

Aquatic Fauna of Three Rivers in Northeast Tobago, West Indies: Updated Species Assemblages and Distributions

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ABSTRACT

To fill gaps in our knowledge of the fish and macroinvertebrate fauna of streams in northeast (hereafter NE) Tobago, we surveyed the upper reaches, middle reaches and river mouths of three NE Tobago rivers; Hermitage, Doctors (Speyside) and Delaford Rivers. We employed multiple sampling techniques at these nine sites to survey ichthyofauna, decapod crustaceans and molluscs. We recorded 11 freshwater and four brackish water fish species, 10 decapod species, and four gastropod mollusc species. The molluscs included two invasive snails (*Tarebia granifera* and *Melanoides tuberculata*) and their expanded distributions in NE Tobago. We also noted a new aquatic gastropod species for the island, *Neritina punctularia*, and a new site locality for the catadromous fish, *Anguilla rostrata*, within the Delaford River. Lastly we have re-documented the presence of the freshwater shrimp *Macrobrachium acanthurus*, which was not detected in the most recent report on macroinvertebrates for the island.

Key words: *Tarebia*, *Melanoides*, *Neritina*, *Anguilla*, *Macrobrachium*, alien invasive species, macroinvertebrates, ichthyofauna, aquatic diversity

INTRODUCTION

The aquatic fauna of a river reflects the overall condition of the system (Heatherly *et al.* 2007; , Karr 1991; Wallace and Webster 1996). Baseline data on aquatic assemblages are therefore needed for assessing future environmental impacts and forming management plans. For example, they allow the documentation of rare or threatened species in need of protection, such as *Anguilla rostrata* (Benchetrit and McCleave 2016). Equally, such data enable the tracking of invasive species, such as the gastropod molluscs *Tarebia granifera* and *Melanoides tuberculata* which have already been documented in the region (Mohammed 2014).

The freshwater fish of Tobago have recently been reviewed (Mohammed *et al.* 2015), however this review did not include estuarine species, which form an important element of the fish fauna in the lower reaches of Trinidad and Tobago's rivers (Phillip *et al.* 2013). Notable surveys of Tobago's aquatic invertebrates include those conducted by Bass (2003) and Rostant (2005). Bass sampled 17 sites, three of which fell within NE Tobago (two in Doctors River, Speyside, and one in the Delaford River), while Rostant (2005) surveyed eight sites for freshwater decapods, two of which were in NE Tobago (Doctors River).

This report is intended to add to the body of knowledge on the aquatic faunal assemblages of NE Tobago focusing on the ichthyofauna (fish), decapod crustaceans and gastropod molluscs within the Hermitage, Doctors and Delaford rivers.

A key strength of this study is the sampling of upper, middle and lower river reaches, so that trends along this

gradient can be detected. The study also benefits from a broader-than-usual scope, due to the inclusion of both vertebrates (fish) and invertebrates (decapods and molluscs).

METHODOLOGY

Sites

Three rivers were surveyed: Hermitage River, flowing northerly towards the Caribbean Sea into Man O' War Bay; Doctors River (also known as the Speyside River), flowing south-easterly towards the Atlantic Ocean; and the Delaford River flowing southerly towards the Atlantic Ocean into King's Bay (Fig. 1). These are the three major rivers in NE Tobago. On each river, three 50m stretches were identified as our sampling sites; one in the upper reach, one in the middle reach and one in the lower reach (at the river mouth). The exact location of each site was determined by its accessibility, and whether it included a deep enough section of river for seining (>0.3m). All survey sites comprised clear water sites with a relatively small catchment area and short water course less than 2 km (Fig. 1). Appendix 1 elaborates on the geographic locations as well as the site descriptions. Other small tributaries, drainages and rivers in NE Tobago were also sampled in an ad hoc manner and observations were noted.

