Spotted Scat (*Scatophagus argus*)
Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, June 2014
Revised, December 2017
Web Version, 11/5/2019

Photo: J. E. Randall. Creative Commons (CC BY-NC 3.0). Available: http://www.fishbase.se/photos/PicturesSummary.php?StartRow=1&ID=4698&what=species&TotRec=13 (December 2017).

1 Native Range and Status in the United States

Native Range

From Froese and Pauly (2017):

"Indo-Pacific: Kuwait to Fiji, north to southern Japan, south to New Caledonia. Reported from Samoa [Lieske and Myers 1994], Tonga [Randall et al. 2003], and the Society Islands [Allen 1991]."

According to Froese and Pauly (2019), *S. argus* is native to the following countries: Andaman Islands, Bahrain, Bangladesh, Cambodia, China and Taiwan, India, Indonesia, Iran, Iraq, Japan (including Ryukyu Islands), Kuwait, Malaysia, Myanmar, Oman, Pakistan, Philippines, Qatar, Saudi Arabia, Singapore, South Korea, Sri Lanka, Thailand, Timor-Leste, United Arab Emirates, Vietnam, Australia, Fiji, French Polynesia, Micronesia, New Caledonia, Palau, Papua New Guinea, Samoa, Tahiti, Tonga, and Vanuatu.

Status in the United States
From Schofield (2017):

"An individual was collected off Cedar Key, Levy County, Florida, in 1992. Another scat was captured in 3-ft of water in a mud/mangrove habitat near the St. Lucie inlet in July 2011."

Schofield (2017) reports the species as "collected," not established, in the above locations.

This species is present in the aquarium trade in the United States. For example:

From Arizona Aquatic Gardens (2019):

"Scat – Green Scat Scatophagus argus
Sale!
List: ~~$21.99~~
~~$19.99~~ $17.44"

Means of Introductions in the United States
From Schofield (2017):

"Probable aquarium release."

Remarks
From Schofield (2017):

"It is unclear whether nominal *S. argus* is in fact composed of more than one species. Differences in the marking pattern (i.e., bars versus spots, size of spots) of juveniles has led to contention over whether the species should be partitioned. The 'red scat' (*Scatophagus argus* rubifrons) may not be a distinct variety of scat, but merely a developmental stage of the common spotted scat (Barry and Low 1992)."

Bailly (2008) lists the following names as synonyms verified by a taxonomic editor for *Scatophagus argus*: *Chaetodon argus* Linnaeus, 1766; *Chaetodon atromaculatus* Bennett, 1830; *Chaetodon pairatalis* Hamilton, 1822; *Ephippus argus* Linnaeus, 1766; *Scatophagus aetatevarians* De Vis, 1884; *Scatophagus argus argus* Linnaeus, 1766; *Scatophagus argus ocellata* Klunzinger, 1880; *Scatophagus bougainvillii* Cuvier, 1831; *Scatophagus maculatus*

Gronow, 1854; *Scatophagus ornatus* Cuvier, 1831; *Scatophagus purpurascens* Cuvier, 1831; *Scatophagus quadranus* De Vis, 1882.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2017):

"Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Osteichthyes
Class Actinopterygii
Subclass Neopterygii
Infraclass Teleostei
Superorder Acanthopterygii
Order Perciformes
Suborder Acanthuroidei
Family Scatophagidae
Genus *Scatophagus*
Species *Scatophagus argus* (Linnaeus, 1766)"

From Eschmeyer et al. (2017):

"Current status: Valid as *Scatophagus argus* (Linnaeus 1766)."

Size, Weight, and Age Range

From Froese and Pauly (2017):

"Maturity: Lm ?, range 14 - ? cm Max length : 38.0 cm TL male/unsexed; [Pethiyagoda 1991]; common length : 20.0 cm TL male/unsexed"

Environment

From Froese and Pauly (2017):

"Marine; freshwater; brackish; reef-associated; amphidromous [Riede 2004]; depth range 0 - 5 m [Allen and Erdmann 2012]. Inhabit harbors, natural embayments, brackish estuaries and the lower reaches of freshwater streams, frequently occurring among mangroves […]"

From Gupta (2016):

“Menasveta (1981) and Gandhi (1998) have reported high temperature tolerance limit for *Scatophagus argus* adult [*sic*]. Very high temperature tolerance limit (41.3°C) has also been reported for scat fry (Macahilig et al., 1988). Scat also has wide salinity tolerance range (Barry and Fast, 1988; Gandhi, 1998; Chang et al., 2005); it is used [*sic*] to occur in waters ranging from fresh water (0 ppt salinity) to greater than seawater (35 ppt salinity). Macahilig et al. (1988) have reported that even at elevated temperatures, scat fry can tolerate salinities over 40 ppt, an outstanding attribute for a cultured species. It has the ability to tolerate low dissolved oxygen concentrations even less than 2 mg/L and has a large pH tolerance range (Macahilig et al., 1988).”

