Oscar (*Astronotus ocellatus*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, February 2011
Revised, January 2018
Web Version, 7/20/2018

Photo: Harum Koh. Creative Commons (CC BY-SA 2.0). Available: https://commons.wikimedia.org/wiki/File:Astronotus_ocellatus_(15594046309).jpg. (February 2018).

1 Native Range and Status in the United States

Native Range

From Froese and Pauly (2018):

"South America: Amazon River basin in Peru, Colombia and Brazil; French Guiana. Reported from Argentina [Lopez et al. 1987]."

From Nico et al. (2018):

"*Astronotus* is native to South America including Orinoco and Amazon basins; also to French Guiana, and to northern part of Paraguay drainage, Parana basin (Kullander 1986)."

From Seriously Fish (2018):

"Widely-distributed in the Amazon region and has been recorded in Colombia, Venezuela, Bolivia, Ecuador, Peru, Brazil, French Guiana, Paraguay, Uruguay and Argentina. Across this range it has been collected from numerous river systems, including the Ucayali, Solimões, Amazonas, Negro, Madeira, Tapajós, Tocantins, Orinoco, Approuague, and Oyapock."

Status in the United States

From Nico et al. (2018):

"Established in south Florida, Hawaii, and Puerto Rico. Failed in Alaska, Arizona, California, Georgia, Indiana, Louisiana, Maryland, Massachusetts, Minnesota, Mississippi, Ohio, Nebraska, New Jersey, North Carolina, Pennsylvania, Rhode Island, South Carolina, Texas, Vermont, Virginia, and Wisconsin."

"Based on recent reports of the Florida Game and Freshwater Fish Commission, oscars now compose a substantial proportion of the recreational fishery catch in some areas of the Everglades (Fury and Morello 1994), especially when cold temperatures have been absent for several years (Shafland et al. 2008). The distribution and abundance of this species in south Florida fluctuate widely based on the prevalence of cold temperatures (Shafland et al. 2008). The Florida size record was a 1.1 kg, 32 cm TL fish taken from Lake Okeechobee, Palm Beach County, on 16 March 1994 (Ray 1994). Oscars have been established in Miami-Dade County, southeastern Florida, since late 1950s, but began to expand range greatly in late 1970s and early 1980s (Hogg 1976a, b; Courtenay and Stauffer 1990; Fury and Morello 1994)."

"Oscars are very common in the aquarium trade."

Means of Introductions in the United States

From Nico et al. (2018):

"The first Florida records were the result of deliberate stockings from an aquarium fish farm in southeastern Dade County in the late 1950s (Courtenay et al. 1974; Courtenay and Hensley 1979a; Courtenay and Stauffer 1990; Jackson 1999). During the same period, attempts were made to popularize the species as a sport fish under the name "velvet cichlid." Anglers have aided dispersal in Florida by transporting fish to new locations (Courtenay et al. 1974). It was sighted at the Anhinga Trail in Everglades National Park in the late 1980s (Loftus and Kushlan 1987). It apparently gained access to the park by way of the South Florida Water Management District's Canal L31W, and it is now considered established (Courtenay 1989). The first introduction of this species [*Astronotus ocellatus*] into Hawaii was in 1952, for purposes of recreational fishing (Devick 1991a, b); Hawaii's Division of Fish and Game made additional reservoir stockings in 1958; the original source of the Hawaii plants [of fish] was a small stock

obtained from Steinhart Aquarium in San Francisco (Brock 1960). Introductions into all other states and in more northern portions of Florida are apparently the result of aquarium releases (Courtenay and Stauffer 1990; Nico, personal communication)."

"Oscars are very common in the aquarium trade. Because they grow large in aquaria and are piscivorous, individuals are likely to be released into natural waters by aquarists loathe to kill their pets. This likely accounts for the numerous instances of single specimen records from both temperate and subtropical states."

Remarks

From Nico et al. (2018):

"Unfortunately, the taxonomy of this group is problematic and future research may determine that some oscars in the aquarium trade, as well as those taken in U.S. waters, are not *A. ocellatus* but another member of the genus (S. O. Kullander, personal communication). To confound the issue, artificial breeding has produced several color variants (Axelrod 1993), and genetic analyses have suggested the presence of morphologically cryptic species within *Astronotus* (Colatreli et al. 2012)."