Sampling

Sampling took place in June 2016, during the meteorological rainy season. Herein, each site was selected as being a 50m portion of river. The sites were selected via stratified convenient sampling. This meant that for

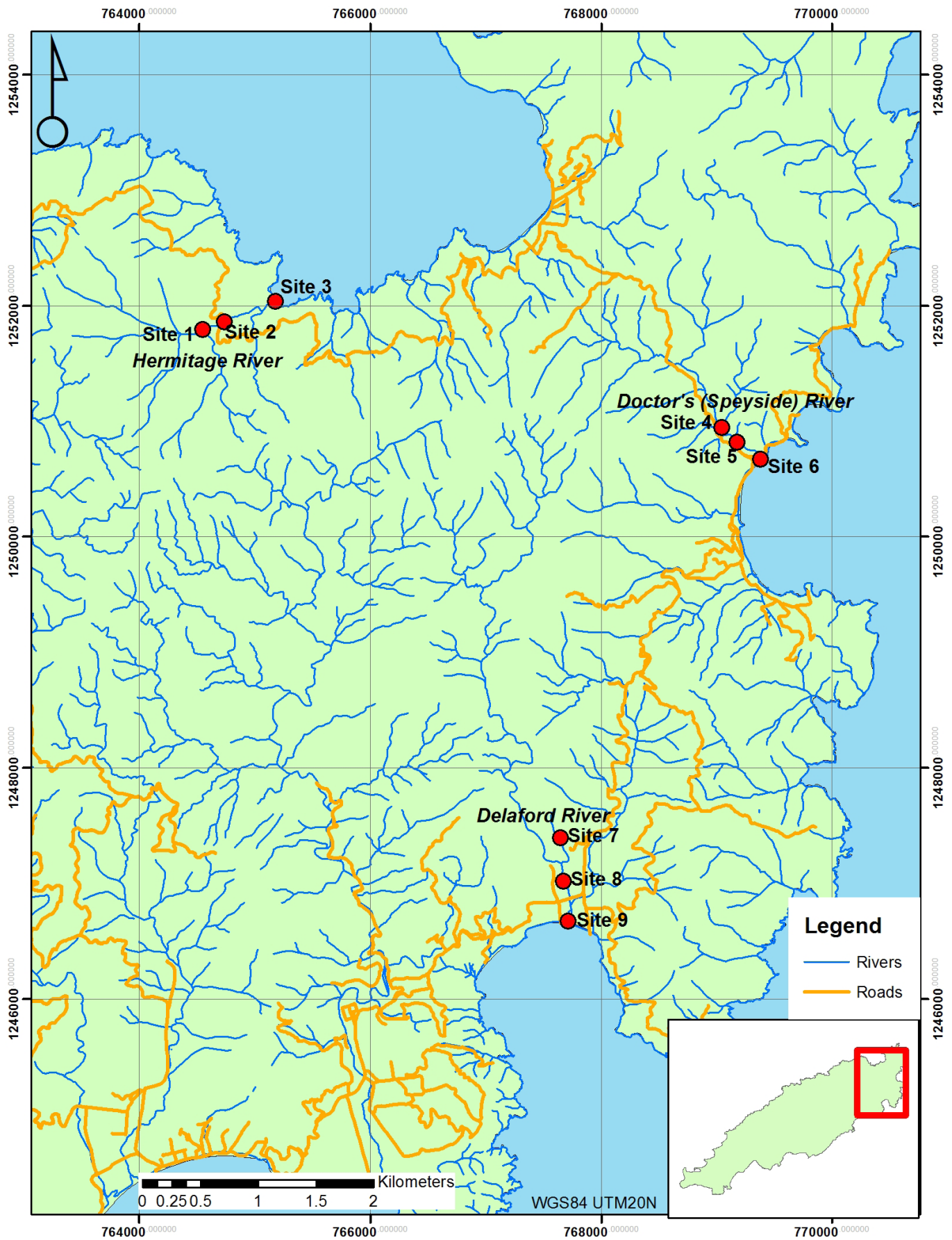


Fig. 1: Sample locations in northeast Tobago.

each site, a general area was chosen based on relative ease of access. Once this area was identified, the criteria of depth and shape were used to select the specific start point. Sampling of each river took place on a single day. At each site, three deployments of a 5m long seine with 0.5cm mesh (aimed at both fish and decapods) were conducted. The seine was dragged along the river bed, moving towards shallower regions. This allowed for cordoning off and capture of the more mobile fish species. Cavities were probed and any individuals that emerged were captured with landing nets. This activity was done in tandem with the use of the seine and was conducted wherever viable cavities were noted.

At each of the nine sites, three 0.25m² quadrats were randomly laid on the river bed and the identities (to species level) and abundances of all molluscs and crustaceans within each quadrat were recorded.