Climate/Range

From Froese and Pauly (2017):

“Tropical; 32°N - 23°S”

Distribution Outside the United States

Native

From Froese and Pauly (2017):

“Indo-Pacific: Kuwait to Fiji, north to southern Japan, south to New Caledonia. Reported from Samoa [Lieske and Myers 1994], Tonga [Randall et al. 2003], and the Society Islands [Allen 1991].”

According to Froese and Pauly (2019), *S. argus* is native to the following countries: Andaman Islands, Bahrain, Bangladesh, Cambodia, China and Taiwan, India, Indonesia, Iran, Iraq, Japan (including Ryukyu Islands), Kuwait, Malaysia, Myanmar, Oman, Pakistan, Philippines, Qatar, Saudi Arabia, Singapore, South Korea, Sri Lanka, Thailand, Timor-Leste, United Arab Emirates, Vietnam, Australia, Fiji, French Polynesia, Micronesia, New Caledonia, Palau, Papua New Guinea, Samoa, Tahiti, Tonga, and Vanuatu.

Introduced

From Schofield (2017):

“The species has been introduced in Malta (Mediterranean Sea) where it is thought to be established (Zammit and Schembri 2011). The Maltese population is thought to have arrived via aquarium releases, although the fish now appears occasionally in the fishery. Interestingly, the spotted scat had been deemed a low risk for introduction and establishment in Malta, as its habitat requirements were considered a poor match for the area (Zammit and Schembri 2011). The surprising establishment of this species in Malta indicates it may be more flexible with regard to habitat requirements than originally considered.”

From Evans et al. (2015):

"Although Zammit & Schembri (2011) comment that 'all indications point to this species having established a breeding population since at least 2007', it has not been recorded since, leading to doubts as to whether *Scatophagus argus* is still established in Maltese waters."

Means of Introduction Outside the United States

From Schofield (2017):

"The Maltese population is thought to have arrived via aquarium releases, although the fish now appears occasionally in the fishery."

From Zammit and Schembri (2011):

"We speculate that this most likely happened when fish being kept in a home aquarium became too large for the tank and were released into the sea.[…] There is always the possibility that the repeated capture of specimens of *S. argus* [in Malta] is due to multiple releases over time, but this seems unlikely."

Short Description

From Froese and Pauly (2017):

"Dorsal spines (total): 10 - 11; Dorsal soft rays (total): 16-18; Anal spines: 4; Anal soft rays: 13 - 15. Ground color greenish. Juveniles with a few large roundish blotches, about size of eye, or with about 5 or 6 broad, dark, vertical bars. In large adults, spots may be faint and restricted to dorsal part of flanks. Body quadrangular, strongly compressed. Dorsal head profile steep. Eye moderately large, its diameter somewhat smaller than snout length. Snout rounded. Mouth small, horizontal, not protractile. Teeth villiform, in several rows on jaws [Kottelat 2001]."

Biology

From Froese and Pauly (2017):

"Feed on worms, crustaceans, insects and plant matter [Mills and Vevers 1989; Allen et al. 2002; Kuiter and Tonozuka 2001]."

From Zammit and Schembri (2011):

"[…] Barry and Fast (1992) report it to be herbivorous on algae on the basis of stomach content analysis of freshly captured fish, while Ghandi [*sic*] (2002) reports it feeding mainly on multicellular algae and detritus but also opportunistically taking other food including small benthic invertebrates. Wongchinawit and Paphavasit (2009) consider the feeding strategy to change as the fish ages, with the larvae feeding on phytoplankton near the surface, juvenile fish feeding on benthic diatoms, zooplankton, benthic invertebrates and detritus, and the adults being mainly detritivorous and opportunistic predators on benthic invertebrates."

"There do not seem to be any reports of aquarists breeding this fish, a situation attributed to the apparent need of the species for different ambient salinities during ontogeny; it seems that the fry and juveniles live in brackish water (Barry and Fast 1992) but adults need full strength seawater to breed (Hering 2000)."

