

Aquatic Invasions Records

First record of the non-native three spot gourami, *Trichogaster trichopterus* (Pallas 1770) (Teleostei: Osphronemidae) in Jamaica

Aaron D. Geheber*, Caleb D. McMahan and Kyle R. Piller

Southeastern Louisiana University, Dept. of Biological Sciences, SLU 10736, Hammond, LA 70402 USA

E-mail: Aaron.geheber@selu.edu (ADG), Caleb.mcmahan@selu.edu (CDM), Kyle.piller@selu.edu (KRP)

* Corresponding author

Received: 4 December 2009 / Accepted: 17 May 2010 / Published online: 22 May 2010

Abstract

Five specimens of the non-native three spot gourami (Osphronemidae: *Trichogaster trichopterus*) were collected from a small pond near the northern coast of Jamaica in June 2009. The collection represents the first documentation of this species in Jamaica. Origin of the introduction is not known. Herein, we discuss the occurrence of this species in Jamaica and possible threats posed to the island's native fish fauna.

Key words: Caribbean Islands, fishes, introductions, ornamentals

Introduction

The introduction and establishment of non-native fishes is a phenomenon occurring throughout the world causing major concerns for many freshwater ecosystems (Gozlan et al. 2010). Especially at risk may be areas with high endemism, where according to Ruesink (2005), the probability of establishment and impact appear to be greater. The Antillean islands of the Caribbean host a relatively unique freshwater fish fauna consisting of 71 species, many endemic to the islands (Burgess and Franz 1989). The Antillean island of Jamaica is quite depauperate in terms of its freshwater fish diversity, harboring only six native species, four of which are endemic to the island (Burgess and Franz 1989). Because the majority of the few native inland fishes present are endemic, the introduction and establishment of non-native fishes is of considerable concern.

Nine non-native fish species have previously been documented as being introduced or established in inland waters of Jamaica (Table 1). The presence of many of these species is the result of their use as food fishes in Jamaica over the past 60 years (Aiken et al. 2002; Watanabe et al. 2002). In contrast, there is less information available regarding the introduction history of the few non-native ornamental fishes present. The pathways of introduction for these species, including when and where, are not well estab-

lished (Aiken et al. 2002), and their impacts, if any, have not been studied. In this paper we document the occurrence of a new ornamental non-native species, the Three Spot Gourami [Osphronemidae: *Trichogaster trichopterus* (Pallas 1770)], in an inland water body of Jamaica and discuss the possible implications of this introduction.

Methods

We sampled a small marsh pond adjacent to the Caribbean Sea near the North coast of Jamaica (18°30.113'N, 77°42.585'W), on 26 June 2009. The specimens collected are permanently archived in the Southeastern Louisiana University Vertebrate Museum. The collection site was located in Trelawny Parish, 25 m North of Highway A-1, and approximately 5.7 km East of the town of Falmouth. Sampling was conducted using a 6-ft, ¼" (1.829 m, 0.6 cm) mesh cast net, and the sampling period was approximately one hour. The pond was shallow (<1 m) and extremely turbid. Salinity level was not measured, however we suspect the water to be brackish given the surrounding vegetation (mainly mangroves), the close proximity of the Caribbean Sea (\cong 10m), and the direct connection of the pond to the sea via a culvert (assumed to allow water through during high tide or wave surge events).

Results and discussion

Five adult *Trichogaster trichopterus* (SLU 6361; Figure 1A) were collected from the sample site (Figure 1B). No additional nearby sites could be sampled and we did not obtain this species at any other collection site on the island. Characters used for positive identification of specimens were based on information provided in Kottelat (1993). All Jamaica specimens were characterized by the presence of a black blotch in the middle of the flank and another dark spot at the caudal base, traits that distinguish *T. trichopterus* from all other *Trichogaster* species. The five captured specimens consisted of two males (58–66 mm standard length [SL]) and three females (53–56mm SL). Other species collected with *T. trichopterus* included the native *Poecilia caudofasciata* (Regan 1913), and the non-native *Oreochromis mossambicus* (Peters 1852).