Lastly, at the middle reach and river mouth sites, a fish trap (30cm × 30cm × 60cm, 0.5cm mesh, single funnel entrance) was deployed. These sites were chosen because the fish traps required a minimum depth of 50cm for effective deployment. Upper sites were not sampled using the fish traps as these sites did not meet the minimum depth requirement. The fish traps (baited with scraps of fish and bread) were left for a total of 48hrs and checked at 12hr intervals.

Identification and Analysis

Specimens were identified using available taxonomic keys (Phillip *et al.* 2013; Rostant 2005; Carpenter 2002). All data were tabulated using Microsoft Excel 2007, and species richness calculated per site. Maps were constructed using ArcMap 10.5 (ESRI 2016) and QGis (Quantum GIS Development Team 2012).

The mollusc density data were grouped into four categories: very high (>100m⁻²), high (30-99m⁻²) medium (10 to 29m⁻²) and low (1-9m⁻²).

RESULTS

In total 15 fish species, 10 decapod crustacean species, and four species of mollusc were detected during sampling (Table 2).

Of the fish species, seven are typically freshwater, two are freshwater river species tolerant of brackish water (*Eleotris pisonis* and *Micropoecilia picta*) and four are marine estuarine species known to venture into river mouths (*Lutjanus griseus*, *L. jocu*, *Mugil hospes* and *Trinectes paulistanus*). One catadromous species, *Anguilla rostrata*, was noted. Most species occurred at multiple sites, while three species were detected at only one (Table 2).

It should be noted that *L. griseus* and *L. jocu* were

additionally observed at the Bloody Bay and Parlatuvier River mouths during the period of this survey, although these rivers were not sampled systematically and so are not included in the present analyses.

Of the decapods, three were crabs, *Armases roberti*, *Callinectes sapidus* and *Rodriguezus garmani* (formerly *Eudaniela garmani*). All others were freshwater shrimp. The freshwater shrimp *Xiphocaris elongata* was found at all nine sites, and was noted as the most abundant overall. *Macrobrachium crenulatum* was found at eight sites but was typically less abundant than *X. elongata*. The freshwater shrimp *Jonga serrei* was only found at two sites, both being in the upper reaches. Similarly, two crab species (*Armases roberti* and *Callinectes sapidus*) were found only at two sites (both of them river mouths). Additionally, *C. sapidus* observed at the Bloody Bay and Parlatuvier River mouths.

Neritina punctulata was found at only two sites on the Hermitage River, and at low densities (1-9 m⁻²), while *Neritina virginea* had medium densities (10 to 29 individuals m⁻²) at the five sites where it was present. *Tarebia granifera* was found in high abundance at all nine sites; with its density being highest at the Speyside River mouth. *Melanoides tuberculata* was present at six sites at consistently moderate densities (Table 2).

All four species were also noted at the Parlatuvier and Bloody Bay Rivers, with *T. granifera* having the highest densities and *N. punctulata* having the lowest. Both *M. tuberculata* and *T. granifera* were also noted in the small drainages within Charlotteville and Pirate's Bay.

River mouth sites tended to have fewer decapod species than middle and upper sites. Conversely, fish species richness was consistently lowest at the upper sites, and was similar between middle and lower sections for each river. Freshwater gastropods had low species richness at all sites (Table 1).

DISCUSSION

A previous survey by Mohammed *et al.* (2015) included 81 sites across the rivers of Tobago, taking a broad-scale approach and focusing on the freshwater fish alone. In contrast, our present study concentrates on just three rivers, while widening its scope in terms of taxa (freshwater fish, estuarine fish, crustaceans and molluscs). We also achieved a finer spatial resolution of the communities by sampling upper, middle and lower reaches on each river. It should be noted that the lack of detection of a taxon during one survey does not imply absence. The current survey rather serves to provide additional information regarding fish, crustacean and mollusc assemblages at three rivers in NE Tobago.

Of the 12 freshwater fish species Mohammed *et al.*

Table 1. Species list, distribution and richness per site.

