

Asian Bonytongue (*Scleropages formosus*)

Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, April 2015
Revised, December 2017
Web Version, 12/16/2019

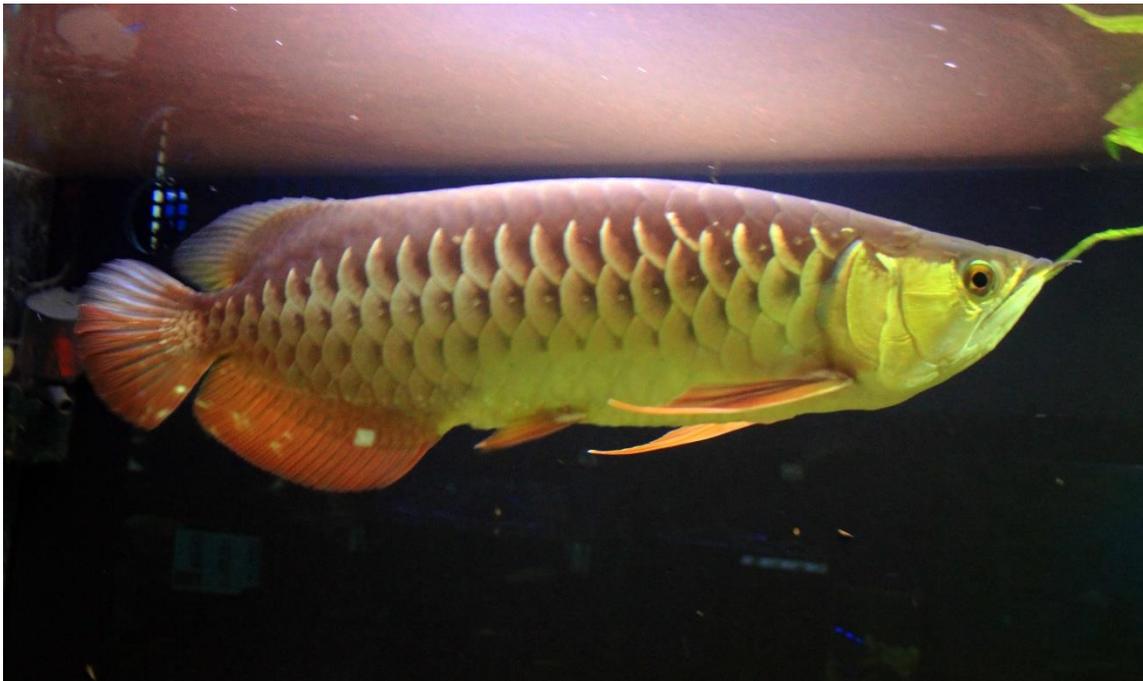


Photo:

Karel Jakubec. Licensed under Creative Commons BY-SA 3.0 Unported. Available: https://commons.wikimedia.org/wiki/File:Scleropages_formosus_Prague_2012_1.jpg. (December 6, 2017).

1 Native Range and Status in the United States

Native Range

Scleropages formosus is native to Cambodia, Indonesia, Malaysia, Myanmar, Thailand, and Viet Nam (Froese and Pauly 2017).

From Froese and Pauly (2017):

“Known from the Cardamom mountains [sic] southward to Kampot [Rainboth 1996] and Sré Umbel [in Cambodia] [Kottelat 1985]. Also [Kottelat et al. 1993].”

“Known from Sumatra and Borneo [Kottelat 1985]. Recorded from Danau Sentarum National Park [in Indonesia] [Kottelat and Widjanarti 2005].”

“Known from the Rajang Basin in Sarawak, Borneo [Parenti and Lim 2005]. Also [Department of Fisheries 1987; Kottelat 1985].”

“Found in the Tenasserim region [Myanmar] [Vidthayanon et al. 2005]. Also [Vidthayanon 2005].”

“Can be found only in some restricted areas of Trat and Chanthaburi provinces. [...] Extirpated from most of its range in Thailand, including peat areas in Pattani and Phuket. Endangered species with highly demanded from aquarium trades, although enlisted [*sic*] in CITES and Thai legally protected species [Vidthayanon 2002]. Also [Suvatti 1981; Kottelat et al. 1993].”

“Known from southern Vietnam [Roberts 1989]. Also [Rainboth 1996].”