From Schofield (2017):

"Females mature at about 7-9 months of age and 150 g, while males mature at a smaller size (Barry and Fast 1992). In the Philippines, spawning is triggered by monsoon rains that begin in June and July and bring rainfall, cooler temperatures, increased river outflows and lower salinities (Barry and Fast 1992). Eggs are about 0.7 mm in diameter and are transparent and spherical (Barry and Fast 1992). The larvae hatch about 20 hours after fertilization at a size of 1.8 mm (Chang and Hsieh 1997)."

From Gupta (2016):

"Rainfall, cooler temperatures, and increased river outflows have been documented as the important environmental cues that stimulate final oocyte maturation and spawning in scats, but contradiction exists there with respect to the role of salinity. Barry et al. [1988], Barry and Fast (1992), and Chang et al. (2005) have reported the preference for low salinity while Hering (2000) and Cai et al. (2010) have reported the preference for high salinity for breeding initiation in scats. Thus, further studies are needed to delineate the underlying reasons for this opposing trend."

From Su et al. (2019):

"In the present study, we report the first successful instance of controlled reproduction in *Scatophagus argus*, which has recently emerged as a new aquaculture resource. The controlled reproduction process for *S. argus* was optimized with regard to salinity acclimation. Gonadal maturation was affected by salinity in both sexes. […] Plasma levels of gonadal steroids were higher in fish held at 25‰ salinity. The highest gonadosomatic indices (GSI) […] were also observed at 25‰ salinity. Nevertheless, the optimal salinity for *S. argus* embryonic development and larval culture was 15‰. Thus, the salinity requirement for gonadal maturation and early development are quite different."

Human Uses

From Froese and Pauly (2017):

"Fisheries: minor commercial; aquaculture: commercial; aquarium: commercial. The dorsal, anal and pelvic spines are believed by Philippine fishers to be venomous and capable of inflicting wounds [Herre 1935]. Used in Chinese medicine [Tang 1987]. In Hong Kong live fish markets [Lee and Sandovy 1998]. Marketed as fresh [Rainboth 1996]."

From Schofield (2017):

"Although interest has been shown in aquaculture (Datta et al. 1984; Barry et al. 1993), the species remains of minor commercial importance. It is occasionally sold in local markets on Indo-Pacific islands and in Southeast Asia where it is caught with gill nets and traps (Bianchi 1985; Rainboth 1996; Kottleat [*sic*] 2001). The species is found in the Hong-Kong live-fish market (Lee and Sadovy 1998). It is a delicacy in the Philippines (Barry and Fast 1992). Juveniles are collected for the aquarium trade."

Diseases

Kamilya and Baruah (2014), citing Reantaso (1991), report *S. argus* as susceptible to epizootic ulcerative syndrome. **Epizootic ulcerative syndrome is an OIE-reportable disease (OIE 2019).**

From Froese and Pauly (2019):

"Trichodinosis, Parasitic infestations (protozoa, worms, etc.)
Caligus Infestation 1, Parasitic infestations (protozoa, worms, etc.)
Transversotrema Infestation, Parasitic infestations (protozoa, worms, etc.)
Procerovum Infestation 1, Parasitic infestations (protozoa, worms, etc.)
Amyloodinium Disease, Parasitic infestations (protozoa, worms, etc.)
Waretrema Infestation, Parasitic infestations (protozoa, worms, etc.)
Filisoma Infestation, Parasitic infestations (protozoa, worms, etc.)
Dactylogyrus Gill Flukes Disease, Parasitic infestations (protozoa, worms, etc.)
Bacterial Infections (general), Bacterial diseases
Cauliflower Disease, Viral diseases
Velvet Disease, Parasitic infestations (protozoa, worms, etc.)
Ichthyobodo Infection, Parasitic infestations (protozoa, worms, etc.)
Velvet Disease 2 (*Piscinoodinium* sp.), Parasitic infestations (protozoa, worms, etc.)
Amphileptus Infection, Parasitic infestations (protozoa, worms, etc.)"