| TAXA | SPECIES | SITE NUMBER | | | | | | | | | Number of sites species observed |
|---------------------------------|---|-------------|----------|----------|----------|-----------|----------|----------|----------|----------|----------------------------------|
| | | 1 U | 2 M | 3 L | 4 U | 5 M | 6 L | 7 U | 8 M | 9 L | |
| FISH | <i>Agonostomus monticola</i> | X | X | X | | X | X | X | | | 6 |
| | <i>Anablepsoides hartii</i> | | | | X | X | | | | | 2 |
| | <i>Anguilla rostrata</i> ^Φ | | X | X | | X | | X | | | 4 |
| | <i>Awaous banana</i> | X | X | | | X | X | | X | X | 6 |
| | <i>Ctenogobius boleosoma</i> | | X | | X | X | | | X | | 4 |
| | <i>Eleotris pisonis</i> | | | X | | | X | | X | X | 4 |
| | <i>Gobiomorus dormitor</i> | | X | X | | X | X | | X | X | 6 |
| | <i>Lutjanus griseus</i> ^ç | | | X | | | X | | X | X | 4 |
| | <i>Lutjanus jocu</i> ^ç | | | X | | X | X | | | X | 4 |
| | <i>Poecilia picta</i> | | | | | X | X | | | | 2 |
| | <i>Mugil hospes</i> ^ç | | | | | | X | | | X | 2 |
| | <i>Poecilia reticulata</i> | | | | X | | | | | | 1 |
| | <i>Sicydium punctatum</i> | X | X | | | X | X | X | X | | 6 |
| | <i>Synbranchus marmoratus</i> | | | | | X | | | | | 1 |
| | <i>Trinectes paulistanus</i> ^ç | | | | | | | | | X | 1 |
| Fish Species Richness | | 3 | 6 | 6 | 3 | 10 | 9 | 3 | 6 | 6 | |
| DECAPODS | <i>Armases roberti</i> | | | | | | X | | | X | 2 |
| | <i>Atya scabra</i> | X | X | | X | X | | | X | | 5 |
| | <i>Callinectes sapidus</i> | | | | | | X | | | X | 2 |
| | <i>Eudaniela garmani</i> | X | X | | X | X | | X | X | | 6 |
| | <i>Jonga serrei</i> | X | | | X | | | | | | 2 |
| | <i>Macrobrachium acanthurus</i> | | | | | | X | X | X | X | 4 |
| | <i>Macrobrachium carcinus</i> | X | X | | X | X | | X | | | 5 |
| | <i>Macrobrachium crenulatum</i> | X | X | X | X | X | X | X | X | | 8 |
| | <i>Potimirim glabra</i> | X | X | | X | | | X | X | | 5 |
| | <i>Xiphocaris elongata</i> | X | X | X | X | X | X | X | X | X | 9 |
| Decapod Species Richness | | 7 | 6 | 2 | 7 | 5 | 5 | 6 | 6 | 4 | |
| MOLLUSCS | <i>Neritina punctulata</i> ** | X | X | | | | | | | | 2 |
| | <i>Neritina virginea</i> | X | X | | | X | | X | X | | 5 |
| | <i>Melanoides tuberculata</i> * | | X | | X | X | X | X | X | X | 6 |
| | <i>Tarebia granifera</i> * | X | X | X | X | X | X | X | X | X | 9 |
| Mollusc Species Richness | | 3 | 4 | 1 | 2 | 3 | 2 | 2 | 3 | 2 | |

U-upper M-middle L-lower (river mouth)

*Invasive species **New species documented for Tobago Φ Catadromous species ç Marine estuarine species

Table 2. Gastropod density (m⁻²) at nine river sites in NE Tobago

| SITE | <i>Neritina punctulata</i> | <i>Neritina virginea</i> | <i>Melanoides tuberculata</i> | <i>Tarebia granifera</i> |
|-------|----------------------------|--------------------------|-------------------------------|--------------------------|
| 1 (U) | 1-9 | 10 to 29 | 0 | 30 to 99 |
| 2 (M) | 1-9 | 10 to 29 | 10 to 29 | 30 to 99 |
| 3 (L) | 0 | 0 | 0 | 30 to 99 |
| 4 (U) | 0 | 0 | 10 to 29 | 30 to 99 |
| 5 (M) | 0 | 10 to 29 | 10 to 29 | 30 to 99 |
| 6 (L) | 0 | 0 | 10 to 29 | >100 |
| 7 (U) | 0 | 0 | 0 | 30 to 99 |
| 8 (U) | 0 | 10 to 29 | 10 to 29 | 30 to 99 |
| 9 (L) | 0 | 10 to 29 | 10 to 29 | 30 to 99 |

(2015) documented for NE Tobago, 11 were detected in this present study, with only *Gobiesox nudus* absent. Phillip (1998) noted *G. nudus* at Site 5 (Doctors River) but this species was not detected in the 2015 survey, and has still not been detected elsewhere in NE Tobago, perhaps indicating its rarity. *Synbranchus marmoratus* was previously noted at Site 5 (Mohammed *et al.* 2015) and was again found in this survey. *Anguilla rostrata* was noted by Phillip (1998) at Site 5, Doctors River and noted by Mohammed *et al.* (2015) at the Hermitage River (Sites 2 and 3). This species was again confirmed at all three of these sites in the present study, and was additionally noted

at the Delaford River (Site 7) at the base of a waterfall.