Status in the United States

No records of *Scleropages formosus* in the United States were found.

Scleropages formosus is on the Conditional list in Florida (Hill 2006). Conditional nonnative species (FFWCC 2019), "are considered to be dangerous to the ecology and/or the health and welfare of the people of Florida. These species are not allowed to be personally possessed, although exceptions are made by permit from the Executive Director for research, commercial use (with security measures to prevent escape or release) or public exhibition purposes."

Scleropages formosus is prohibited for possession by the general public in New Mexico (New Mexico Department of Game and Fish 2010).

Scleropages formosus that have been bred in captivity are available for sale. From Arowana Fish For Sale (2019):

“Asian Red Arowana

\$250.00 – \$410.00

[...]

Scleropages formosus they have common name Asian arowana they are long in length and smart in water.”

Means of Introductions in the United States

No records of *Scleropages formosus* in the United States were found.

Remarks

From Kottelat (2013):

“[IUCN] Red List Category & Criteria: Endangered A4cd ver 3.1”

From Froese and Pauly (2017):

“International trade banned (CITES I, since 1.7.75).”

“Protected by Indonesian law [Kottelat and Whitten 1996] and CITES I and II.”

“Status of threat: Endangered. [In Myanmar]”

“[...] Thai legally protected species [Vidthayanon 2002].”

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From Eschmeyer et al. (2017):

“**Current status:** Valid as *Scleropages formosus* (Müller & Schlegel 1840).”

From ITIS (2015):

“Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Osteichthyes
Class Actinopterygii
Subclass Neopterygii
Infraclass Teleostei
Superorder Osteoglossomorpha
Order Osteoglossiformes
Suborder Osteoglossoidei
Family Osteoglossidae
Subfamily Osteoglossinae
Genus *Scleropages*
Species *Scleropages formosus* (Müller and Schlegel, 1844)”

Size, Weight, and Age Range

From Froese and Pauly (2017):

“Max length : 90.0 cm TL male/unsexed; [Axelrod et al. 1991]”

From Department of the Environment, Australia (2014):

“Longevity (Lifespan): 10 – 20 years in ideal circumstances

Size: $\leq 90\text{cm}$ (max.); Typically 40 – 60cm max. for adults, 6cm Juvenile at birth (i.e. when free swimming) Weight: $\leq 7\text{kg}$ ”

Environment

From Froese and Pauly (2017):

“Freshwater; benthopelagic. [...]; 24°C - 30°C [assumed to be recommended aquarium temperature range] [Baensch and Riehl 1985]”

Climate/Range

From Froese and Pauly (2017):

“Tropical; [...]”

Distribution Outside the United States

Native

Scleropages formosus is native to Cambodia, Indonesia, Malaysia, Myanmar, Thailand, and Viet Nam (Froese and Pauly 2017).

From Froese and Pauly (2017):

“Known from the Cardamom mountains [sic] southward to Kampot [Rainboth 1996] and Sré Umbel [in Cambodia] [Kottelat 1985]. Also [Kottelat et al. 1993].”

“Known from Sumatra and Borneo [Kottelat 1985]. Recorded from Danau Sentarum National Park [in Indonesia] [Kottelat and Widjanarti 2005].”

“Known from the Rajang Basin in Sarawak, Borneo [Parenti and Lim 2005]. Also [Department of Fisheries 1987; Kottelat 1985].”

“Found in the Tenasserim region [Myanmar] [Vidthayanon et al. 2005]. Also [Vidthayanon 2005].”

“Can be found only in some restricted areas of Trat and Chanthaburi provinces. [...] Extirpated from most of its range in Thailand, including peat areas in Pattani and Phuket. Endangered species with highly demanded from aquarium trades, although enlisted in CITES and Thai legally protected species [Vidthayanon 2002]. Also [Suvatti 1981; Kottelat et al. 1993].”

“Known from southern Vietnam [Roberts 1989]. Also [Rainboth 1996].”

Introduced

Scleropages formosus is listed as introduced to Philippines but “Needs confirmation” (Froese and Pauly 2017). It is listed as introduced but with no further data to Australia, Bangladesh, Brazil, Brunei, Canada, China, France, Germany, India, Indonesia (which contains part of the native range), Israel, Japan, Korea, Malaysia (which contains part of the native range), Mauritius, New Zealand, Norway, Russia, Saudi Arabia, Sri Lanka, Switzerland, Taiwan, Thailand (which contains part of the native range), the United Kingdom, and Viet Nam (which contains part of the native range) (Froese and Pauly 2017).

