Dorado (*Salminus brasiliensis*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, February 2022
Revised, March 2022
Web Version, 4/11/2023

Organism Type: Fish
Overall Risk Assessment Category: Uncertain

Photo: Brent Tibbatts. Licensed under CC-BY 3.0. Available: https://www.fishbase.se/summary/Salminus-brasiliensis.html (February 2022).

1 Native Range and Status in the United States

Native Range

From Froese and Pauly (2022):

"South America: Paraná, Paraguay, and Uruguay River basins [Argentina, Brazil, Bolivia, Paraguay, Uruguay]; Laguna dos Patos drainage, upper Chaparé and Mamoré River basin in Bolivia. Occurrence in the remaining Amazon River highly doubtful."

From Gagne et al. (2017):

"The Juramento River [Argentina] has historically been a hook and line subsistence harvest fishery for […] golden dorado (*Salminus brasiliensis*). […] Golden dorado are also found in rivers of Bolivia, Brazil, Paraguay, and Uruguay (Hahn et al., 2011)."

Status in the United States

No records of *Salminus brasiliensis* in the wild in the United States were found.

Although individuals were not in stock during this assessment, *S. brasiliensis* may be for sale in the United States (e.g., Predatory Fins 2018, 2022).

From Florida Department of State (2021):

"Live specimens of the following species, including their taxonomic successors, subspecies, or hybrids or eggs thereof may be possessed only pursuant to permit issued by the Executive Director except as provided in Rule 68-5.005, F.A.C."

"[…] Dorados (Genus *Salminus*, all species)."

From Mississippi Secretary of State (2019):

"All species of the following animals and plants have been determined to be detrimental to the State's native resources and further sales or distribution are prohibited in Mississippi. No person shall import, sell, possess, transport, release or cause to be released into the waters of the state any of the following aquatic species or hybrids thereof. However, species listed as prohibited may be allowed under a permitting process where environmental impact has been assessed."

"Dorados or dourados Genus *Salminus*"

From Oklahoma Secretary of State (2019):

"Until such time as is necessary for the Department of Wildlife Conservation to obtain adequate information for the determination of other harmful or potentially harmful exotic species, the importation into the State and/or the possession of the following exotic fish or their eggs is prohibited:"

"Piranha group: Serrasalmus spp., Pygocentrus spp., Rooseveltiella spp., Catoprion spp., Hydrocynus spp., and Salminus spp."

From Texas Parks and Wildlife (2020):

"The organisms listed here are legally classified as exotic, harmful, or potentially harmful. No person may possess or place them into water of this state except as authorized by the department. Permits are required for any individual to possess, sell, import, export, transport or propagate listed species for zoological or research purposes; […]"

"Dourados, Family Characidae
All species of genus *Salminus*"

Means of Introductions in the United States

No records of *Salminus brasiliensis* in the wild in the United States were found.

Remarks

From Gubiani et al. (2010):

"Most commonly used synonyms are *S. brevidens* and *S. maxillosus*, names often used in biological and fishery literature (Rodríguez-Olarte and Taphorn 2006)."

The valid name, *Salminus brasiliensis*, and the synonym, *S. maxillosus*, were used to search for information for this screening.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

According to Fricke et al (2022), *Salminus brasiliensis* (Cuvier 1816) is the current valid name for this species. It was originally described as *Hydrocynus brasiliensis* Cuvier 1816.

From ITIS (2022):

Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Actinopterygii
Class Teleostei
Superorder Ostariophysi
Order Characiformes
Family Characidae
Genus *Salminus*
Species *Salminus brasiliensis* (Cuvier, 1816)

Size, Weight, and Age Range

From Vitule et al. (2014):

"It is one of the largest characins, reaching more than one meter in total length, and over 30 kg (Britski et al. 1999; Froese and Pauly 2013). Gonadal maturation in females occurs when fish attain 324-378 mm (Suzuki et al. 2004; Agostinho et al. 2007)."

