Snakeskin Gourami (*Trichopodus pectoralis*)

Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, June 2014
Revised, December 2017
Web Version, 9/11/2019

Photo: Rodolfo B. Reyes. Licensed under Creative Commons BY-NC 3.0 Unported. Available: http://www.fishbase.se/photos/PicturesSummary.php?StartRow=1&ID=499&what=species&TotRec=5. (November 5, 2014).

1 Native Range and Status in the United States

Native Range

From Froese and Pauly (2017):

"Naturally occurring in the Mekong basin [in Cambodia] [Rainboth 1996]. Found around the Tonle Sap Great Lake and river [Thuok and Sina 1997] and Stung Sen [Kottelat 1985]. Known from the flooded forests of the lower Mekong and gradually moves back to rivers and Great Lake as floodwaters recede [Rainboth 1996; Cambodian National Mekong Committee 1998]."

"Occurs in the Mekong basin [in Laos] [Kottelat 2001]. Found in the Khone Falls [Hill and Hill 1994]."

"Naturally found in Mekong and Chao Phraya basins [in Thailand] [Kottelat 2001]. Recorded from Maeklong and Southeast Thailand river systems [Vidthayanon et al. 1997]; also from Klong Kok Kamyan (Suphanburi), Bangkok, Bung Borapet (Nakhon Sawan), Chai Nat and Songkhla [Monkolprasit et al. 1997]. Naturally absent from Peninsular, Northern, and Western Thailand."

"Naturally found in the Mekong basin [in Viet Nam] [Kottelat 2001]."

From Vidthayanon (2012):

"The species is widely distributed in southeast Asia, occurring in both the Mekong and Chao Phraya drainages, although its native distribution is not completely certain as it has been introduced widely. Paepke (2009) gives the native range as southern Viet Nam, Lao PDR, Thailand, and the Malay Peninsular, and it is also present in Myanmar."

Status in the United States

No records of *Trichopodus pectoralis* introductions in the United States were found.

Trichopodus pectoralis is for sale in the United States under the name *Trichogaster pectoralis* (Fish Net 2017).

Means of Introductions in the United States

No records of *Trichopodus pectoralis* introductions in the United States were found.

Remarks

The valid name for this species is *Trichopodus pectoralis* (Eschmeyer et al. 2017). Previously it was *Trichogaster pectoralis* (Eschmeyer et al. 2017; ITIS 2017). Information searches were conducted using both names to ensure that all pertinent information was found.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From Eschmeyer et al. (2017):

"**Current status:** Valid as *Trichopodus pectoralis* Regan 1910. Osphronemidae: Trichogastrinae."

From Froese and Pauly (2019):

"Animalia (Kingdom) > Chordata (Phylum) > Vertebrata (Subphylum) > Gnathostomata (Superclass) > […] Actinopterygii (Class) > Perciformes (Order) > Anabantoidei (Suborder) >

Osphronemidae (Family) > Luciocephalinae (Subfamily) > *Trichopodus* (Genus) > *Trichopodus pectoralis* (Species)"

Size, Weight, and Age Range

From Froese and Pauly (2017):

"Max length : 25.0 cm TL male/unsexed; [Pethiyagoda 1991]; common length : 15.0 cm TL male/unsexed; [Davidson 1975]; max. published weight: 500.00 g [Pethiyagoda 1991]"

Environment

From Froese and Pauly (2017):

"Freshwater; benthopelagic; pH range: 6.0 - 8.3; dH range: 2 - 3; potamodromous [Riede 2004]; depth range 4 - ? m [Frimodt 1995]. […] 23°C - 28°C [assumed to be recommended aquarium temperature range] [Riehl and Baensch 1991]; […]"

Climate/Range

From Froese and Pauly (2017):

"Tropical; […]; 20°N - 22°S"

Vidthayanon (2012) reports a lower elevation limit of 2 m and an upper elevation limit of 180 m.

Distribution Outside the United States

Native

From Froese and Pauly (2017):

"Naturally occurring in the Mekong basin [in Cambodia] [Rainboth 1996]. Found around the Tonle Sap Great Lake and river [Thuok and Sina 1997] and Stung Sen [Kottelat 1985]. Known from the flooded forests of the lower Mekong and gradually moves back to rivers and Great Lake as floodwaters recede [Rainboth 1996; Cambodian National Mekong Committee 1998]."

"Occurs in the Mekong basin [in Laos] [Kottelat 2001]. Found in the Khone Falls [Hill and Hill 1994]."

"Naturally found in Mekong and Chao Phraya basins [in Thailand] [Kottelat 2001]. Recorded from Maeklong and Southeast Thailand river systems [Vidthayanon et al. 1997]; also from Klong Kok Kamyan (Suphanburi), Bangkok, Bung Borapet (Nakhon Sawan), Chai Nat and Songkhla [Monkolprasit et al. 1997]. Naturally absent from Peninsular, Northern, and Western Thailand."

"Naturally found in the Mekong basin [in Viet Nam] [Kottelat 2001]."

From Vidthayanon (2012):

“The species is widely distributed in southeast Asia, occurring in both the Mekong and Chao Phraya drainages, although its native distribution is not completely certain as it has been introduced widely. Paepke (2009) gives the native range as southern Viet Nam, Lao PDR, Thailand, and the Malay Peninsular, and it is also present in Myanmar.”

Introduced

Froese and Pauly (2017) list *Trichopodus pectoralis* as introduced and established in Singapore; introduced but not established in Hong Kong, India, and Japan; and introduced and status unknown in Bangladesh, and Haiti. It was previously cultured in Pakistan from 1950–1974 and did not become established in the wild.