Froese and Pauly (2018) list *Lobotes ocellatus, Cychla rubroocellata, Acara compressus, Acara hyposticta, Astronotus ocellatus zebra,* and *Astronotus orbiculatus* as synonyms for *Astronotus ocellatus.* Information searches for this ERSS were conducted using these synonyms, as well as the accepted scientific name, *Astronotus ocellatus*, as search terms.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2018):

"Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Actinopterygii
Class Teleostei
Superorder Acanthopterygii
Order Perciformes
Suborder Labroidei
Family Cichlidae
Genus *Astronotus*
Species *Astronotus ocellatus* (Agassiz in Spix and Agassiz, 1831) – oscar"

"Current Standing: valid"

Size, Weight, and Age Range

From Froese and Pauly (2018):

"Max length : 45.7 cm TL male/unsexed; [IGFA 2001]; common length : 24.0 cm TL male/unsexed; [Hugg 1996]; max. published weight: 1.6 kg [IGFA 2001]."

Environment

From Nico et al. (2018):

"Lower lethal limit is 12°C (Shafland and Pestrak 1982). Extremely tolerant to low oxygen conditions (Muusze et al. 1998), and known to perform aquatic surface respiration to help mitigate hypoxia (Kramer and McClure 1982)."

From Froese and Pauly (2018):

"[…] 22°C - 25°C [Riehl and Baensch 1991; assumed to represent recommended aquarium water temperature]"

Climate/Range

From Froese and Pauly (2018):

"Tropical; […] 4°N - 15°S, 78°W - 47°W"

Distribution Outside the United States

Native

From Froese and Pauly (2018):

"South America: Amazon River basin in Peru, Colombia and Brazil; French Guiana. Reported from Argentina [Lopez, Menni, and Miguelarena 1987]."

From Nico et al. (2018):

"*Astronotus* is native to South America including Orinoco and Amazon basins; also to French Guiana, and to northern part of Paraguay drainage, Parana basin (Kullander 1986)."

From Seriously Fish (2018):

"Widely-distributed in the Amazon region and has been recorded in Colombia, Venezuela, Bolivia, Ecuador, Peru, Brazil, French Guiana, Paraguay, Uruguay and Argentina. Across this range it has been collected from numerous river systems, including the Ucayali, Solimões, Amazonas, Negro, Madeira, Tapajós, Tocantins, Orinoco, Approuague, and Oyapock."

Introduced

Froese and Pauly (2018) list Singapore, Poland, Philippines, Italy, Guam, Germany, Australia, Brazil, Canada, Côte d'Ivoire, and China as countries where *A. ocellatus* has been introduced. Among these countries, Singapore and Brazil are listed as places where populations have been established.

According to Corfield et al. (2007), *A. ocellatus* is established in Australia, in the Ross River and creeks around Cairns, northern Queensland.

Means of Introduction Outside the United States

Aquarium releases and escape from aquaculture facilities are likely the primary vectors for introduction (Corfield et al. 2007; CABI 2018).

Short Description

From Froese and Pauly (2018):

"Dorsal spines (total): 12 - 14; Dorsal soft rays (total): 19-21; Anal spines: 3; Anal soft rays: 15 - 17. Large mouth with thick lips; 7 preopercular pores; first gill arch without lobe; gill rakers short and thick with many denticles; dorsal and anal fins bases densely scaled; many branched rays; body color dark with bright orange opercle margin and ventral parts of the lateral sides of the body; often a black rounded blotch with orange margin at caudal fin base [Keith, Le Bail, and Planquette 2000]."

Biology

From Froese and Pauly (2018):

"Preferably inhabits quiet shallow waters in mud-bottomed and sand-bottomed canals and ponds [Page and Burr 1991]. Feeds on small fish, crayfish, worms and insect larvae. Quite popular with aquarists but not for aquaculturists because of its slow growth [Keith, Le Bail, and Planquette 2000]. Maximum length 40 cm TL [Page and Burr 1991].

Human Uses

From Froese and Pauly (2018):

A highly esteemed food fish in South America [Yamamoto and Tagawa, 2000]."

"Fisheries: commercial; gamefish: yes; aquarium: highly commercial"

Diseases

From Froese and Pauly (2018):

"White spot Disease, Parasitic infestations (protozoa, worms, etc.)
Dactylogyrus Gill Flukes Disease, Parasitic infestations (protozoa, worms, etc.)
Ichthyobodo Infection, Parasitic infestations (protozoa, worms, etc.)