From Froese and Pauly (2022):

"[…] max. reported age: 9 years [Cordiviola 1966]"

Environment

From Froese and Pauly (2022):

"Freshwater; benthopelagic; potamodromous [Riede 2004]."

Climate

From Froese and Pauly (2022):

"Tropical"

Distribution Outside the United States

Native

From Froese and Pauly (2022):

"South America: Paraná, Paraguay, and Uruguay River basins [Argentina, Brazil, Bolivia, Paraguay, Uruguay]; Laguna dos Patos drainage, upper Chaparé and Mamoré River basin in Bolivia. Occurrence in the remaining Amazon River highly doubtful."

From Gagne et al. (2017):

"The Juramento River [Argentina] has historically been a hook and line subsistence harvest fishery for […] golden dorado (*Salminus brasiliensis*). […] Golden dorado are also found in rivers of Bolivia, Brazil, Paraguay, and Uruguay (Hahn et al., 2011)."

Introduced

From Vitule et al. (2014):

"Our newest record is based on an individual that was sampled at Rio das Pombas, a tributary of the Guaraguaçu River basin [Brazil] in the Atlantic rainforest biome."

"[…] we did identify many important human-mediated extralimital introductions of *S. brasiliensis* […]: Doce River basin (Ruschi 1965, […]), Paraíba do Sul River basin (Bizerril and Primo 2001; Buckup et al. 2007, […]), Iguaçu River basin (Gubiani et al. 2010, […]), all in the Atlantic Rainforest biome [southeast Brazil and northeast Argentina]."

"We also found many anedoctal [sic] reports in the World Wide Web about dourado fishing and sport fishing activities, some of them in areas outside its natural range (e.g., in Ribeira do Iguape River basin, Dr João Alves Vieira, personal communication, and anedoctal [sic] images and videos […])."

From Gubiani et al. (2010):

"We register here the first occurrence of the "dourado" *Salminus brasiliensis* (family: Characidae) in Salto Santiago Reservoir in the Iguaçu River basin, Paraná State, Brazil, a global biodiversity ecoregion with an extremely rich endemic ichthyofauna. The single specimen captured, an adult female measuring 480-mm total length, was taken with gillnet in January 2008. No additional *S. brasiliensis* were captured during general fish surveys conducted at four sites in the reservoir even though multiple types of gear were used (gill and trammel nets and long-line fishing) over a period of nearly two years (bimonthly from July 2006 to September 2008)."

From Ribeiro et al. (2017):

"In the Iguaçu River, the dourado was first recorded in 2008 (Gubiani et al., 2010); records of its occurrence in the river have increased over time […]."

"Sampling conducted from 2003 to 2016 in Salto Santiago and Salto Osório reservoirs (for more details see Gubiani et al., 2010; Gerpel/Instituto Neotropical de Pesquisas ambientais/Tractebel, 2015) recorded 20 specimens of dourado […], with an average standard length of 40.40 ± 14.50 cm (SD) (ranging from 17 to 70 cm) and average weight of 2106.10 ± 2359.00 g (ranging from 88.60 g to 9964.00 g)."

"During the period from 2003 to 2016, only two immature males smaller than the recorded size at first maturity were captured, indicating that this species is probably already reproducing in the region […]. However, the migratory behavior of dourado could limit their invasion success since the area is known to be highly impounded (Daga and Gubiani, 2012, Antonio et al., 2007, Daga et al., 2015). Nevertheless, the invasion success of *S. brasiliensis* in other Neotropical rivers with similar limitations on migration has already been reported (Ruschi, 1965, Vitule et al., 2014), which leads us to conclude that its successful establishment in the Iguaçu River is only a matter of time."

Means of Introduction Outside the United States

From Vitule et al. (2014):

"The dourado invasion is probably related to the occurrence of human activity and particularly sport fishing (e.g., McKinney 2006; Leprieur et al. 2008)."