From Froese and Pauly (2017):

“Feral and established in some reservoirs [in Singapore].”

From FAO (2015):

“*Scleropages formosus* introduced to China from Thailand.”

From Department of the Environment, Australia (2014):

“There is limited available information on the establishment of breeding populations of *Scleropages* outside of their natural range, however, Table 5 [in source material] displays a register of all known introductions (total of 27) [Fishbase.org, 22nd July 2014]. There has been only one occasion out of 27 introductions where the species has been able to establish a population and this occurrence was within its natural range (Singapore) although it is not known if this population is currently still established. There has been no record of the Asian Arowana establishing as a pest on any other content [*sic*]. This may be attributed, in part, to the limited number of releases and the high monetary expense associated to releasing a quantifiable number of specimens to a suitable location.”

From Humphreys (2014):

“*Scleropages formosus* (Teleostei: Osteoglossoidei: Osteoglossidae) is probably introduced; it has been recorded from an unspecified location and its present status on Christmas Island is unknown.”

Means of Introduction Outside the United States

From FAO (2015):

“1) ornamental”

From Froese and Pauly (2017):

“Assumed to be introduced for aquaria.”

From Ng and Tan (2010):

“The presence of this popular aquarium species in the Upper Peirce Reservoir [Singapore] is in large part due to the release of captive-bred specimens by the Primary Production Department in 1983 (Tay G, in litt.). Similar releases in the MacRitchie and Upper Seletar reservoirs [Singapore] may also have occurred (Yang SL, pers. comm. to Ng PKL). The presence of this species in the Bedok, Lower Seletar, and Pandan reservoirs [Singapore] is likely due to the discarding of unwanted aquarium fish by members of the public.

Short Description

From Froese and Pauly (2017):

“With 1 pair of barbels; scales large.”

From Department of the Environment, Australia (2014):

“The Asian Arowana [*S. formosus*] is readily distinguishable from other species of fish given its long slender and somewhat prehistoric appearance.”

From Baker (2019):

“Their bodies are elongate, with a rounded tail fin and large dorsal, pectoral and anal fins. The lower jaw bears two, short barbels. Their scales are large. There are a number of colour varieties in different regions, including green, silver, red and golden.”

Biology

From Froese and Pauly (2017):

“Occurs in tannin stained blackwater streams [Rainboth 1996]. Found in forest covered streams including peat adjacent areas. Take [*sic*] around three months for free swimming fries [Vidthayanon 2002]. Young individuals feed on insects at the water surface, adults take fishes [Rainboth 1996; Vidthayanon 2002] and smaller vertebrates [Kottelat and Widjanarti 2005]. A mouth brooder, young about 6 cm at birth [Kottelat et al. 1993; Vidthayanon 2002].”

“From an observation of a breeding pair in a concrete tank, courtship lasts from several weeks to months. During this stage, the breeding pair swims near the water surface usually at night. "The male chases the female around the perimeter of the tank. Sometimes, the pair circle each other nose-to-tail. About one to two weeks before spawning takes place, the fish swim side by side with their bodies touching. Eventually, the female releases a cluster of orange-red eggs. The male fertilises the eggs and then scoops them into its mouth where it incubates them. After hatching which occurs in about a week, the young larvae continue to live in the male's mouth for 7-8 weeks more until the yolk sac is totally absorbed" [Møller and Schwarzhans 2006].”

From Kottelat (2013):

“This is a fairly large mouthbrooding fish which lives in lakes, deep parts of swamps, flooded forests and stretches of deep rivers with slow currents and dense, overhanging vegetation (M. Kottelat pers. comm. 2011).”

Human Uses

From Kottelat (2013):

“This has been a highly valued species in the international aquarium trade since the 1970s. There are a number of registered CITES breeders in Asia and the specimens they produce can be imported into several nations. Other nations restrict or prohibit possession of this species. Illegal trade does occur.

This species is utilized as part of local subsistence fisheries, although fisherman catching one would try to keep it alive as it would be worth more in the aquarium trade (M. Kottelat pers. comm. 2011).”

From Froese and Pauly (2017):

“Valued as an aquarium fish, its flesh commands a moderate price.”

“International trade banned (CITES I, since 1.7.75).”