From Froese and Pauly (2017):

“Introduced to Sumatra, Borneo, Java and Sulawesi [Indonesia] [Kottelat et al. 1993]. Introduced in Danau Sentarum National Park in the Kapuas basin, Kalimantan Barat, Borneo in order to increase the fisheries productivity but introduction did not result to establishment. This species now occurs only in some swampy areas along the Kapuas mainriver.”

“Introduced by the Inland Fisheries Department [of Indonesia] which later became widely cultured in ponds and is established in open waters in Java, Borneo and Celebes. Present in the Ajamaru Lakes, Irian Jaya in the 1950s, but its current status is uncertain [Allen 1991]. Introduced in 1937. Established in the Ajamaru Lakes in the 1950s and its current status is uncertain [Bartley 2006].”

“Introduced in the Krian rice-bowl area, northwestern Peninsular Malaysia.”

“[Introduced to the Philippines:] Common in Lake Bombon (=Taal) [Bleher 1996; Mercene 1997]. Recorded from Candaba Swamp and Pampanga River [Paz-Alberto et al. 2009]. Known from Lake Mainit, Mindanao [Pauly et al. 1990; Mercene 1997; Labajo and Nuñeza 2003], Lake Buluan [Yap et al. 1983], Laguna de Bay [Palma et al. 2005], Lake Lanao [Bleher 1994; Ismail et al. 2014] and Lake Naujan [Mercene 1997].”

“[Introduced to Sri Lanka:] Found throughout Sri Lanka, particularly in the dry zone tanks, but not in the central hills.”

“Introduced [and established] in New Caledonia at Port Laguerre in 1955 [Marquet et al. 2003].”

“Introduced to the Western Highlands, Central and Gulf districts [of Papua New Guinea].”

“Established in the Magdalena (Ciénaga Grande de Santa Marta) (10°43'-11°00'N and 74°16'-74°35'W) [Leal-Flórez et al. 2008] and Orinoco watersheds [Colombia]. Widespread in fish rearing facilities and has presumably escaped into local waters.”

"Thus [due to geography of native range and widespread introductions], status of occurrence in Myanmar needs confirmation."

According to FAO (2017) *Trichopodus* (*Trichogaster*) *pectoralis* is established in Malaysia, Papua New Guinea, and the Philippines; as introduced but status unknown in Hong Kong, India, and Japan; and introduced and not established in Bangladesh.

Means of Introduction Outside the United States

FAO (2017) listed reasons of introduction as aquaculture, pest control, and ornamental.

Trichopodus (*Trichogaster*) *pectoralis* was introduced to Sri Lanka by the government to establish a commercial fishery (Bambaradeniya 2002).

From Froese and Pauly (2017):

"Widespread in fish rearing facilities [in Colombia] and has presumably escaped into local waters."

"Also introduced to fill ecological niche [and other pest control in Sri Lanka]."

Trichopodus (*Trichogaster*) *pectoralis* was introduced to Bangladesh for insect control and experimental cultural purposes (Pallewatta et al. 2003).

Short Description

From Froese and Pauly (2017):

"Dorsal spines (total): 7 - 8; Dorsal soft rays (total): 10-11; Anal spines: 9-12; Anal soft rays: 33 - 38. Dorsal fin with short spines and long soft rays. Caudal fin slightly emarginate. First soft ray of pelvic fins prolonged into a tentacle extending posteriorly to hind margin of caudal fin. Body with numerous dark oblique cross bands which are not always distinct; presence of irregular black stripe from eye to middle of caudal fin base [Kottelat 2001]."

Froese and Pauly (2017) also list the following characteristics: 52-57 scales on lateral line, 55-63 scales in lateral series, 66-70 total gill rakers, and 9-10 pectoral rays.

Biology

From Froese and Pauly (2017):

"Found in shallow sluggish or standing-water habitats with a lot of aquatic vegetation. Occurs in flooded forests of the lower Mekong and gradually moves back to rivers and Great Lake as floodwaters recede [Rainboth 1996; Vidthayanon 2002]. Feeds mainly on planktonic invertebrates [Yap 1988]. Generally feeds on aquatic plants. Can breathe air directly, as well as absorb oxygen from water through its gills [Frimodt 1995]."

"Male creates a bubble-nest at the surface. After fertilization, male, with the use of its mouth, collects the eggs and pushes them up into the bubble-nest [Ukkatawewat 2005]. Male guards the eggs until hatching [Frimodt 1995]; both parents care for the young [Pethiyagoda 1991]."

Human Uses

From Froese and Pauly (2014):

"The flesh is of good quality; may be grilled or used for fish soup. In Thailand there is a trade of dried pla salid [local common name for *T. pectoralis*] for the benefit of people in areas where it is not caught [Davidson 1975]. Cultured both for food and for export as aquarium fish [Frimodt 1995]. Marketed fresh [Rainboth 1996]. Highly economic species; both by capture and culture includes in the peat areas [Vidthayanon 2000]."

"Formed an important fishery in the country [Malaysia] [Welcomme 1988; Ang et al. 1989]. An important fish for the subsistence fisheries in the paddy growing areas [Chong et al. 2010]. Genetic research (genetic relationship studies using electrophoretic markers) for the aquaculture sector is being done in the country [Nguyen 2004]. […] Has colonized swamps, canals and rice paddies where it yields 94-202 kg/ha but has been badly affected by double cropping of rice and wide use of pesticides."