From Gubiani et al. (2010):

"The presence of *S. brasiliensis*, a large, predacious freshwater species native to other parts of Brazil, may be related to its use as a sport fish, and the single specimen taken from the reservoir may have escaped from ponds built by aquaculturists for recreational angling."

From Ribeiro et al. (2017):

"In Brazil, on the grounds that few native fish species are suitable for sport fishing, the introduction of non-native species, such as […] the dourado *Salminus brasiliensis* (Cuvier, 1816), has been encouraged and even carried out by government agencies, as well as illegally by fishermen, with the aim of developing this fishing modality in the country (Vitule, 2009, Vitule et al., 2014)."

"The project 'Iguaçu Dourado' […] aims at the implementation of a program for the sustainable exploitation of sport fishing tourism in the Iguaçu River basin. In its publicity material the project claims to be in favor of the conservation of the region and the sustainable development of the local population […]. Although not explicit, the intention of the group is to introduce and/or maintain the dourado by catch and release programs, as well as by clandestine restocking by individual or group activity, is clear […], even though the organizers are aware that this practice is prohibited by the federal laws nos. No. 5197/67 and No. 9605/98."

Short Description

From Ota et al. (2018):

"Body deep; greatest depth contained 3.6 to 3.7, caudal peduncle depth 11.3 to 11.5 times in SL [standard length]; head length 3.1 to 3.3, predorsal distance 1.8 to 1.9, caudal peduncle length 9.3 to 9.6 in SL; snout length 3.4 to 4.0, horizontal orbital diameter 5.7 to 5.9 and least interorbital width 2.7 to 3.2 in HL [head length]. Mouth terminal; inner row of premaxilla with 9-11, outer row with 8, inner row of dentary with 40-50, outer row with 28 or 29 and maxilla with 30-33 teeth. Lateral line with 93-96 pored scales; transverse series above lateral line with 16-18 scale rows and below with 8-9 scale rows. Dorsal fin with 11 or 12, pectoral fin with 15, pelvic fin with 9, anal fin with 26-29 and caudal fin with 19 rays. Ground color yellowish; longitudinal series of dark-brown spots on flank scales; dark-brown transverse band on posterior portion of caudal peduncle, extending to distal margin of median caudal-fin rays. Yellowish fins (Graça, Pavanelli, 2007)."

Biology

From Pereira et al. (2015):

"In the present study, the diet of the native *S. brasiliensis* was composed by piscivorous individuals (26%) and, among them, the invasive [*Cichla*] *kelberi* (13%). This fact demonstrates that this native is acting directly as a predator of the invasive species, corroborating the importance of such species in providing biotic resistance against invaders."

"*S. brasiliensis*, a migratory species, has been highly affected by reservoir construction which, combined with intense human occupation and fishing, causes serious depletions in its abundance (Agostinho et al., 2007[a]; Hahn et al., 2011; Petrere-Jr et al., 2002)."

From Gubiani et al. (2010):

"This species inhabits riverine systems, including the channels of large and small rivers and streams as well as reservoirs (Hahn et al. 2004). The reproductive period extends from October to January and mature individuals make annual spawning migrations (up to 1000 km; Petrere Jr. 1985). First maturity in females occurs at about 378 mm and in males at about 324 mm (Suzuki et al. 2004; but see Rodríguez-Olarte and Taphorn 2006). On the other hand, Barbieri et al. (2001) found 447.4 mm for females and 346.7 mm for males, in the Mogi Guaçu River, São Paulo State, to first sexual maturation. *Salminus brasiliensis* adults are aggressive predators, mainly piscivorous. Adults, in the upper Paraná River floodplain, it fed on mainly characid of small size (Almeida et al. 1997). Its maximum size nearly 1 m long (Britski et al. 1999), and highly prized by anglers (Banducci Jr. 2000; Barbieri et al. 2001). In aquaculture conditions, young *S. brasiliensis* exhibit cannibalistic behavior (Companhia Energética de Minas Gerais 2000)."