“This has been bred in captivity by several companies in Pontianak and Indonesia has been allowed to export a given number of captive bred individuals per year. As a result of this captive breeding, juveniles are the most exported commodity which coincided with a change of trade practices in the Kapuas Lakes area [Borneo, Indonesia]. In 1995, fishermen reported that adults were released and juveniles were grown, occasionally obtained from the mouthbrooding parent. This indicates that a part of the juveniles exported as captive bred originate from the wild [Kottelat and Widjanarti 2005].”

“An expensive aquarium fish [Tang 2004]. Also [NSS Vertebrate Study Group 2014].”

“Its flesh has a good flavour and is used mainly for preparing special dishes [Ukkatawewat 2005]; also from Surat Thani [Monkolprasit et al. 1997].”

“China is one of the countries that allow import of CITES' registered farmed Arowanas (R. Faulder, pers. comm.). Also [Ma et al. 2003].”

Specific information on the duration or volume of this species in trade was not found.

Diseases

No records of OIE reportable diseases (OIE 2017) were found.

From Froese and Pauly (2014):

“Congenital Deformities, Others”

Threat to Humans

From Froese and Pauly (2014):

“Harmless”

3 Impacts of Introductions

FAO (2015) lists “Probably none” for ecological effects but states that there were some beneficial socioeconomic effects from the introduction to Singapore. No further information was found.

From Department of the Environment, Australia (2014):

“There is limited available information on the establishment of breeding populations of *Scleropages* outside of their natural range, however, Table 5 [in source material] displays a register of all known introductions (total of 27) [Fishbase.org, 22nd July 2014]. There has been only one occasion out of 27 introductions where the species has been able to establish a population and this occurrence was within its natural range (Singapore) although it is not known if this population is currently still established. There has been no record of the Asian Arowana establishing as a pest on any other content [*sic*]. This may be attributed, in part, to the limited number of releases and the high monetary expense associated to releasing a quantifiable number of specimens to a suitable location.”

4 Global Distribution

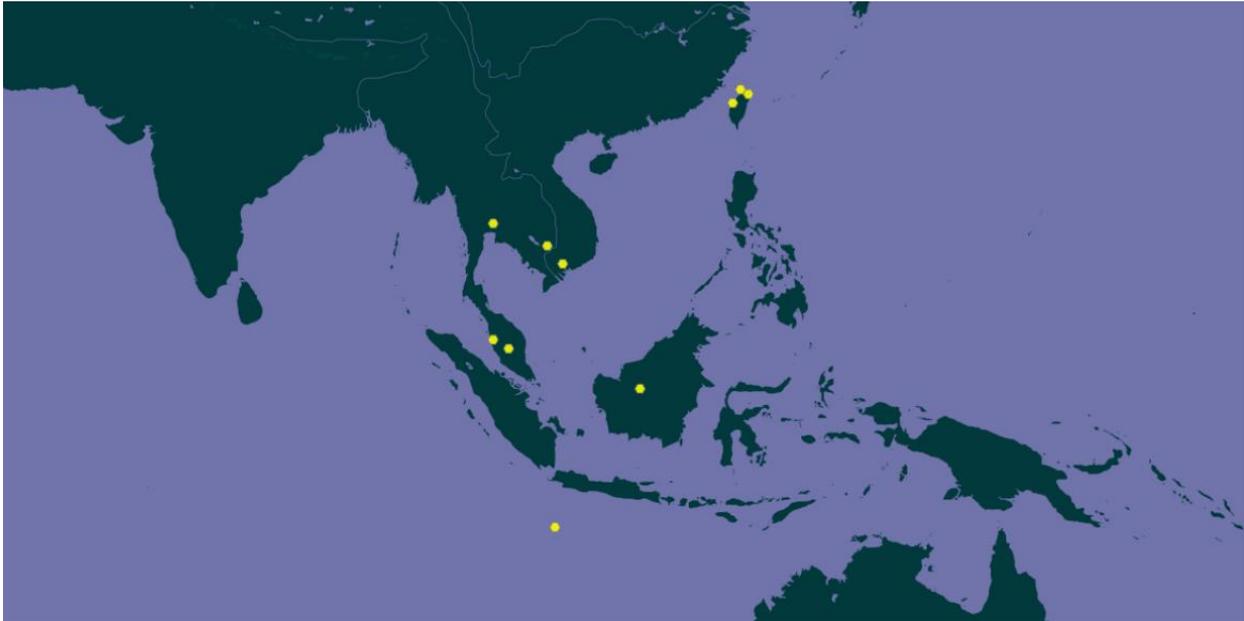


Figure 1. Known global distribution of *Scleropages formosus*. Observations are reported from Taiwan, Thailand, Cambodia, Vietnam, Malaysia, and Indonesia. Map from GBIF Secretariat (2017).