The presence of *T. trichopterus* in Jamaica is a potential threat to natives, partly due to its territorial nature as well as its known aggressiveness as an opportunistic carnivore (Webb et al. 2007). Moreover, it is known to be very tolerant of wide ranges of environmental conditions including, varying pH (6.0-8.8), temperature (21°-31°C), and dissolved oxygen levels (Priest 2002). Furthermore, the three spot gourami possesses a labyrinth apparatus, which allows it to breathe air in hypoxic conditions (Das 1928). It is known to tolerate brackish salinity levels, however the upper limit has not yet been determined (Webb et al. 2007). The salinity tolerance of this fish could be very problematic, creating a potential threat towards brackish native fishes, and furthermore allowing possible coastal dispersal. Native and some introduced populations are reported to reproduce year round (Hails and Abdullah 1982).

It is unclear if the *T. trichopterus* population in Jamaica is reproducing or is yet established. However, the presence of adult males and females in our sampled site suggests that a reproducing population may potentially be present in the region. Although the fishes of the inland waters of Jamaica do not appear to be routinely sampled or reported on, no prior records exist documenting the occurrence of *T. trichopterus* in Jamaica; therefore, at present we can only assume that its origin of introduction is, or is in close proximity to, our sampling site.

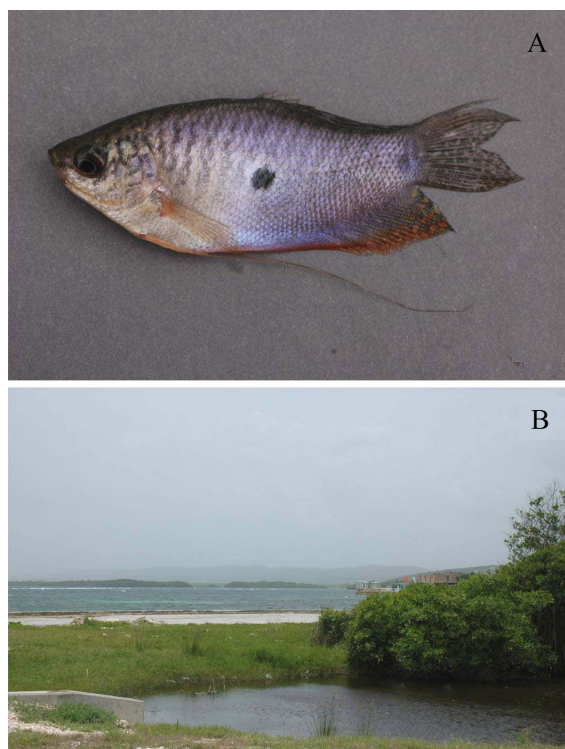


Figure 1. (A) Photograph of a *Trichogaster trichopterus* specimen (SLU 6361) collected in Jamaica, June 2009 and (B) site in the foreground where specimens were collected (note its close proximity to the Caribbean Sea). Photographs by KRP.

The three spot gourami is a freshwater fish native to Southeast Asia; however, given past introductions its exact range is uncertain but possibly includes Thailand, Laos, Kampuchea, Vietnam, Malay Peninsula, Sumatra, Myanmar, Java, and Madura (Fuller et al. 1999). Its wide popularity as an ornamental fish has likely contributed to all or most introductions outside its native range. There is evidence that established populations exist in India (Daniels and Rajagopal 2004), Taiwan (Shen 1993), North Western Australia (Webb 2003), Philippines (Juliano et al. 1989), Papua New Guinea (Allen 1991), Southern Africa (FAO 1997), South America (Welcomme 1988) and Dominican Republic (Lever 1996). The species has also been collected or reported from other regions, for example Florida (Fuller et al. 1999) and Canada (Crossman 1984), but without evidence of establishment.