From Vidthayanon (2012):

"The species is commonly consumed throughout its range, fished by small scales fisheries mixed with other lacustrine fishes. It is popular in pond aquaculture (farmers in central and southern Thailand, central Myanmar, using introduced stocks from Thailand). It is exported as dry preserved fish from Myanmar and Thailand to Malaysia and Indonesia."

In 2008 Brazil banned import of *Trichopodus pectoralis*, it was still found in aquarium shops after then ban took place (Magalhães 2013).

Trichopodus pectoralis has been in the aquarium trade in Israel (Paperna et al. 1987), Greece (Papavlasopoulou et al. 2014), and the United States (Fish Net 2017; under the name *Trichogaster pectoralis*).

Diseases

Epizootic ulcerative syndrome is on the 2017 list of OIE reportable diseases (OIE 2017).

From Froese and Pauly (2017):

"Trichodinosis, Parasitic infestations (protozoa, worms, etc.)
Costia Disease, Parasitic infestations (protozoa, worms, etc.)
Dactylogyrus Gill Flukes Disease, Parasitic infestations (protozoa, worms, etc.)
Bacterial Infections (general), Bacterial diseases
Epizootic Ulcerative Syndrome, Viral diseases"

Poelen et al. (2014) list *Edwardsiella tarda*, *Gnathostoma spinigerum*, and *Pallisentis ophiocephali* as pathogens of *Trichopodus pectoralis.*

From Tansatit et al. (2014):

"In 1985, metacercaria of *C*[*linostomum*]. *piscidium* was detected in the abdominal cavity of *T*[*richogaster*]. *pectoralis* and *T. trichopterus* from Samutprakarn Province, Thailand (Charoenpornsook, 1985)."

From Molnár et al. (2003):

"[…] semisporulated oöcysts from the gut of *Trichogaster* [*Trichopodus*] *pectoralis* were identified as *Goussia trichogasteri* Székely & Molnár, 1992."

Paperna et al. (1987) list *Clinostomum* and *Centrocestus* sp. as pathogens of *Trichopodus pectoralis.*

From Ang et al. (1989):

"[…]; infected with hemorrhagic septicaemia; […]"

Threat to Humans

From Ang et al. (1989):

"There is no negative impact of introduced species [analysis included *Trichopodus pectoralis*] on human life-styles, customs or economic systems."

3 Impacts of Introductions

The following information indicates **mixed ecological** impacts from *Trichopodus pectoralis* introductions.

From Ang et al. (1989):

"It is difficult to gauge the impact this species has had on the environment [in Malaysia]. Soong (1948) maintained that this species has had no deleterious effect on other rice-field fishes, especially the climbing perch (*Anabas testudineus*), the snakehead (*Channa striata*) and catfish (*Clarias* spp.). However, it is certain that the indigenous *Trichogaster trichopterus* has been displaced, at least to some extent, since both have similar feeding habits and occupy the same niche in the paddy field ecosystem."

From Hyslop (1998):

"Lower diversity indices [than at the other study sites elsewhere in the river] were recorded for the floodplain pools at Inawi and Inawabui [Papua New Guinea] due to the dominance of *Oreochromis mossambicus* and *Trichogaster* [*Trichopodus*] *pectoralis*."

From Polhemus et al. (2004):

"Two species in the family Belontiidae, the snakeskin gourami (*Trichogaster pectoralis*) and threespot gourami (*Trichogaster trichopterus*) have restricted ranges and do not appear to be highly invasive as the range of both of these species remains quite limited in New Guinea (Allen 1991) […]. Impacts to native biota from gouramies are likely minimal because these species have not spread or even become successfully established except in a few instances."

From Leal-Flórez (2007):

"No clear evidence has been found [in Colombia] that indicates a negative impact of *O. niloticus* and *T. pectoralis* on the abundance and species composition of the native ichthyofauna."

From Froese and Pauly (2017):

"Has populated rivers and reservoirs and is regarded as a useful addition to the fauna of swampy areas [in the Philippines].

From NACA (2005):

"There is no report on negative impact in the environment [in Myanmar]."

From Chong et al. (2010):

"There has been no serious attempt to list the introduced fish species or to identify the threats they pose to the local biota and environment. […] Most introduced species [in Malaysia] are, however, not considered invasive; many like *Pangasianodon hypophthalmus* (Sauvage), *Barbonymus gonionotus* (Bleeker) and *Trichogaster pectoralis* (Regan) do not or have not yet seriously threatened the native fish species unlike tilapia *Oreochromis* spp."

The following indicates a **beneficial economic** impact from *Trichopodus pectoralis* introductions:

From Christensen (1993):

"Altogether nine fish species have been introduced [to Indonesia] whereby two are now of major importance to the fishery: the kissing and the snakeskin gourami. They compose > 40 % of fresh fish and almost 30 % of dried fish landings (Table 1 [in source material])."

From NACA (2005):

"It supports food security and income generation in rural areas [in Myanmar]."

From Chong et al. (2010):

"*Trichogaster pectoralis* is an important fish for the subsistence fisheries in the paddy growing areas [where is has been introduced in Malaysia]."

4 Global Distribution

Figure 1. Known global distribution of *Trichopodus pectoralis*. Locations are in Colombia, Myanmar, Thailand, Laos, Cambodia, Vietnam, Malaysia, Indonesia, Singapore, Papua New Guinea, and the Philippines. Map from GBIF Secretariat (2017).