Bacterial Infections (general), Bacterial diseases
Intestinal Worm Infection (general), Parasitic infestations (protozoa, worms, etc.)
Nematode Infection (general), Parasitic infestations (protozoa, worms, etc.)
Procamallanus Infection 10, Parasitic infestations (protozoa, worms, etc.)
Goezia Disease 6, Parasitic infestations (protozoa, worms, etc.)"

From Sreedharan et al. (2011):

"Pathogenic strains of *Aeromonas veronii* resistant to multiple antibiotics were isolated from A. ocellatus individuals showing signs of infectious abdominal dropsy. The moribund fish showed haemorrhage in all internal organs, and pure cultures could be obtained from the abdominal fluid."

No OIE-listed diseases reported.

Threat to Humans

From Froese and Pauly (2018):

"Harmless"

From Nico et al. (2018):

"In 1993, the state of Florida issued a health advisory warning people about eating freshwater fish contaminated with mercury. For portions of south Florida, the oscar was included in the list of fish for which limited consumption was recommended."

3 Impacts of Introductions

From Corfield et al. (2007):

"Under the right conditions, oscars can grow to a large size (40 cm) and they have been shown to be capable of feeding on other small fish as well as on invertebrates. The males display aggressive behaviour to other fish during spawning and the species is known to 'burrow' into the substrate (probably during nest preparation). These attributes collectively indicate a relatively high behavioural potential for impact on native fish and invertebrates [...] This species also has a high propensity to spread [...] This, together with its wide 'potential' geographic distribution and propensity to cause an impact mean that it has a high risk of becoming a pest species."

From Nico et al. (2018):

"[Impact of Introduction is] largely unknown. In 1993, the state of Florida issued a health advisory warning people about eating freshwater fish contaminated with mercury. For portions of south Florida, the oscar was included in the list of fish for which limited consumption was recommended. Oscars are considered potential competitors with native centrarchids (sunfishes) for food and possibly for spawning areas (Courtenay and Hensley 1979a), and as predators on

native fishes and invertebrates."

From Latini and Petrere (2004):

"Three alien species occur in the lakes of the park: the peacock cichlid, C[ichla] *cf. monoculus*, the oscar, *A. ocellatus* and the red piranha, *P*[*ygocentrus*] *nattereri* […] The presence of alien species in lakes of the River Doce State Park [Brazil] is correlated with reduced richness of the local fish community. This agrees with ecological studies in several parts of the world that focus on the invasion of reservoirs by alien species (Ricciardi, Neves & Rasmussen 1998). Taken together, such studies indicate a non-random pattern in the response of communities faced with invasion by alien species."

4 Global Distribution

Figure 1. Map of reported global occurrences of *Astronotus ocellatus*. Map from GBIF Secretariat (2017). Locations in Canada, India, and China were not included in the climate matching analysis because *A. ocellatus* is not confirmed as established in those countries. GBIF Secretariat (2017) does not provide georeferenced occurrences for *A. ocellatus* in Uruguay, Singapore or Australia. See Section 5: Distribution Within the United States for locations included and excluded from the climate matching analysis with the United States.