Human Uses

From Adriano et al. (2009):

"This characid […] is appreciated for its meat and is an important species in the fishing economy of the regions where it occurs (850,000 kg of dourado was commercialized in 2006) (Ibama, 2008). The dourado is also highly prized by sport fisherman and is one of the few South American fish widely recognized by the international sport fishing community (Resende, 2003). The dourado has been cultivated for production meat, sport fishing and as ornamental fish (Mai and Zaniboni-Filho, 2005)."

From Seriously Fish (2022):

"We've included this species on the site purely because there have been an alarming number of juvenile fish showing up in some aquatic stores and, as a result, in hobbyists tanks. This species is simply not suited to captive life in any respect. If you see one for sale, and they are undeniably an attractive fish, please don't be tempted to buy it."

"As responsible fishkeepers we should consider the long term well-being of any fish that we buy, and housing a dorado for life is beyond the reach of virtually all hobbyists. Sadly, owning this species and others like it seems to be fashionable at the moment, with some aquarists even viewing them as a status symbol."

Diseases

No records of OIE-reportable diseases (OIE 2022) were found for *Salminus brasiliensis.*

Poelen et al. (2014) list the following as parasites of *Salminus brasiliensis*: *Prosthenhystera obesa, Cladocystis intestinalis, Monticellia* sp.*, Monticellia coryphicephala, Rhinoxenus bulbovaginatus, Neophilometroides paraguayensis, Cucullanus interrogativus, Ascaris casta, Cystidicoloides fischeri, Freitascapillaria maxillosa, Spirocamallanus inopinatus, Paracapillaria piscicola, Capillaria maxillosa, Neocladocystis* sp.*, Bellumcorpus schubarti, Rhipidocotyle jeffersoni, Halipegus dubius, Genarchella overstreeti, Genarchella* sp.*,*

Cladocystis sp.*, Genarchella parva, Dadaytrema oxycephala, Eustrongylides ignotus, Spirocamallanus hilarii*.

From Adriano et al. (2009):

"In this report, we describe the morphology and histopathology of *Myxobolus salminus* n. sp., a parasite of the gill filaments of wild *Salminus brasiliensis* (dourado) from the Brazilian Pantanal."

"The absence of *M. salminus* n. sp. in fish farm specimens probably reflected the low prevalence of the parasite in wild specimens and suggests that the risk of introducing this parasite to fish farms through infected fish is low. Nevertheless, the occurrence of *M. salminus* n. sp. in gill filament blood vessels of wild dourado indicates that this parasite is a potentially important pathogen, and the presence and dispersion of which need to be monitored closely by commercial fish farmers."

Threat to Humans

From Froese and Pauly (2022):

"Harmless"

3 Impacts of Introductions

There are records of introductions for *Salminus brasiliensis*. However, there are no documented impacts of introduction. The following refers to potential impacts of introductions.

From Ribeiro et al. (2017):

"The diet of *S. brasiliensis* is predominantly composed of fish, especially species of genus *Astyanax* (Esteves and Pinto Lôbo, 2001). This genus is very abundant and known to be an important food resource for many top-predator fish species in the Iguaçu River (Garavello and Sampaio, 2010, Daga and Gubiani, 2012, Baumgartner et al., 2012, Delariva et al., 2013). In addition, it has a high rate of endemism among its species (Pavanelli and Bifi, 2009). Therefore, because of the high availability of resources, the invasion of *S. brasiliensis* will probably be successful in this region, where it has the potential to be extremely harmful to the endemic fish fauna (Gubiani et al., 2010, Vitule et al., 2014)."

The importation, possession, and/or trade of *Salminus brasiliensis* is regulated in the following States (see section 1 for detailed information): Florida (Florida Department of State 2021), Mississippi (Mississippi Secretary of State 2019), Oklahoma (Oklahoma Secretary of State 2019), and Texas (Texas Parks and Wildlife 2020).