Figure 2. Known global distribution of *Scleropages formosus*. Observations are reported from Thailand, Cambodia, Vietnam, Malaysia, and Indonesia. Map from VertNet (2017). The point on Christmas Island was not used as a source for the climate match as the status of the population there is unknown (Humphreys 2014).

No georeferenced observations were found for Myanmar.

5 Distribution Within the United States

No records of *Scleropages formosus* in the United States were found.

6 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Scleropages formosus* was high in parts of Florida (near Fort Lauderdale and Tampa) and medium in the remainder of Florida, and along most of the Gulf Coast and parts of the southern Atlantic Coast. Everywhere else had a low climate match. The Climate 6 score (Sanders et al. 2014; 16 climate variables; Euclidean distance) for the contiguous United States was 0.013, medium. (Scores between 0.005 and 0.103 are classified as medium.) Florida had a high individual climate score; all other States had low individual climate scores.

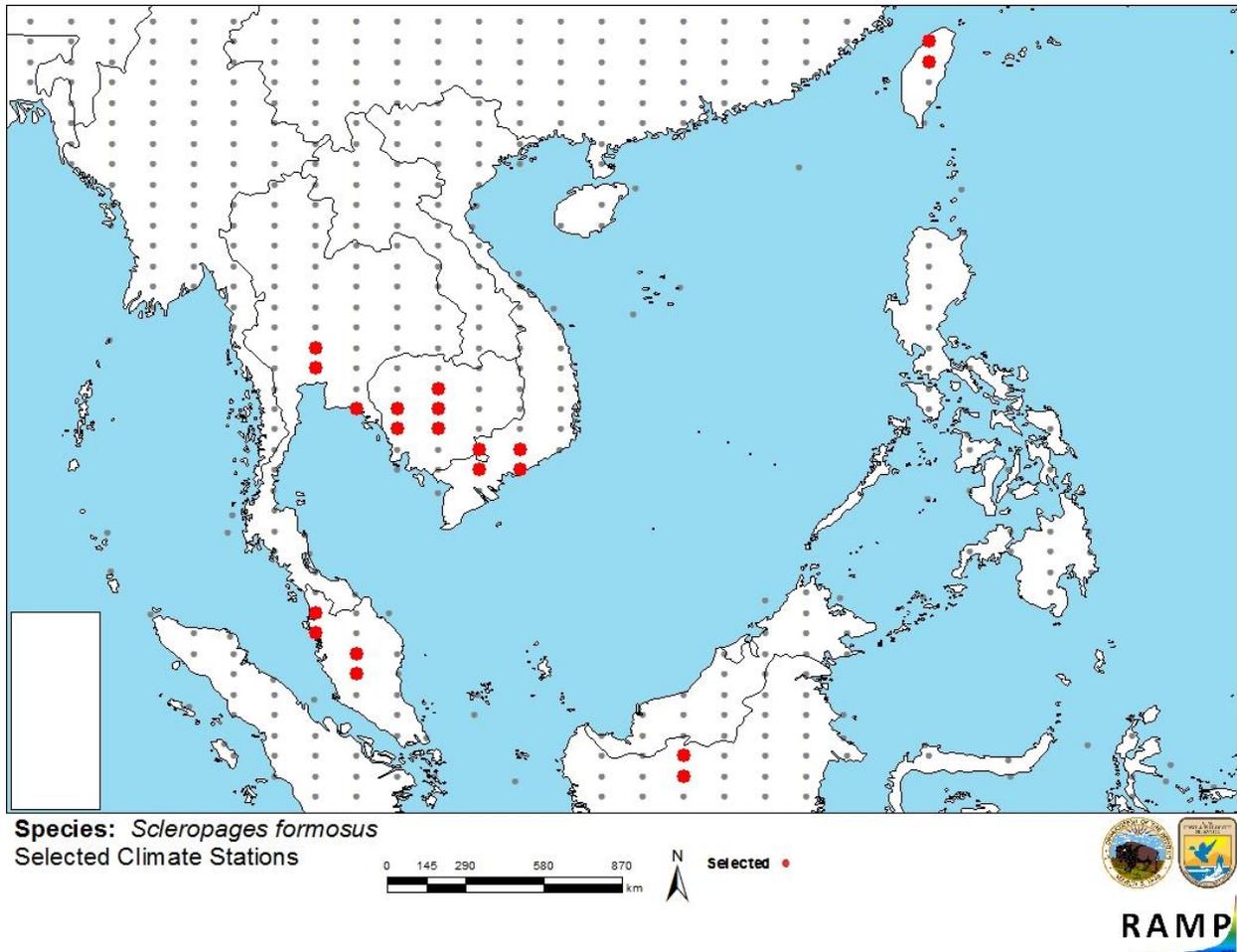


Figure 3. RAMP (Sanders et al. 2014) source map showing weather stations selected as source locations (red; Thailand, Taiwan, Cambodia, Vietnam, Malaysia, Indonesia) and non-source locations (grey) for *Scleropages formosus* climate matching. Source locations from GBIF Secretariat (2017) and VertNet (2017). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