Of the 63 estuarine fish species Phillip (2013) noted for both Trinidad and Tobago, four were recorded in our survey. It is likely that additional estuarine species venture into the lower portions of these three river systems, as the composition is temporally dynamic and our survey represents only a snapshot in time. Furthermore, at the time of sampling all three rivers had physical barriers near their mouths, limiting the movement of fish between the sea and the river. During the survey period, only the Delaford River showed evidence of flow at high tide, which likely explains why this river had the greatest number of brackish water fish species detected.

In addition to Rostant (2005), four other surveys have examined decapod distributions in rivers of Tobago. These include Chace (1972), who sampled the middle Hermitage River (Site 2); Hart (1980), who surveyed Doctors River in detail, as well as the mouths of the Delaford, Bloody Bay and mid Roxborough Rivers; and Ramnarine *et al.* (1994) who surveyed 22 sites across the island, including detailed surveys of Doctors River and its tributaries, as well as the mouth of the Delaford River (Site 9). Lastly, Bass (2003) surveyed the entire island for macroinvertebrates in 1996. All species previously documented by these authors were noted again by Rostant (2005), with the exception of *Macrobrachium acanthurus*. In our current survey we note for the first time since 2003 the presence of *M. acanthurus* at the Delaford River (all sites) and Doctors River mouth. Four species (*Atya innocuous*, *Macrobrachium faustinum*, *Macrobrachium heterochirus* and *Micratya poeyi*) were not detected during our survey. All four were previously observed at Site 4, upper Speyside River (Bass 2003; Hart 1980; Ramnarine *et al.* 1994; Rostant 2005). Further sampling with additional gear such as electrofishing should be conducted to confirm whether their absence is an artefact of under sampling (Deacon *et al.* 2017).

Of the ten gastropod species listed by Bass (2003), only two species (*Melanoides tuberculata* and *Neritina virginea*) from his NE Tobago sites were detected in our survey. Our surveys only shared two sites in common; Sites 7 and 8 at the upper and middle Delaford River. Like Bass, we found three species at these sites, however they are not the same three. Missing from our survey is *Pyrgophorus parvulus*, while we add *T. granifera* to the species assemblage for the site. At Site 9 on the same river, only the invasive freshwater gastropods were observed. Van Oosterhout *et al.* (2013) noted *T. granifera* for the first time on the island in 2012, and demonstrated that it had some tolerance to sea water. Based on their distribution map (which included similar sites to Bass (2003)) and our current survey, there is an indication that this species may be spreading in the rivers of NE Tobago, an issue which deserves

further attention. Both *M. tuberculata* and *T. granifera* are alien invasive species and it has been suggested that the more recent arrival, *T. granifera*, may be outcompeting *M. tuberculata* (Van Oosterhout *et al.* 2013; Snider 2007).

In Bass' 1996 list (Bass 2003), *Neritina punctularia* is absent (either through misidentification or genuine absence), making this the first report of this species for the island. Given that we know so little about the status and distribution of *N. punctularia*, and that it appears to be fairly rare, potential effects of competition from *T. granifera* and *M. tuberculata* should be monitored in future surveys as it is already present at the same locations. Bivalves were not noted for any sites in NE Tobago but have been noted previously by Bass (2003) in southern rivers on the Caribbean coast.

In conclusion, our study adds to our knowledge of the fish, crustacean and mollusc assemblages of three rivers in NE Tobago. We have noted the expanded distributions of two alien invasive gastropods, listed a new gastropod species for Tobago and new distribution records for crustaceans and fish. These findings justify the approach of sampling smaller regions in greater detail using multiple types of sampling gear and techniques to provide higher resolution of species composition within a river. With this in mind, further detailed surveys should be conducted on selected rivers and catchments with repeated sampling events and longer sampling periods, which can be used to inform the future management of riverine and estuarine ecosystems by providing a baseline of species distributions and abundances.

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