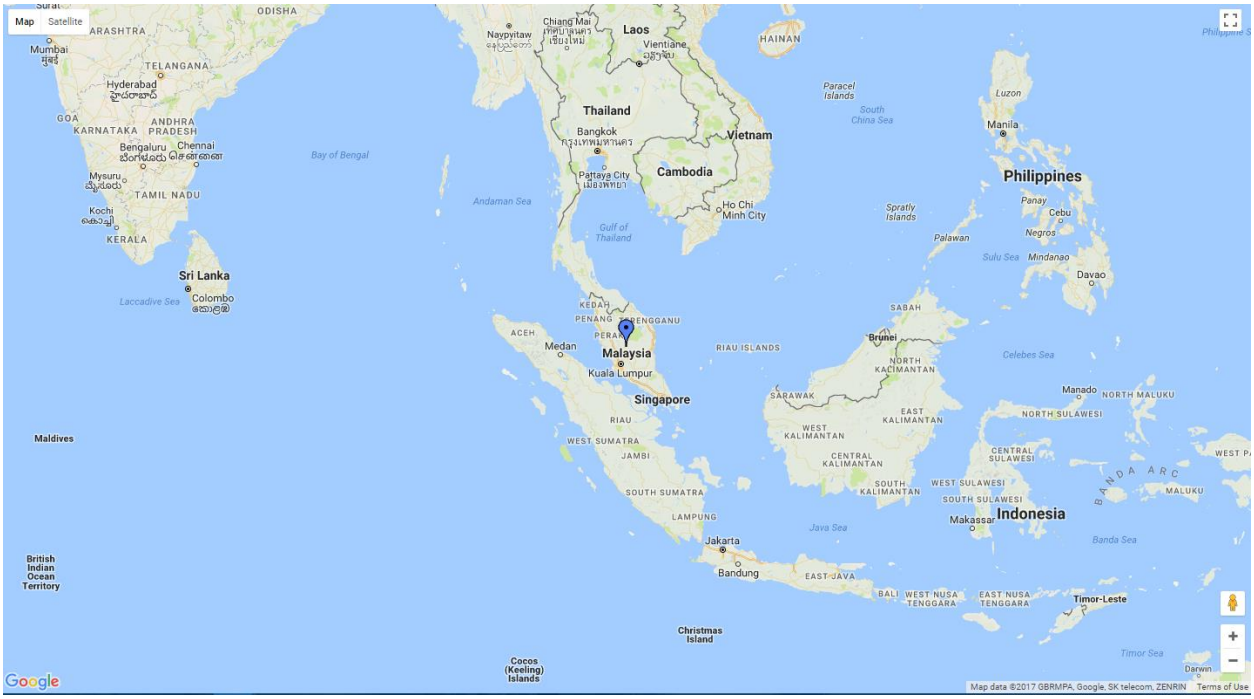

Figure 2. Additional known location of *Trichopodus pectoralis* in Malaysia. Map from Froese and Pauly (2017).

Figure 3. Additional known locations of *Trichopodus pectoralis* in Southeast Asia and the Pacific. Locations are in Myanmar, Thailand, Laos, Cambodia, Vietnam, Malaysia, Indonesia, and Papua New Guinea. Map from VertNet (2017).

Trichopodus pectoralis is established in Sri Lanka (Froese and Pauly 2017) but no georeferenced observations were available to use in selecting source points for the climate match.

5 Distribution Within the United States

No records of *Trichopodus pectoralis* introductions in the United States were found.

6 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Trichopodus pectoralis* to the contiguous United States was mostly low. There were areas of medium match in southern Florida and the southeastern tip of Texas. The Climate 6 score (Sanders et al. 2014; 16 climate variables; Euclidean distance) for the contiguous United States was 0.001, low (scores between 0.000 and 0.005, inclusive, are classified as low). All States had low individual Climate 6 scores, except Florida, which had a medium score.