5 Distribution Within the United States

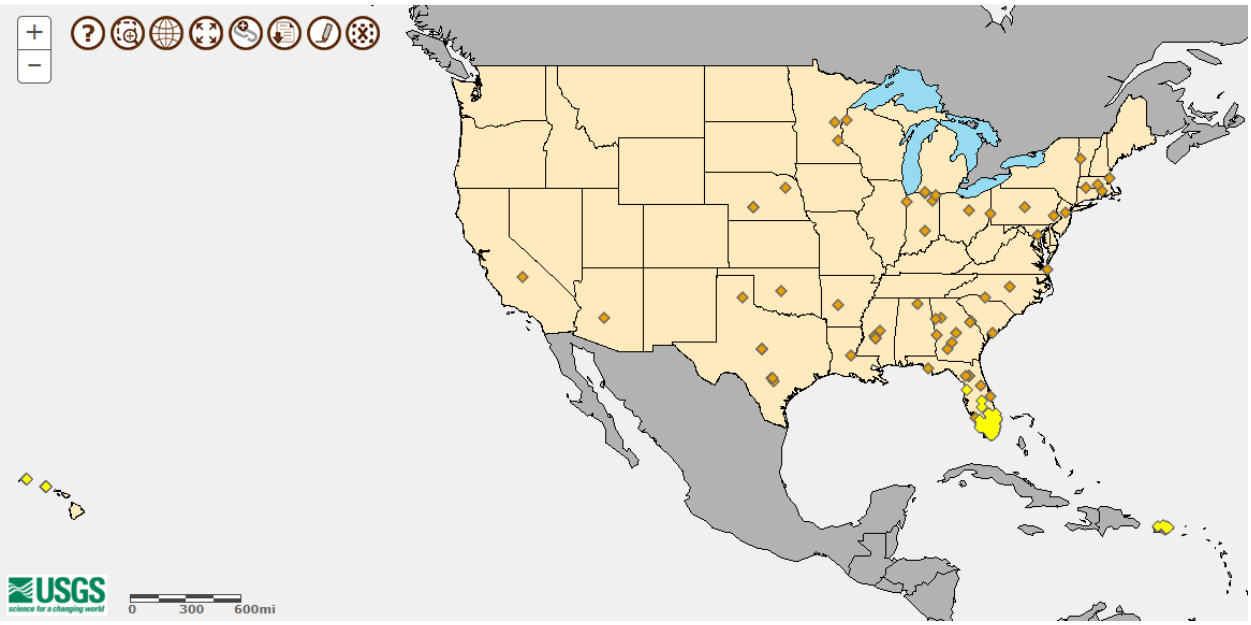

Figure 2. Distribution map of *Astronotus ocellatus* within the United States. Map from Nico et al. (2018). Established populations (found only in Florida, Puerto Rico, and Hawaii) are represented by yellow diamonds and were included in the climate matching analysis. Collection locations without established populations are represented by orange diamonds and were omitted from the climate matching analysis.

6 Climate Matching

Summary of Climate Matching Analysis

The climate match (Sanders et al. 2018) was high in Florida, coastal Georgia, and a small area around Galveston, Texas. Medium match was found all along the Gulf of Mexico coastline, eastern and southern Texas, small areas of southern California and southern Arizona, and along the Atlantic Coast as far north as Maryland. Low match occurred across the rest of the contiguous United States. Climate 6 match indicated that the contiguous United States has a medium climate match overall. The range of scores classified as medium climate match is 0.005 to 0.103; Climate 6 score of *Astronotus ocellatus* is 0.052.