Despite existence of multiple established populations across the world, the ecological

Table 1. Non-native freshwater fishes of Jamaica. Population status of ‘reported’ indicates species has been captured or recorded but without evidence of reproduction; ‘established’ indicates evidence is available to show species is reproducing.

Family	Species	Population status	Introduction Pathway	Citations
Cyprinidae	<i>Ctenopharyngodon idella</i> (Valenciennes 1844)	reported	aquaculture	Chakalall (1993); Aiken et al. (2002)
	<i>Cyprinus carpio</i> (Linnaeus 1758)	reported	aquaculture	Chakalall (1993); Aiken et al. (2002)
	<i>Hypophthalmichthys molitrix</i> (Valenciennes 1844)	reported	aquaculture	Chakalall (1993); Aiken et al. (2002)
Characidae	<i>Colossoma macropomum</i> (Cuvier 1816)	reported	aquaculture	Chakalall (1993); Aiken et al. (2002)
Cichlidae	<i>Oreochromis mossambicus</i> (Peters 1852)	established	aquaculture	Burgess and Franz (1989); Lever (1996); Aiken et al. (2002)
	<i>Oreochromis niloticus</i> (Linnaeus 1758)	reported	aquaculture	Chakalall (1993); Aiken et al. (2002)
Osphronemidae	<i>Trichogaster trichopterus</i> (Pallas 1770)	reported	aquarium trade	This study
Poeciliidae	<i>Poecilia reticulata</i> (Peters 1859)	established	aquarium trade	Lever (1996)
	<i>Xiphophorus hellerii</i> (Heckel 1848)	established	aquarium trade	Burgess and Franz (1989); Lever (1996)
	<i>Xiphophorus maculatus</i> (Günther 1866)	established	aquarium trade	Burgess and Franz (1989); Lever (1996)

impacts of this species have not been adequately explored. Past studies by Arthington et al. (1999), Bomford and Glover (2004) have emphasized the high invasiveness of *T. trichopterus* in Australia as compared to other non-indigenous fishes, however direct effects on native faunas are still in question. A study by Liao and Liu (1989) suggests that *T. trichopterus* may be a strong resource competitor, possibly causing declines in some Taiwanese native fishes. Humphrey (1995) reported that members of the genus *Trichogaster* carry a number of pathogenic diseases. This suggests introduction of *T. trichopterus* poses a possible threat as a vector of disease and parasites both to native fish faunas, as well as to fishes being raised in aquaculture conditions in the region.

Although its pathway of introduction is uncertain, the presence of *T. trichopterus* in Jamaica is likely the result of its importation as an ornamental fish. Over recent years there has been a push by the Jamaican government urging citizens to utilize ornamental fish rearing as a potential source of income (Jamaica Information Service 2006). Due to growing popularity of the ornamental fish trade in Jamaica, the documentation of *T. trichopterus* may just be the

beginning of many concerns to come in Jamaica’s aquatic ecosystems. A thorough survey of the distributional extent of this and other non-native fish species in Jamaica is warranted. To that extent, given the possibility of restriction to a single pond, or perhaps one or a few nearby locations, an attempt to immediately eradicate the population is in order.

Acknowledgements

We thank Klaus Wolf and Karl Aiken for providing assistance with the logistical aspects of conducting fieldwork in Jamaica. We are thankful to Ms. Yvette Strong and the personnel of Jamaica’s National Environmental Planning Agency for providing permits to conduct fieldwork in Jamaica. We are also thankful to anonymous reviewer comments and suggestions which helped to improve the manuscript. This trip was in part supported by a Raney Research Grant from the American Society of Ichthyologists and Herpetologists, and Lerner-Gray Research Grant from the American Museum of Natural History, awarded to CDM.