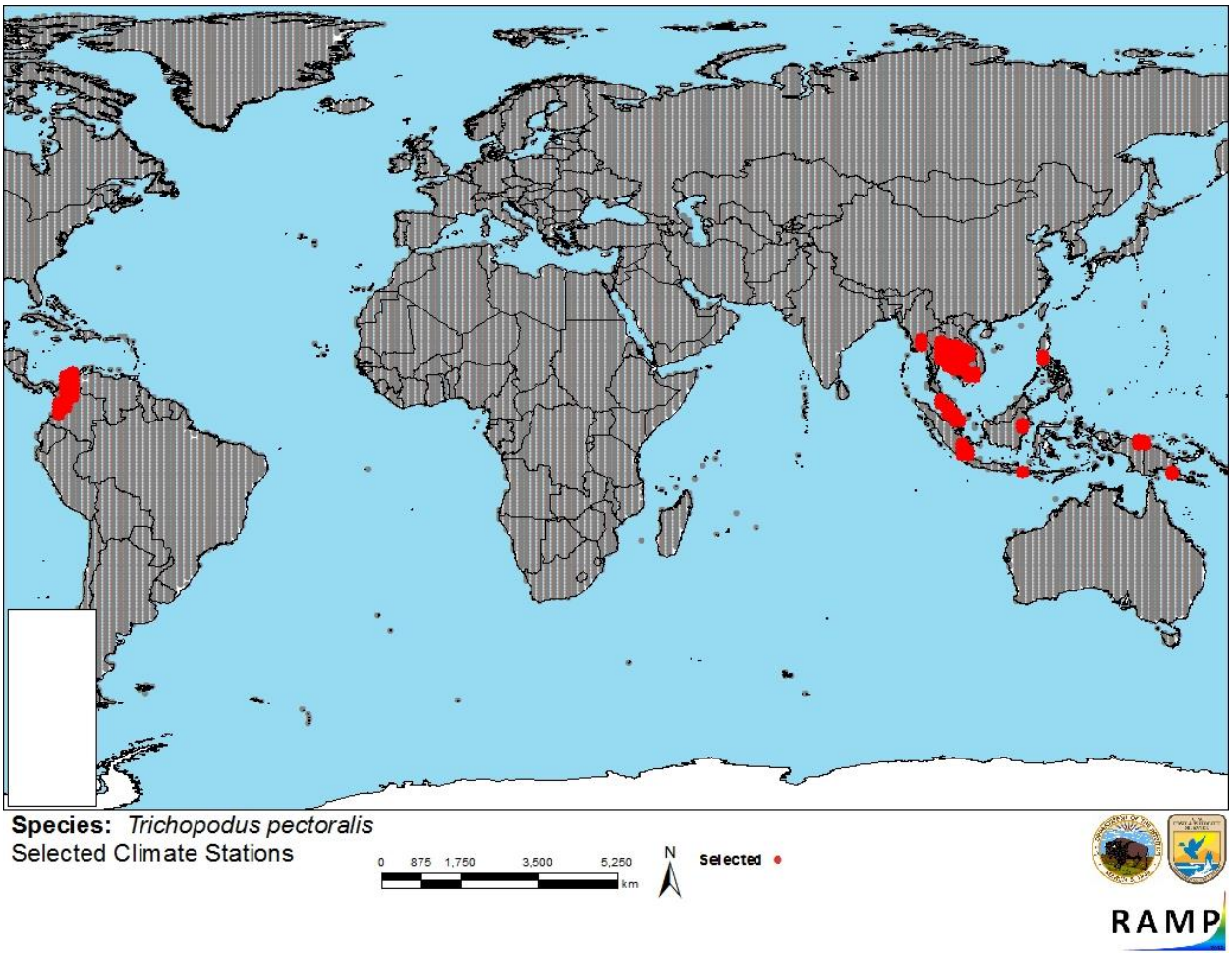

Figure 4. RAMP (Sanders et al. 2014) source map showing weather stations selected as source locations (red; Colombia, Myanmar, Thailand, Cambodia, Laos, Vietnam, Malaysia, Indonesia, Papua New Guinea) and non-source locations (grey) for *Trichopodus pectoralis* climate matching. Source locations from Froese and Pauly (2017), GBIF Secretariat (2017), and VertNet (2017). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