4 History of Invasiveness

Salminus brasiliensis has been introduced to multiple drainages in South America outside of its native range to improve local sport fishing opportunities. It has become established outside its native range in rivers such as the Iguaçu in Brazil, where its population seems to be increasing (Ribeiro et al. 2017). Despite many documented introductions of this species, there is no information available on negative impacts of its introduction. In Ribeiro et al. (2017), it is posited that introductions of *S. brasiliensis* will harm native fish species through predation, though no sources documenting actual impacts of introduction could be found. The History of Invasiveness category for this species is therefore Data Deficient.

5 Global Distribution

Figure 1. Known global distribution of *Salminus brasiliensis*. Observations are reported from South America (Colombia, Peru, Brazil, Bolivia, Paraguay, Uruguay, Argentina). Map from GBIF Secretariat (2022). Points in Colombia, Peru, and in Brazil along the border with northern Bolivia were excluded from climate matching because they occur outside the reported established range of this species. A point in the South Atlantic Ocean was excluded from the extent of this map and from climate matching analysis because of coordinate error.

6 Distribution Within the United States

No records of *Salminus brasiliensis* in the wild in the United States were found.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Salminus brasiliensis* with the contiguous United States was variable with the areas of high match found in the Southeast from central Texas to New Jersey. Much of the central and eastern regions from southeastern Arizona to southern Minnesota, and eastward to New England had a medium climate match. Low matches were generally found throughout most western States and in the extreme Northeast (northern Vermont, Maine). The overall Climate 6 score (Sanders et al. 2021; 16 climate variables; Euclidean distance) for the contiguous United States was 0.394, High (scores greater than 0.103, inclusive, are classified as high). The following States had High individual Climate 6 scores: Alabama, Arkansas, Arizona, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Louisiana, Maryland, Michigan, Missouri, Mississippi, North Carolina, New Jersey, New Mexico, New York, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, and West Virginia. Iowa, Nebraska, and Wisconsin had Medium individual scores. All remaining States had Low individual scores.