References

- Aiken KA, Morris D, Hanley FC, Manning R (2002) Aquaculture in Jamaica. *NAGA, WorldFish Center Quarterly* 25 (3-4): 10-15

- Allen GR (1991) Field guide to the freshwater fishes of New Guinea. Christensen Research Institute, Madang, Papua New Guinea
- Arthington AH, Kailola PJ, Woodland DJ, Zalucki JM (1999) Baseline environmental data relevant to an evaluation of quarantine risk potentially associated with the importation to Australia of ornamental finfish. Australian Quarantine and Inspection Service, Department of Agriculture, Fisheries and Forestry, Canberra. ACT, 451 pp
- Bomford M, Glover J (2004) Risk assessment model for the import and keeping of exotic freshwater and estuarine finfish. Bureau of Rural Sciences, Canberra. ACT, 125 pp
- Burgess GH, Franz R (1989) Zoogeography of the Antillean freshwater fish fauna. In: Woods CA (ed) Biogeography of the West Indies: past, present, and future. Sandhill Crane Press, Gainesville, Florida, USA, pp 263-304
- Chakalall B (1993) Species cultured in insular Caribbean countries, Belize, French Guiana, Guyana and Suriname. Caribbean Technical Co-operation Network in Artisanal Fisheries and Aquaculture. FAO Regional Office for Latin America and the Caribbean. Santiago, Chile. pp 32
- Crossman EJ (1984) Introduction of exotic fishes into Canada. In: Courtenay WR, Stauffer JR (eds), Distribution, biology and management of exotic fishes. Johns Hopkins University Press, Baltimore, USA, pp 78-101
- Cuvier G (1816) Le Règne Animal distribué d'après son organisation pour servir de base à l'histoire naturelle des animaux et d'introduction à l'anatomie comparée. Les reptiles, les poissons, les mollusques et les annélides. Edition 1. Le Règne Animal distribué d'après son organisation pour servir de base à l'histoire naturelle des animaux et d'introduction à l'anatomie comparée. Les reptiles, les poissons, les mollusques et les annélides. Edition 1(2): i-xviii + 1-532, Pls. (4)9-10
- Cuvier G, Valenciennes A (1844) Histoire naturelle des poissons. Tome dix-septième. Suite du livre dix-huitième. Cyprinoides. *Histoire naturelle des poissons* 17: 1-497, Pls. 487-519
- Daniels RJ, Rajagopal B (2004) Fishes of Chembarampakkam Lake - a wetland in the outskirts of Chennai. *Zoos' Print Journal* 19(5): 1481-1483
- Das BK (1928) The bionomics of certain air-breathing fishes of India, together with an account of the development of air-breathing organs. *Philosophical Transactions of the Royal Society* 216B: 183-219, doi:10.1098/rstb.1928.0003
- FAO (1997) Food and Agriculture Organization of the United Nations (FAO) FAO Database on Introduced Aquatic Species, Rome, Italy
- Fuller PL, Nico LG, Williams JD (1999) Nonindigenous fishes introduced to inland waters of the United States. Bethesda, Maryland, American Fisheries Society. 613 pp
- Gozlan RE, Britton JR, Cowx I, Copp GH (2010) Current knowledge on non-native freshwater fish introductions. *Journal of Fish Biology* 76: 751-756, doi:10.1111/j.1095-8649.2010.02566.x
- Günther A (1866) Catalogue of fishes in the British Museum. Catalogue of the Physostomi, containing the families Salmonidae, Percopsidae, Galaxiidae, Mormyridae, Gymnarchidae, Esocidae, Umbridae, Scombroideae, Cyprinodontidae, in the collection of the British Museum. Catalogue of the fishes in the British Museum. 6: i-xv + 1-368
- Hails AJ, Abdullah Z (1982) Reproductive biology of the tropical fish *Trichogaster pectoralis* (Regan). *Journal of Fish Biology* 21(2): 157-170, doi:10.1111/j.1095-8649.1982.tb03996.x