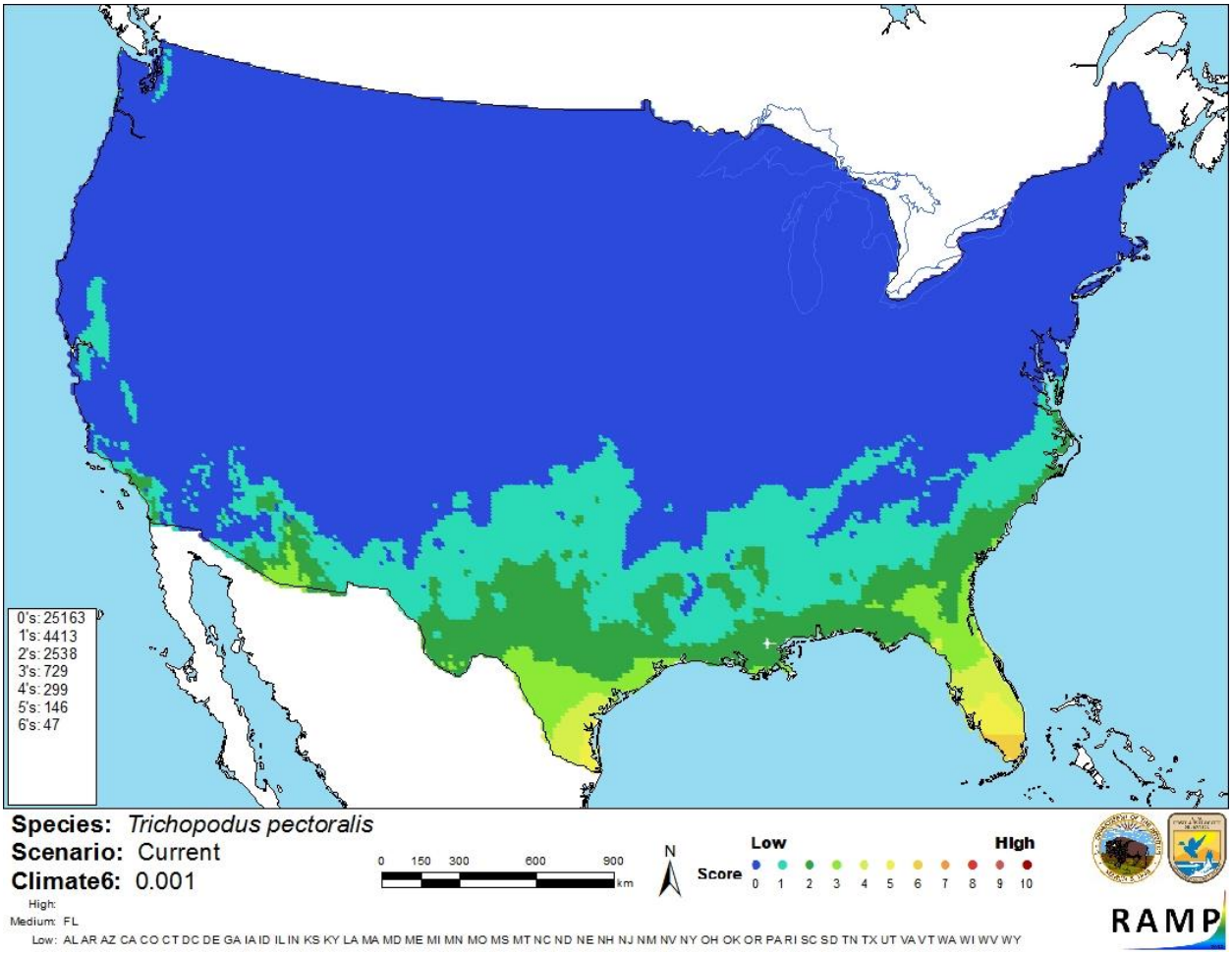

Figure 5. Map of RAMP (Sanders et al. 2014) climate matches for *Trichopodus pectoralis* in the contiguous United States based on source locations reported by Froese and Pauly (2017), GBIF Secretariat (2017), and VertNet (2017). 0 = Lowest match, 10 = Highest match.

The High, Medium, and Low Climate match Categories are based on the following table:

Climate 6: Proportion of (Sum of Climate Scores 6-10) / (Sum of total Climate Scores)	Climate Match Category
0.000≤X≤0.005	Low
0.005<X<0.103	Medium
≥0.103	High

7 Certainty of Assessment

The certainty of this assessment is low. There was a good amount of biological and ecological information available for *Trichopodus pectoralis*. A large number of introduction records were found for this species and information regarding impacts was available, but results were mixed and the one source with scientifically defensible results did not separate impacts from *T. pectoralis* and another non-native species.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Snakeskin Gourami (*Trichopodus pectoralis*) is native to Southeast Asia. *T. pectoralis* is used for subsistence fishing, small scale commercial fishing, aquaculture, pest control, and for the aquarium trade. It has been introduced and established in much of Southeast Asia outside its native range, Papua New Guinea, Philippines, Sri Lanka, New Caledonia, and Colombia. It has also been introduced to Hong Kong, India, and Japan but failed to establish. It also been introduced to Bangladesh and Haiti but the species' status in those countries is unknown. Virtually all introductions were the result of intentional stocking, starting as early as the 1930s, for fisheries and pest control. It has been banned in Brazil. Information on impacts is mixed and not of sufficiently high quality for high confidence. There are reports of *T. pectoralis* displacing native species in Malaysia and lowering diversity indices in portions of the river where present (with another non-native species) in Papua New Guinea. However, other systems with non-native *T. pectoralis* reported little to no observed ecological impacts from this fish. A beneficial economic impact from use of this species in fisheries is reported in several countries. Based on the lack of high quality studies documenting impact or lack thereof, history of invasiveness is none documented. The climate match for the contiguous United States was low; only southeast Texas and southern Florida had a medium match. The certainty of the assessment is low due to quality of information on impacts. The overall risk assessment is uncertain.

Assessment Elements

- **History of Invasiveness (Sec. 3): None Documented**
- **Climate Match (Sec. 6): Low**
- **Certainty of Assessment (Sec. 7): Low**
- **Remarks/Important additional information** *Trichopodus pectoralis* can carry epizootic ulcerative syndrome, an OIE reportable disease.
- **Overall Risk Assessment Category: Uncertain**

9 References

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 10.

Ang, K. J., R. Gopinath, and T. E. Chua. 1989. The status of introduced fish species in Malaysia. Pages 71–82 in S. S. De Silva, editor. Exotic aquatic organisms in Asia. Proceedings of the workshop on introduction of exotic aquatic organisms in Asia. Asian Fisheries Society, Special Publication 3, Manila, Philippines.

Bambaradeniya, C. N. B. 2002. The status and implications of alien invasive species in Sri Lanka. Zoos' Print Journal 17(11):930–935.

Chong, V. C., P. K. Y. Lee, and C. M. Lau. 2010. Diversity, extinction risk and conservation of Malaysian fishes. Journal of Fish Biology 76(9):2009–2066.

Christensen, M. S. 1993. The artisanal fishery of the Mahakam River floodplain in East Kalimantan, Indonesia. Journal of Applied Ichthyology 9:185–192.

Eschmeyer, W. N., R. Fricke, and R. van der Laan, editors. 2017. Catalog of fishes: genera, species, references. Available: http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp. (December 2017).

FAO (Fisheries and Agriculture Organization of the United Nations). 2017. Database on introductions of aquatic species. Available: http://www.fao.org/fishery/introsp/search/en. (December 2017).

Fish Net. 2017. Snakeskin Gourami – *Trichogaster pectoralis*. Fish Net, Inc. Available: http://www.thatpetplace.com/Trichogaster-pectoralis-snakeskin-gourami-208534. (December 2017).

Froese, R., and D. Pauly, editors. 2017. *Trichopodus pectoralis* Regan, 1910. FishBase. Available: http://www.fishbase.ca/summary/Trichopodus-pectoralis.html. (December 2017).

Froese, R., and D. Pauly, editors. 2019. *Trichopodus pecoralis*. *In* World Register of Marine Species. Available: http://www.marinespecies.org/aphia.php?p=taxdetails&id=1017825. (September 2019).

GBIF Secretariat. 2017. GBIF backbone taxonomy: *Trichopodus pectoralis* Regan, 1910. Global Biodiversity Information Facility, Copenhagen. Available: https://www.gbif.org/species/5211177. (December 2017).