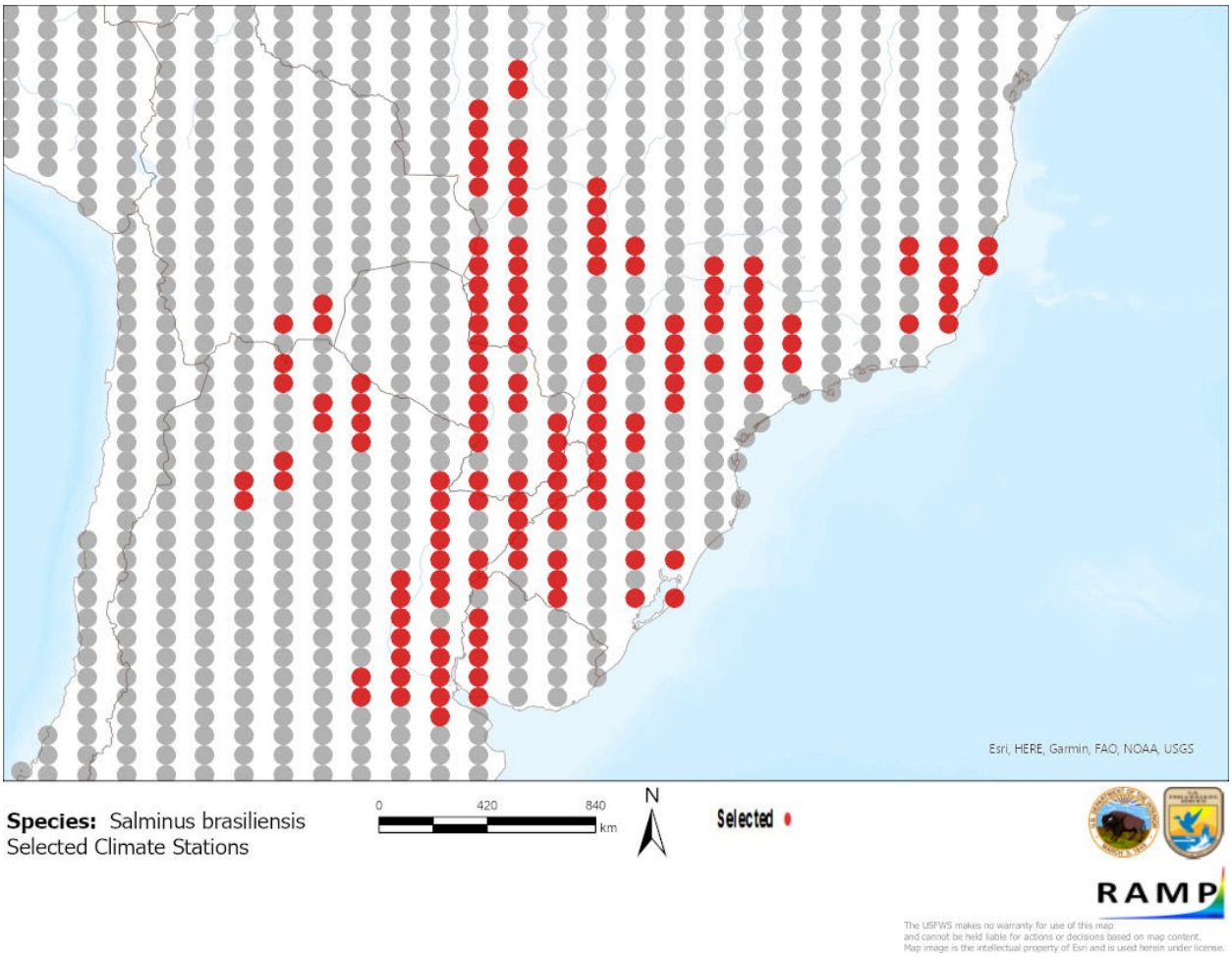

Figure 2. RAMP (Sanders et al. 2021) source map showing weather stations in central and southern South America selected as source locations (red; Argentina, Bolivia, Brazil, Paraguay, Uruguay) and non-source locations (gray) for *Salminus brasiliensis* climate matching. Source locations from GBIF Secretariat (2022). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

