclusions

The targeted survey for fishes during the 2025 Jawoyn Country Bush Blitz added significant spatial information on species distributions in the area, including key gaps in the Nitmiluk National Park (first official fish survey), tributaries to the mid-Katherine River and along the Daly/Roper headwater divide. The habitat is remote and without current major threats or river regulation and alien fishes. Freshwater fish endemism is high, and mapping and monitoring the multiple narrow range endemics in the region is a strong management recommendation. There is scope for further ranger-led surveys of areas of Nitmiluk, especially waterfalls and plunge pools along the northern boundary, and ongoing collaborative research efforts to resolve taxonomy on problematic groups will further highlight the diversity and uniqueness of the Arnhem Land Escarpment.

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Appendices

Appendix 1. List of Giyowk freshwater fishes recorded during the Jawoyn Country Bush Blitz

Family	Species	Common name
Fishes		
Plotosidae	*Neosilurus hyrtlii*	Hyrtl's Catfish
Atherinidae	*Craterocephalus stercusmuscarum*	Flyspecked Hardyhead
Melanotaeniidae	*Melanotaenia australis*	Western Rainbowfish
Melanotaeniidae	*Melanotaenia exquisita*	Exquisite Rainbowfish
Melanotaeniidae	*Melanotaenia splendida inornata*	Checkered Rainbowfish
Melanotaeniidae	*Melanotaenia trifasciata*	Banded Rainbowfish
Ambassidae	*Ambassis* sp. NW	Northwest Glassfish
Terapontidae	*Leiopotherapon unicolor*	Spangled Grunter
Terapontidae	*Hephaestus carbo*	Coal Grunter
Terapontidae	*Hephaestus fuliginosus*	Sooty Grunter
Terapontidae	*Syncomistes bonapartensis*	Lake Bonaparte Grunter
Apogonidae	*Glossamia aprion*	Mouth Almighty
Eleotridae	*Hypseleotris barrawayi*	Barraway's Fish
Eleotridae	*Mogurnda mogurnda*	Northern Purplespotted Gudgeon
Eleotridae	*Mogurnda* sp. sandstone	Sandstone Purplespotted Gudgeon
Decapod Crustaceans (opportunistic)		
Parastacidae	*Cherax quadricarinatus*	Redclaw
Palaemonidae	*Macrobrachium bullatum*	Northwest Australian River Prawn
Gecarcinucidae	*Austrothelphusa transversa*	Freshwater Crab

Appendix 2. Relative abundance of freshwater fishes recorded at each survey site. **Mogurnda* species require genetic screening to confirm the presence of multiple species and or hybrids

Species by site	MH25-01	MH25-02	MH25-03	MH25-04	MH25-05	MH25-06	MH25-07	MH25-08	MH25-09	MH25-10	MH25-11	MH25-12	MH25-13	MH25-14	MH25-15	MH25-16
Craterocephalus stercusmuscarum								2								
Melanotaenia australis	5	100	20			10	10					20				
Melanotaenia exquisita				20	50	100	30	100	50	5		10	200		20	50
Melanotaenia splendida														20		
Melanotaenia trifasciata														20		
Ambassis sp. NW					5	10		10		3			1			
Leiopotherapon unicolor					11	2	1	10	20			1	100			
Hephaestus carbo														5		20
Hephaestus fuliginosus						2						5		10		
Syncomistes bonapartensis												1				
Glossamia aprion	5													5		
Neosilurus hyrtlii			4		1	10	5									1
Hypseleotris barrawayi	15		20									30				
*Mogurnda mogurnda**		30	3	20	2	50	10	50	10	5	30	5	50	50	50	50
Mogurnda sp. sandstone*												1				
Cherax quadricarinatus														x		
Macrobrachium bullatum	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Austrothelphusa transversa			x													x