Hyslop, E. J. 1998. Longitudinal variation in fish species composition in the Angabanga River, Papua New Guinea with observations on the tropic status of certain fish species. Ecology of Freshwater Fish 8:102–107.

ITIS (Integrated Taxonomic Information System). 2017. *Trichogaster pectoralis* (Regan, 1910). Integrated Taxonomic Information System, Reston, Virginia. Available: http://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=172639. (December 2017).

Leal-Flórez, J. 2007. Impacts of non-native fishes on the fish community and the fishery of the Ciénaga Grande de Santa Marta estuary, northern Colombia. Doctoral dissertation. University of Bremen, Bremen, Germany.

Magalhães, A. L. B. 2013. Presence of prohibited fishes in Brazilian aquarium trade: effectiveness of laws, management options and future prospects. Journal of Applied Ichthyology 31:170–172

Molnár, K., F. Shaharom-Harrison, and Cs. Székely. 2003. A survey of coccidian infections of freshwater fishes of Peninsular Malaysia, with descriptions of three species of *Goussia* Labbé, 1896 (Apicomplexa: Eimeriidae). Systemic Parasitology 55:11–18.

NACA (Network of Aquaculture Centres in Asia-Pacific). 2005. The way forward: building capacity to combat impacts of aquatic invasive alien species and associated transboundary pathogens in ASEAN (Association of Southeast Asian Nations) countries. Final Report. Workshop hosted by Department of Fisheries, Malaysia July 12-16, 2004. Network of Aquaculture Centres in Asia-Pacific, Bangkok, Thailand.

OIE (World Organisation for Animal Health). 2017. OIE-listed diseases, infections and infestations in force in 2017. Available: http://www.oie.int/animal-health-in-the-world/oie-listed-diseases-2017/. (December 2017).

Pallewatta, N., J. K. Reaser, and A. T. Gutierrez, editors. 2003. Invasive alien species in South-Southeast Asia: national reports & directory of resources. Global Invasive Species Programme, Cape Town, South Africa.

Papavlasopoulou, I., L. Vardakas, C. Perdikaris, D. Kommatas, and I. Paschos. 2014. Ornamental fish in pet stores in Greece: a threat to biodiversity? Mediterranean Marine Science 15:126–134.

Paperna, I., T. M. Venture, and A. P. Matos. 1987. Lymphosystis infection in snakeskin gourami, *Trichogaster pecotralis* (Regan), (Anabantidae). Journal of Fish Diseases 10:11–19.

Poelen, J. H., J. D. Simons, and C. J. Mungall. 2014. Global Biotic Interactions: an open infrastructure to share and analyze species-interaction datasets. Ecological Informatics 24:148–159.

Polhemus, D. A., R. A. Englund, and G. R. Allen. 2004. Freshwater biotas of New Guinea and nearby islands: analysis of endemism, richness, and threats. Final Report. Contribution 2004-004. Conservation International, Washington, D.C.

Sanders, S., C. Castiglione, and M. Hoff. 2014. Risk assessment mapping program: RAMP, version 2.81. U.S. Fish and Wildlife Service.

Tansatit, T., P. Sobhon, S. Sahaphong, P Sangsuriya, and S. Klinsrithong. 2014. Prevalence and histopathology of *Trichogaster pectoralis* harbouring metacercaria of *Clinostomum piscidium* (Southwell and Prashad, 1918) in Central Thailand. The Thai Journal of Veterinary Medicine 44(2):223–230.

VertNet. 2017. VertNet. Available: http://www.vertnet.org/index.html. (December 2017).

Vidthayanon, C. 2012. *Trichopodus pectoralis*. The IUCN red list of threatened species 2012: e.T188087A1852593. Version 2014.2. Available: http://www.iucnredlist.org/details/full/188087/0. (November 2014).

10 References Quoted But Not Accessed

Note: The following references are cited within quoted text within this ERSS, but were not accessed for its preparation. They are included here to provide the reader with more information.

Allen, G. R. 1991. Field guide to the freshwater fishes of New Guinea. Christensen Research Institute, Publication 9, Madang, Papua New Guinea.

Bartley, D. M., editor. 2006. Introduced species in fisheries and aquaculture: information for responsible use and control (CD-ROM). Rome, FAO.

Bleher, H. 1994. Lanao. Aqua Geographia 10(4):6–30.

Bleher, H. 1996. Bombon. Aqua Geographia 12(4):6–34.

Cambodian National Mekong Committee. 1998. Natural resources-based development strategy for the Tonlé Sap area, Cambodia. Final Report CMB/95/003.

Charoenpornsook, K. 1985. *Clinostomum piscidium* (Southwell & Phashad, 1918) the digenetic trematode in the body cavity of pla-salid (*Trichogaster pectoralis*, Regan, 1910). Master's thesis. Mahidol University, Bangkok, Thailand.

Davidson, A. 1975. Fish and fish dishes of Laos. Imprimerie Nationale Vientiane.

Frimodt, C. 1995. Multilingual illustrated guide to the world's commercial warmwater fish. Fishing News Books, Osney Mead, Oxford, England.

Hill, M. T., and S. A. Hill. 1994. Fisheries ecology and hydropower in the lower Mekong River: an evaluation of run-of-the-river projects. Mekong Secretariat, Bangkok, Thailand.

Ismail, G. B., D. B. Sampson, and D. L. G. Noakes. 2014. The status of Lake Lanao endemic cyprinids (*Puntius* species) and their conservation. Environmental Biology of Fish 97:425–434.

Kottelat, M. 1985. Fresh-water fishes of Kampuchea. Hydrobiologia 121:249–279.