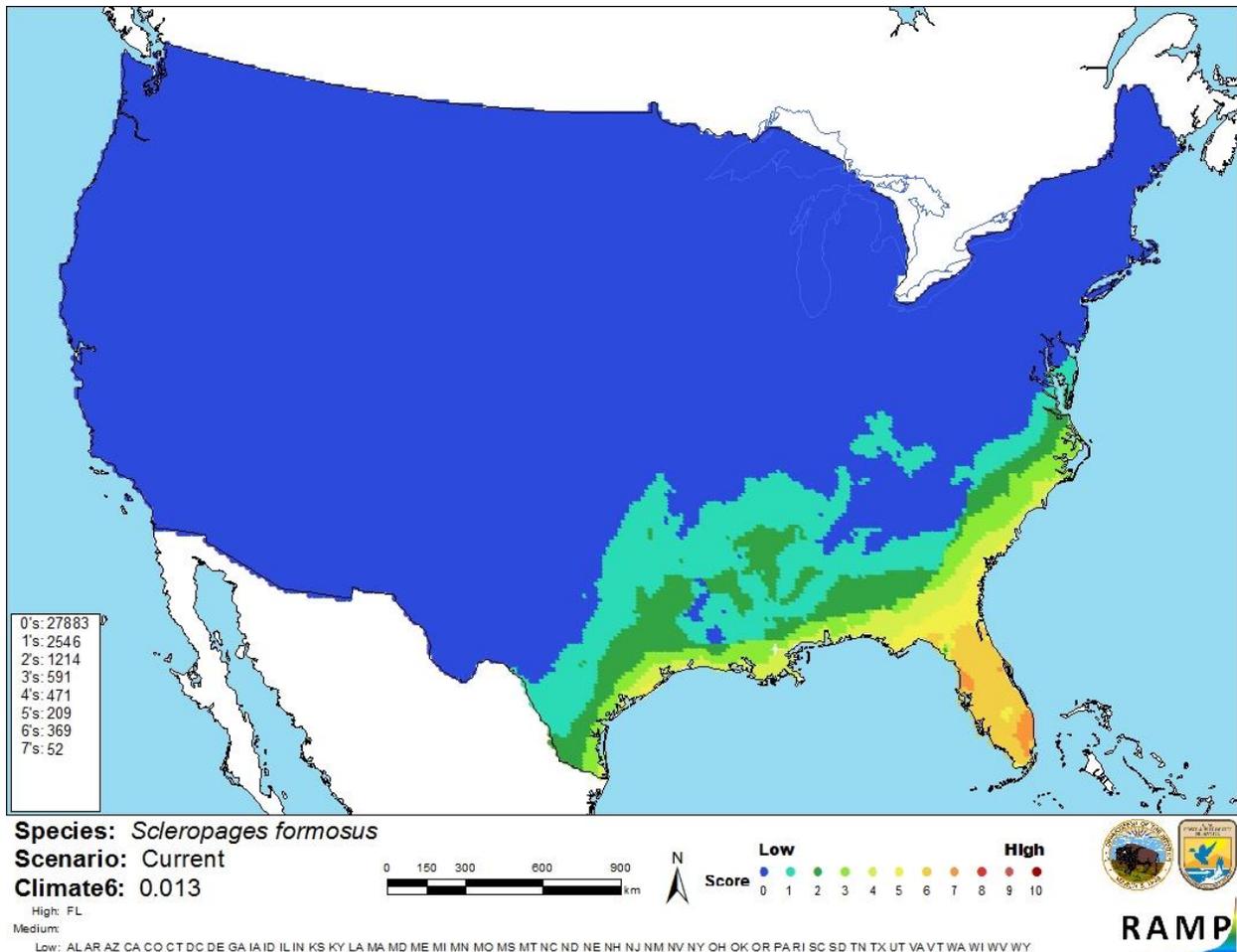


Figure 4. Map from RAMP (Sanders et al. 2014) showing results of the climate match for *Scleropages formosus* in the contiguous United States based on source locations reported by GBIF Secretariat (2017) and VertNet (2017). 0 = Lowest match, 10 = Highest match.

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
$0.000 \leq X \leq 0.005$	Low
$0.005 < X < 0.103$	Medium
≥ 0.103	High

7 Certainty of Assessment

The certainty of this assessment is low. There was adequate biological and ecological information available for this species. Many records of introductions were found, but no records of any environmental impacts of those introductions were found. No specific information on trade was available.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Asian Bonytongue (*Scleropages formosus*) is a fish native to Southeast Asia. *S. formosus* is used in local subsistence fisheries and is highly prized in the aquarium industry. The history of invasiveness is none documented. A many records of introduction were found, but only one is reported as resulting in an established population. No records of any impacts from introductions were found. This species is in trade, but it is prohibited to be collected from the wild under CITES, and is regulated in two States. Specific information on the duration or volume of this species in trade was not found. Certainty of assessment is low due to lack of information on introductions and impacts. The climate match is 0.013, medium. Florida had a high state level climate 6 score. The overall risk assessment category is uncertain.

Assessment Elements

- **History of Invasiveness (Sec. 3): None Documented**
- **Climate Match (Sec. 6): Medium**
- **Certainty of Assessment (Sec. 7): Low**
- **Remarks/Important additional information** No additional remarks.
- **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.

Arowana Fish For Sale. 2019. Asian Red Arowana. Arowana Fish Farms Online. Available: <https://www.arowanafishforsale.com/product/asian-red-arowana/>. (December 2019).

Baker, N. 2019. Asian Arowana. Ecology Asia. Available: <https://www.ecologyasia.com/verts/fishes/asian-arowana.htm>. (December 2019).

Department of the Environment, Australia. 2014. Application to amend the current list of specimens taken to be suitable for live import (Live Import List), to include the Asian Arowana – *Scleropages formosus* and *Scleropages inscriptus*.