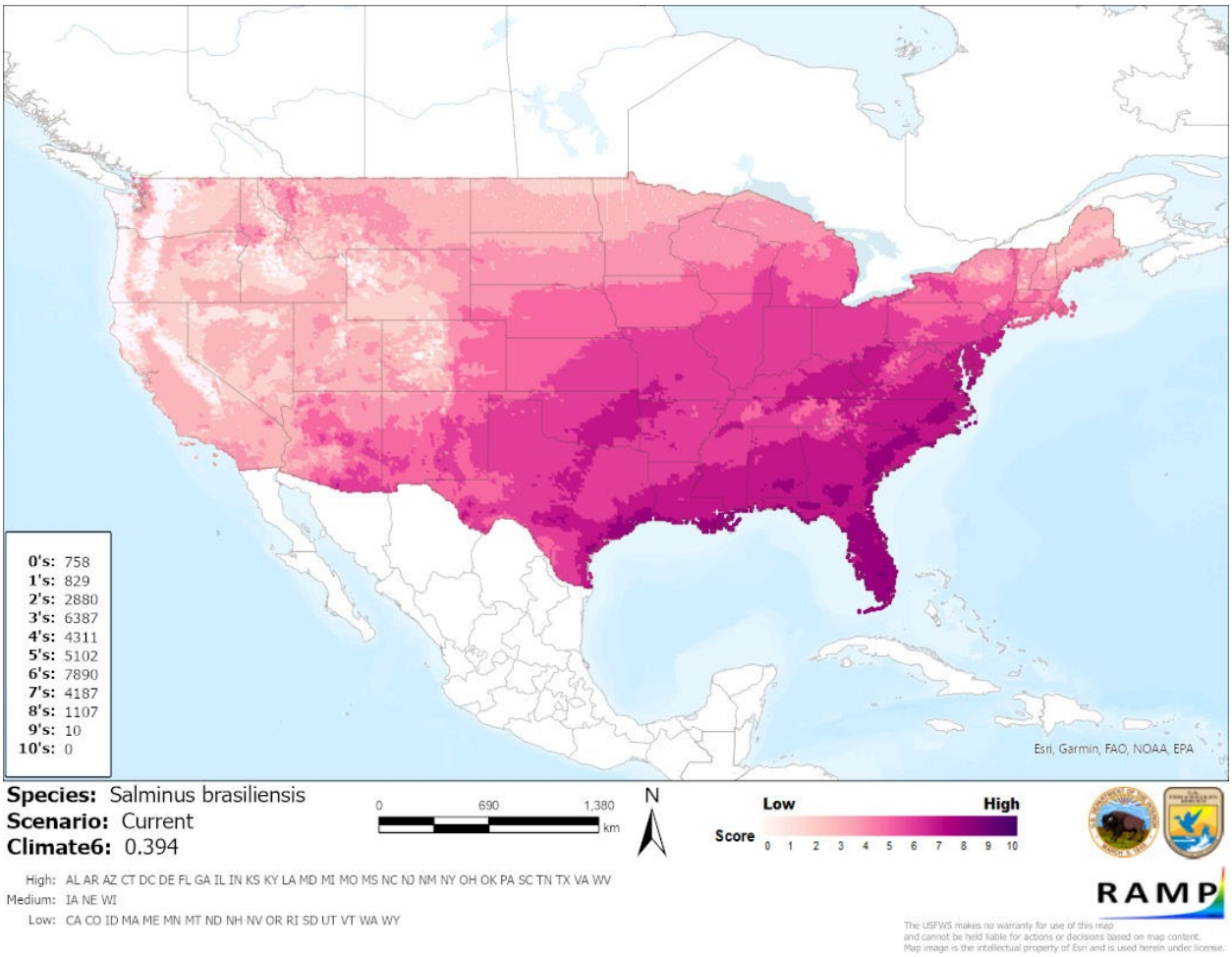

Figure 3. Map of RAMP (Sanders et al. 2021) climate matches for *Salminus brasiliensis* in the contiguous United States based on source locations reported by GBIF Secretariat (2022). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

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

Climate 6: (Count of target points with climate scores 6-10)/ (Count of all target points)	Overall Climate Match Category
0.000≤X≤0.005	Low
0.005<X<0.103	Medium
≥0.103	High

8 Certainty of Assessment

There is adequate information available about the biology and distribution of *Salminus brasiliensis*. This species has been reported as introduced and established outside of its native range, and the pathway of its introduction is clear. Despite this, no information is available on

impacts of introductions for this species. Further information is needed to adequately assess the risk *S. brasiliensis* poses to the contiguous United States. The certainty of assessment is Low.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Salminus brasiliensis, the Dorado, is a large, piscivorous, migratory fish species native to drainages in central and southern South America. This is a prized species in sport fisheries, which has led to its introduction outside of its native range to increase recreational fishing opportunities. Although its mature size and biology generally make it unsuitable for home aquaria, it may be found for sale in the United States. Additionally, its possession is regulated in Florida, Mississippi, Oklahoma, and Texas. *S. brasiliensis* has a High overall climate match with the contiguous United States. Areas of high match are mainly found in the Southeast. The certainty of assessment for this species is Low because although it is established outside of its native range, no information could be found assessing impacts of its introduction. As such, the history of invasiveness is classified as Data Deficient. The overall risk assessment category is Uncertain.

Assessment Elements

- **History of Invasiveness (Sec. 4): Data Deficient**
- **Overall Climate Match Category (Sec. 7): High**
- **Certainty of Assessment (Sec. 8): Low**
- **Remarks, Important additional information: No additional remarks.**
- **Overall Risk Assessment Category: Uncertain**

10 Literature Cited

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 11.

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11 Literature Cited in Quoted Material

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.

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