Kottelat, M. 2001. Fishes of Laos. WHT Publications, Colombo, Sri Lanka.

Kottelat, M., A. J. Whitten, S. N. Kartikasari, and S. Wirjoatmodjo. 1993. Freshwater fishes of Western Indonesia and Sulawesi. Periplus Editions, Hong Kong.

Labajo, Y. I., and O. M. Nuñeza. 2003. Ichthyofauna of Lake Maiinit, Mindanao. 3rd Annual Scientific Convention of the Philippines for the study of Nature. May. UPV, Iloilo, Philippines.

Leal-Flórez, J., M. Rueda, and M. Wolff. 2008. Role of the non-native fish *Oreochromis niloticus* in the long-term variations of abundance and species composition of the native ichthyofauna in a Caribbean estuary. Bulletin of Marine Science 82(3):365–380.

Marquet, G., P. Keith, and E. Vigneux. 2003. Atlas des poissons et des crustacés d'eau douce de Nouvelle-Calédonie. Muséum national d'Histoire naturelle, Paris. Patrimoines Naturels 58.

Mercene, E. C. 1997. Freshwater fishes of the Philippines. Pages 81–105 *in* R. Guerrero III, A. Calpe, and L. Darvin, editors. Aquatic biology research and development in the Philippines. Proceedings of the First Nat'l Symposium-Workshop on Aquatic Biology R&D, 1995, Los Baños, Laguna. PCAMRD Book Series 20.

Monkolprasit, S., S. Sontirat, S. Vimollohakarn, and T. Songsirikul. 1997. Checklist of fishes in Thailand. Office of Environmental Policy and Planning, Bangkok, Thailand.

Nguyen, T. T. T. 2004. Genetic considerations in fisheries and aquaculture with regard to impacts upon biodiversity. Aquaculture 9(3):5–9.

Paepke, H.-J. 2009[a]. The nomenclature of *Trichopodus pectoralis* Regan, 1910; *Trichopus cantoris* Sauvage, 1884 and *Osphronemus saigonensis* Borodin, 1930 (Teleostei: Perciformes: Osphronemidae). Vertebrate Zoology 59(1):53–60.

Paepke, H.-J. 2009[b]. Again: about the nomenclature of *Trichopodus pectoralis* Regan, 1910; *Trichopus cantoris* Sauvage, 1884 and *Osphronemus saigonensis* Borodin, 1930 -- a necessary correction (Teleostei: Perciformes: Osphronemidae). Vertebrate Zoology 59(2):143–145.

Palma, A. L., E. C. Mercene, and M. R. Goss. 2005. Fish. Pages 115–132 *in* R. D. Lasco and M. V. O. Espaldon, editors. Ecosystems and people: the Philippine millennium ecosystem assessment (MA) sub-global assessment. Environmental Forestry Programme, College of Forestry and Natural Resources, University of the Philippines, Los Baños.

Pauly, D., M. Small, R. Vore, and M. L. D. Palomares. 1990. Fisheries yields and morphoedaphic index of Lake Mainit, Philippines. Pages 835–838 *in* R. Hirano and I. Hanyu, editors. The Second Asian Fisheries Forum. Asian Fisheries Society, Manila, Philippines.

Paz-Alberto, A. N., E. S. Castro, V. L. Flores, and M. A. V. Romero. 2009. Endemic, indigenous and introduced species in the freshwater ecosystems of Nureva Ecija and Pampanga: status, diversity and impacts. Silliman Journal 50(2):43–60.

Pethiyagoda, R. 1991. Freshwater fishes of Sri Lanka. The Wildlife Heritage Trust of Sri Lanka, Colombo.

Rainboth, W. J. 1996. Fishes of the Cambodian Mekong. FAO Species Identification Field Guide for Fishery Purposes. FAO, Rome.

Regan, C. T. 1910. The Asiatic fishes of the family Anabantidae. Proceedings of the Zoological Society of London 1909(4):767–787.

Riede, K. 2004. Global register of migratory species - from global to regional scales. Final Report, R&D-Projekt 808 05 081. Federal Agency for Nature Conservation, Bonn.

Riehl, R., and H. A. Baensch. 1991. Aquarien atlas. Band. 1. Melle: Mergus, Verlag für Natur- und Heimtierkunde, Germany.

Thuok, N., and L. Sina. 1997. Review of the fisheries and aquaculture sector in Cambodia. Pages 35–36 *in* Natural resources-based development strategy for the Tonle Sap Area. Report CMB\95\003.

Ukkatawewat, S. 2005. The taxonomic characters and biology of some important freshwater fishes in Thailand. Manuscript. National Inland Fisheries Institute, Department of Fisheries, Ministry of Agriculture, Bangkok, Thailand.

Vidthayanon, C. 2002. Peat swamp fishes of Thailand. Office of Environmental Policy and Planning, Bangkok, Thailand.

Vidthayanon, C., J. Karnasuta, and J. Nabhitabhata. 1997. Diversity of freshwater fishes in Thailand. Office of Environmental Policy and Planning, Bangkok.

Welcomme, R. L. 1988. International introductions of inland aquatic species. FAO Fisheries Technical Paper 294.

Yap, S.-Y. 1988. Food resource utilization partitioning of fifteen fish species at Bukit Merah Reservoir, Malaysia. Hydrobiologia 157:143–160.

Yap, W., E. A. Baluyot, and J. F. Pavico. 1983. Limnological features of Lake Buluan: preliminary findings and observations. Fisheries Research Journal of the Philippines 8(1):18–25.