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). 2015. Database on introductions of aquatic species. FAO, Rome. Available: <http://www.fao.org/fishery/introsp/search/en>. (April 2015).

- FFWCC (Florida Fish and Wildlife Conservation Commission). 2019. Conditional species list. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida. Available: <https://myfwc.com/wildlifehabitats/nonnatives/conditional-species-list/>. (December 2019).
- Froese, R., and D. Pauly, editors. 2017. *Scleropages formosus* (Müller & Schegel, 1840). FishBase. Available: <http://www.fishbase.org/summary/Scleropages-formosus.html>. (December 2017).
- GBIF Secretariat. 2017. GBIF backbone taxonomy: *Scleropages formosus* (Müller & Schegel, 1840). Global Biodiversity Information Facility, Copenhagen. Available: <https://www.gbif.org/species/2402231>. (December 2017).
- Hill, J. E. 2006. Regulations pertaining to non-native fish in Florida aquaculture. Fisheries and Aquatic Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agriculture Sciences, FA-121, University of Florida, Ruskin.
- Humphreys, W. F. 2014. Subterranean fauna of Christmas Island: habitats and salient features. Raffles Bulletin of Zoology (Supplement) 30:29–44.
- ITIS (Integrated Taxonomic Information System). 2015. *Scleropages formosus* (Müller & Schegel, 1840). Integrated Taxonomic Information System, Reston, Virginia. Available: http://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=201898. (April 2105).
- Kottelat, M. 2013. *Scleropages formosus*. The IUCN red list of threatened species 2013: e.T20034A9137739. Available: <http://www.iucnredlist.org/details/full/20034/0>. (April 2015).
- New Mexico Department of Game and Fish. 2010. Director's species importation list. New Mexico Department of Game and Fish, Law Enforcement Division, Special Use Permits Program, Santa Fe.
- Ng, H. H., and H. H. Tan. 2010. An annotated checklist of the non-native freshwater fish species in the reservoirs of Singapore. *Cosmos* 6(1):95–116.
- 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).
- Sanders, S., C. Castiglione, and M. Hoff. 2014. Risk assessment mapping program: RAMP, version 2.81. U.S. Fish and Wildlife Service.
- VertNet. 2017. VertNet. Available: <http://www.vertnet.org/index.html>. (December 2017).