- Heckel JJ (1848) Eine neue Gattung von Poecilien mit rochenartigem Anklammerungs-Organ. Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften. Mathematisch-Naturwissenschaftliche Classe v. 1 (pt 1-5) [1848]: 289-303, Pls. 8-9.
- Humphrey JD (1995) Australian quarantine policies and practices for aquatic animals and their products: A review for the Scientific Working Party on Aquatic Animal Quarantine, Part 1: Review and Annexes, Bureau of Resource Sciences, Canberra
- Jamaica Information Service (2006) Jamaicans urged to explore ornamental fish rearing. <http://www.jis.gov.jm/agriculture> (Accessed 5 September 2009)
- Juliano RO, Guerrero RD, Ronquillo I (1989) The introduction of exotic aquatic species in the Philippines. In: De Silva SS (ed) Exotic aquatic organisms in Asia. Asian Fisheries Society, Spec. Publ. Manila, Philippines, pp 83-90
- Kottelat M, Whitten AJ, Kartikasari SN, Wirjoatmodjo S (1993) Freshwater fishes of Western Indonesia and Sulawesi. Periplus edn Ltd, Republic of Indonesia, 221 pp
- Lever C (1996) Naturalized fishes of the world. Academic Press, California, USA
- Liao LC, Liu HC (1989) Exotic aquatic species in Taiwan. In: De Silva SS (ed) Exotic aquatic organisms in Asia. Asian Fisheries Society, Darwin, Australia, pp 101-118
- Linnaeus C (1758) Systema Naturae, Ed. X. (Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. Tomus I. Editio decima, reformata.) Holmiae. Systema Naturae, Ed. X. v. 1: i-ii + 1-824
- Pallas PS (1770) Spicilegia Zoologica quibus novae imprimis et obscurae animalium species iconibus, descriptionibus atque commentariis illustrantur. Berolini, Gottl. August. Lange. Spicilegia Zoologica quibus novae imprimis et obscurae animalium species iconibus, descriptionibus atque commentariis illustrantur 1 (8): 1-56, Pls. 1-5
- Peters WCH (1852) Diagnosen von neuen Flussfischen aus Mossambique., Monatsb. Akad. Wiss. Berlin, 681-685 pp
- Peters WCH (1859) Eine neue vom Herrn Jagor im atlantischen Meere gefangene Art der Gattung *Leptocephalus*, und über einige andere neue Fische des Zoologischen Museums. Monatsberichte der Akademie der Wissenschaft zu Berlin 1859: 411-413
- Priest A (2002) When two are three and gold is blue. *Osphronemid* 4(4): 6-11
- Regan CT (1913) A revision of the Cyprinodont Fishes of the Subfamily Poeciliinae. *Proc Zool Soc London* 2: 977-1018, Pls 99-101
- Ruesink JL (2005) Global analysis of factors affecting the outcome of freshwater fish introductions. *Conservation Biology* 19(6): 1883-1893
- Shen SC (1993) Fishes of Taiwan. Department of Zoology, National Taiwan University, Taipei, pp 960
- Watanabe WO, Losordo TM, Fitzsimmons K, Hanley F (2002) Tilapia production systems in the Americas: technological advances, trends, and challenges. *Reviews in fisheries science* 10(3-4): 465-498, doi:10.1080/20026491051758
- Webb AC (2003) The ecology of invasions of non-indigenous freshwater fishes in northern Queensland. PhD thesis, School of Tropical Biology, James Cook University, Townsville, Queensland
- Webb AC, Maughan M, Knott M (2007) Pest fish profiles *Trichogaster trichopterus* - The three spot gourami. Australian centre for tropical freshwater research (ACTFR), James Cook University, 1-5 pp
- Welcomme RL (1988) International introductions of inland aquatic species. Food and Agriculture Organization of the United Nations (FAO). FAO Technical report No 294, 318 pp