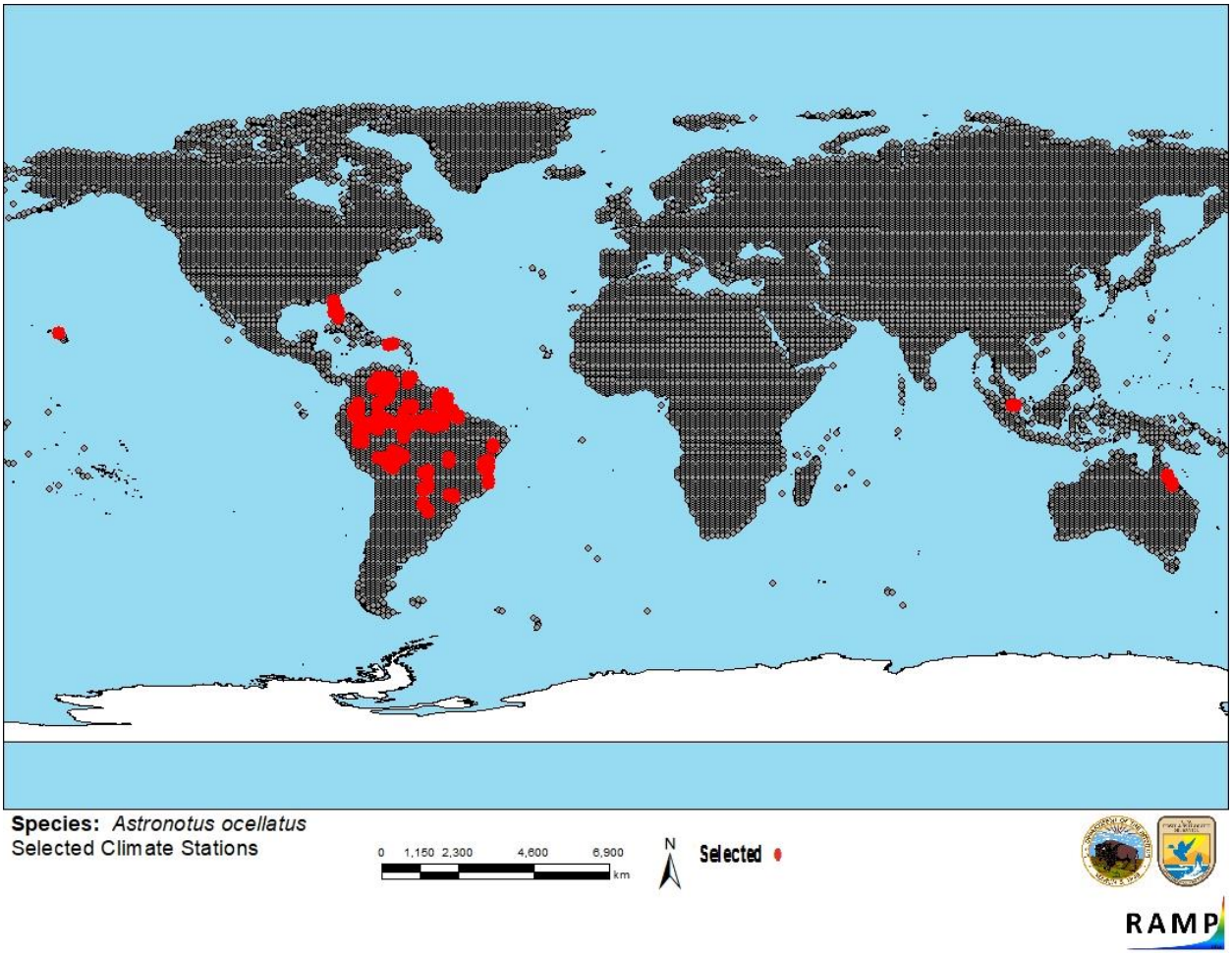

Figure 3. RAMP (Sanders et al. 2018) source map showing weather stations across the world selected as source locations (red; United States including the states of Florida and Hawaii and the Commonwealth of Puerto Rico, Colombia, Venezuela, French Guiana, Ecuador, Peru, Brazil, Bolivia, Paraguay, Argentina, Singapore, and Australia) and non-source locations (gray) for *A. ocellatus* climate matching. Source locations represent established populations and are from GBIF Secretariat (2017) and Nico et al. (2018). Two established populations were added within Australia (Corfield et al. 2007), while an additional population was added in Singapore (Froese and Pauly 2018).