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.

- Axelrod, H. R., W. E. Burgess, N. Pronek, and J. G. Walls. 1991. Dr. Axelrod's atlas of freshwater aquarium fishes, 6th edition. T. F. H. Publications, Neptune City, New Jersey.
- Baensch, H. A., and R. Riehl. 1985. Aquarien atlas, band 2. Mergus, Verlag für Natur-und Heimtierkunde GmbH, Melle, Germany.
- Department of Fisheries. 1987. Annual fishery statistics. Ministry of Agriculture, Malaysia.
- Kottelat, M. 1985. Fresh-water fishes of Kampuchea. *Hydrobiologia* 121:249–279.
- Kottelat, M., and T. Whitten. 1996. Freshwater biodiversity in Asia, with special reference to fish. World Bank Technical Paper 343.
- Kottelat, M., A. J. Whitten, S. N. Kartikasari, and S. Wirjoatmodjo. 1993. Freshwater fishes of Western Indonesia and Sulawesi. Periplus Editions, Hong Kong.
- Kottelat, M., and E. Widjanarti. 2005. The fishes of Danau Sentarum National Park and the Kapuas Lakes area, Kalimantan Barat, Indonesia. *Raffles Bulletin of Zoology Supplement* 13:139–173.
- Ma, X., X. Bangxi, W. Yindong, and W. Mingxue. 2003. Intentionally introduced and transferred fishes in China's inland waters. *Asian Fisheries Society* 16(3&4):279–290.
- Møller, P. R., and W. Schwarzhans. 2006. Review of the Dinematichthyini (Teleostei, Bythitidae) of the Indo-west Pacific, Part II. *Dermatopsis*, *Dermatopsoides* and *Dipulus* with description of six new species. *The Beagle* 22:39–76.
- Monkolprasit, S., S. Sontirat, S. Vimollohakarn, and T. Songsirikul. 1997. Checklist of fishes in Thailand. Office of Environmental Policy and Planning, Bangkok, Thailand.
- Müller, S., and H. Schlegel. 1840. Beschrijving van een' nieuwen Zoetwater-visch van Borneo, *Osteoglossum formosum*. *Verhandelingen over de natuurlijke geschiedenis der Nederlandsche overzeesche bezittingen / door de Leden der Natuurkundige Commissie in Indië en andere schrijvers; uitgegeven. C. J. Temminck* 2:1–7.
- NSS Vertebrate Study Group. 2014. A checklist of the freshwater fishes, amphibians, reptiles and mammals of Singapore. Singapore Government, National Parks.
- Parenti, L. R., and K. K. P. Lim. 2005. Fishes of the Rajang Basin, Sarawak, Malaysia. *Raffles Bulletin of Zoology Supplement* 13:175–208.

- Rainboth, W. J. 1996. Fishes of the Cambodian Mekong. FAO Species Identification Field Guide for Fishery Purposes. FAO, Rome.
- Roberts, T. R. 1989. The freshwater fishes of western Borneo (Kalimantan Barat, Indonesia). *Memoirs of the California Academy of Sciences* 14:1–210.
- Suvatti, C. 1981. Fishes of Thailand. Royal Institute of Thailand, Bangkok.
- Tang, B. Y. 2004. Fishes introduced to Singapore. Excel file attached to email dated 21/08/04.
- 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. 2005. Thailand red data: fishes. Office of Natural Resources and Environmental Policy and Planning, Bangkok, Thailand.
- Vidthayanon, C., A. Termvidchakorn, and M. Pe. 2005. Inland fishes of Myanmar. Southeast Asian Fisheries Development Center.