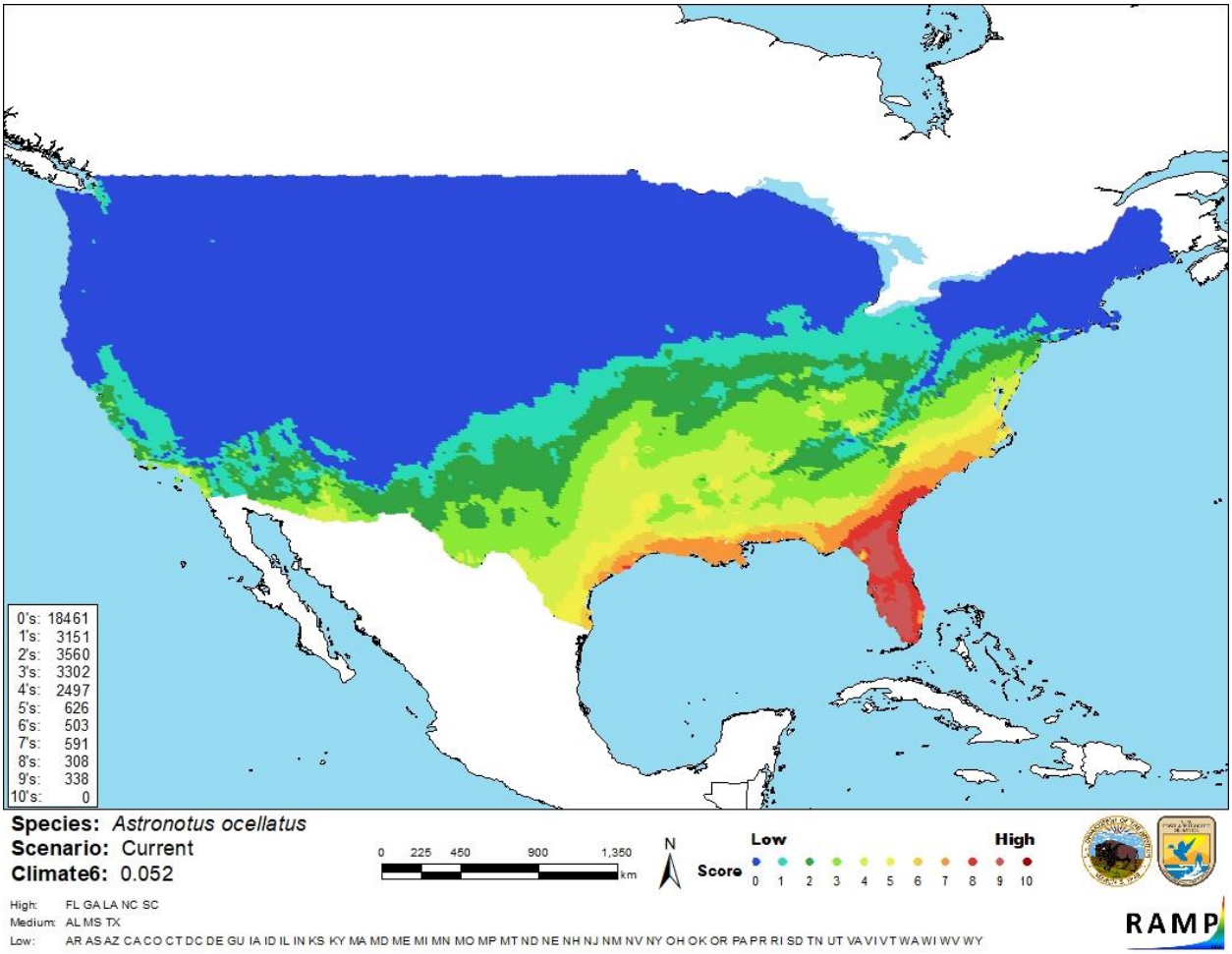

Figure 4. Map of RAMP (Sanders et al. 2018) climate matches for *Astronotus ocellatus* in the contiguous United States based on source locations from GBIF Secretariat (2017), Nico et al. (2018), Corfield et al. (2007), and Froese and Pauly (2018). 0=Lowest match, 10=Highest match.

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

There is currently a considerable amount of information available on the biology and ecology of *Astronotus ocellatus*. Despite numerous specimens being captured outside their native range, only a limited number of established non-native populations exists. Aside from its inclusion in a State of Florida health advisory for mercury contamination, impacts of introduction are largely unknown, although there is high behavioral potential for impact on native fish and invertebrates. One report noted the presence of the alien peacock cichlid, *C. monoculus*, the oscar, *A. ocellatus*

and the red piranha, *P. nattereri* was correlated with reduced richness of the local fish community in the lakes of River Doce State Park, Brazil. However, it is unknown to what degree *A. ocellatus*, specifically, played a role in this outcome. Taxonomy of the species is somewhat problematic such that some *A. ocellatus* found outside the native range may later be determined to be a separate species. Given these factors, the certainty of assessment is low.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Oscar (*Astronotus ocellatus*) is a cichlid native to much of South America. Extremely tolerant to low oxygen conditions, this species prefers slow-moving waters where it feeds on fruits, small fish, crayfish, worms and insect larvae. Under the right conditions this omnivorous fish can grow to a large size. *A. ocellatus* is common in the aquarium trade, and is used as a game and commercial fish for human consumption. It is reportedly affected by a number of bacterial and parasitic infections. Numerous *A. ocellatus* specimens have been taken from waterbodies across the contiguous United States. Most of these introductions likely resulted from aquarium releases, although, in Florida, the species was deliberately stocked as a sport fish in the 1950s. This species is now established in ponds, rock pits, and canals in southern Florida, and in Hawaii and Puerto Rico. Distribution and abundance in Florida varies with prevalence of cold temperatures. *A. ocellatus* has expanded its range greatly in south Florida since introduction in the 1950's, and is believed to have expanded to the Everglades National Park through Water Management District canals. Taxonomy is somewhat problematic, such that some specimens found in the United States may later be determined to be a separate species. *A. ocellatus* was included by the State of Florida in a health advisory warning people about eating freshwater fish contaminated with mercury in 1993. In Brazil, introductions of *A. ocellatus*, *Pygocentrus nattereri*, and *Cichla* cf. *monoculus* have been associated with the disappearance of native species from several water bodies, although the distinct contributions of *A. ocellatus* were not identified. Biologists have noted *A. ocellatus* may prey on native fish and invertebrates, compete with native sunfish for food, and possibly nesting sites, and males may be aggressive during spawning, but these potential impacts have yet to be documented. Climate match with the contiguous United State was medium, with a high match throughout Florida. Because the evidence for negative impacts of introduction is not clear and convincing, the certainty of the assessment is low and the overall risk assessment category for *Astronotus ocellatus* 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: May bioaccumulate mercury to levels that are harmful to humans if consumed.**
- **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.

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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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