Threat to humans

From Froese and Pauly (2017):

"Venomous [Herre 1935]"

3 Impacts of Introductions

From Schofield (2017):

"Unknown"

4 Global Distribution

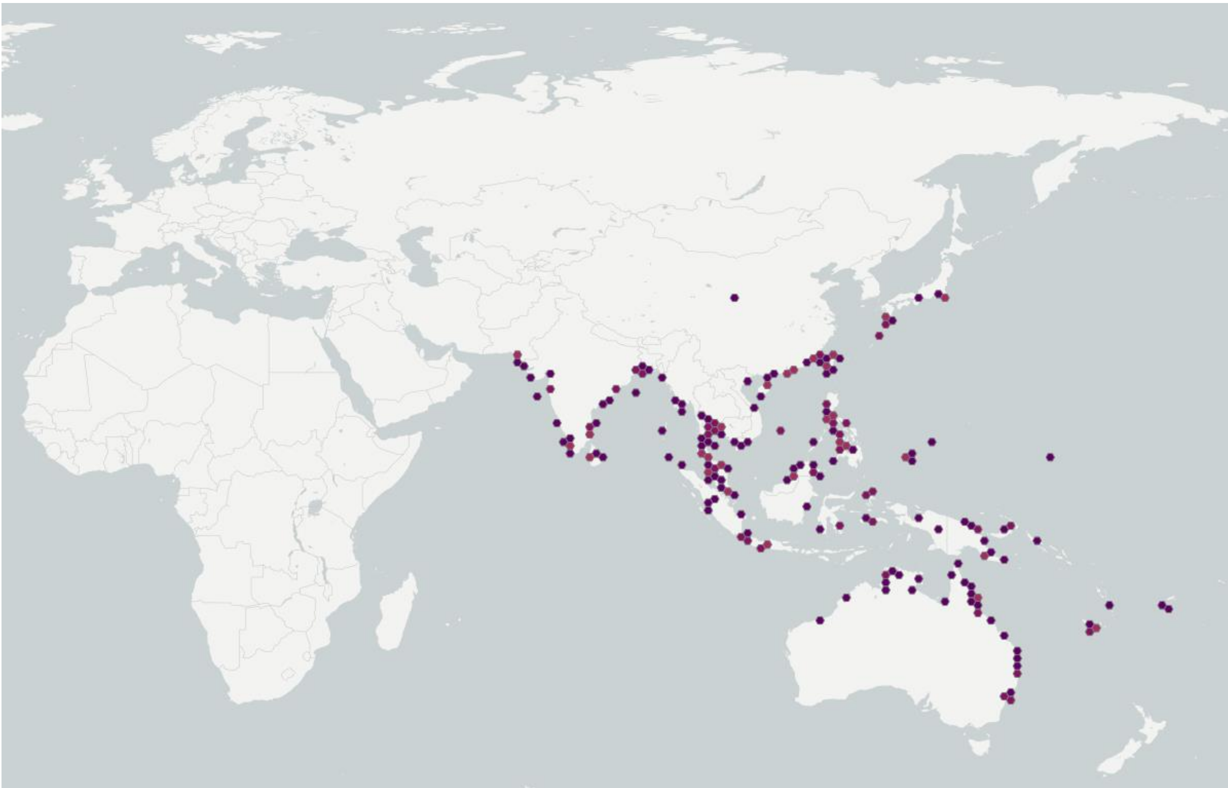

Figure 1. Known global distribution of *Scatophagus argus*, reported from coastal areas of southern and eastern Asia and Oceania. Map from GBIF Secretariat (2019). Locations reported in the United States were excluded from the extent of this map and the climate matching analysis because they do not represent established populations. According to GBIF Secretariat (2019), the occurrence reported in central China does not represent a specific occurrence and was not included in the climate matching analysis. Because the climate matching analysis is not valid for marine waters, no marine occurrences were used in the climate matching analysis. There were no georeferenced occurrences available for the following countries that are part of the species native range: Bahrain, Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia, South Korea, Timor-Leste, United Arab Emirates, French Polynesia, Micronesia, Samoa, Tahiti, and Tonga.

5 Distribution within the United States

Figure 2. Known occurrences of *Scatophagus argus* in the United States. Map from Schofield (2017). None of the mapped occurrences represent established populations and were omitted from the climate matching analysis.

6 Climate Matching

Summary of Climate Matching Analysis

Because *S. argus* is not known to reproduce in freshwater, the climate match presented here refers only to where the species can survive in freshwater and brackish environments and not necessarily to where it can reproduce and establish a viable population.

The climate match (Sanders et al. 2018) was high in southern Florida and parts of Texas. A medium match was found in the Southeast, Mid-Atlantic, lower Midwest, southern Great Plains, and portions of the Desert Southwest. There was a low match across the rest of the contiguous United States. The Climate 6 score for the contiguous United States was 0.068, indicating a medium overall climate match. (Scores between 0.005 and 0.103 are classified as medium.) Individually, six States (Florida, Missouri, North Carolina, Oklahoma, South Carolina, and Texas) had high climate scores and five States (Arkansas, Arizona, Georgia, Kansas, and Virginia) had medium climate scores. All other States had low climate scores.

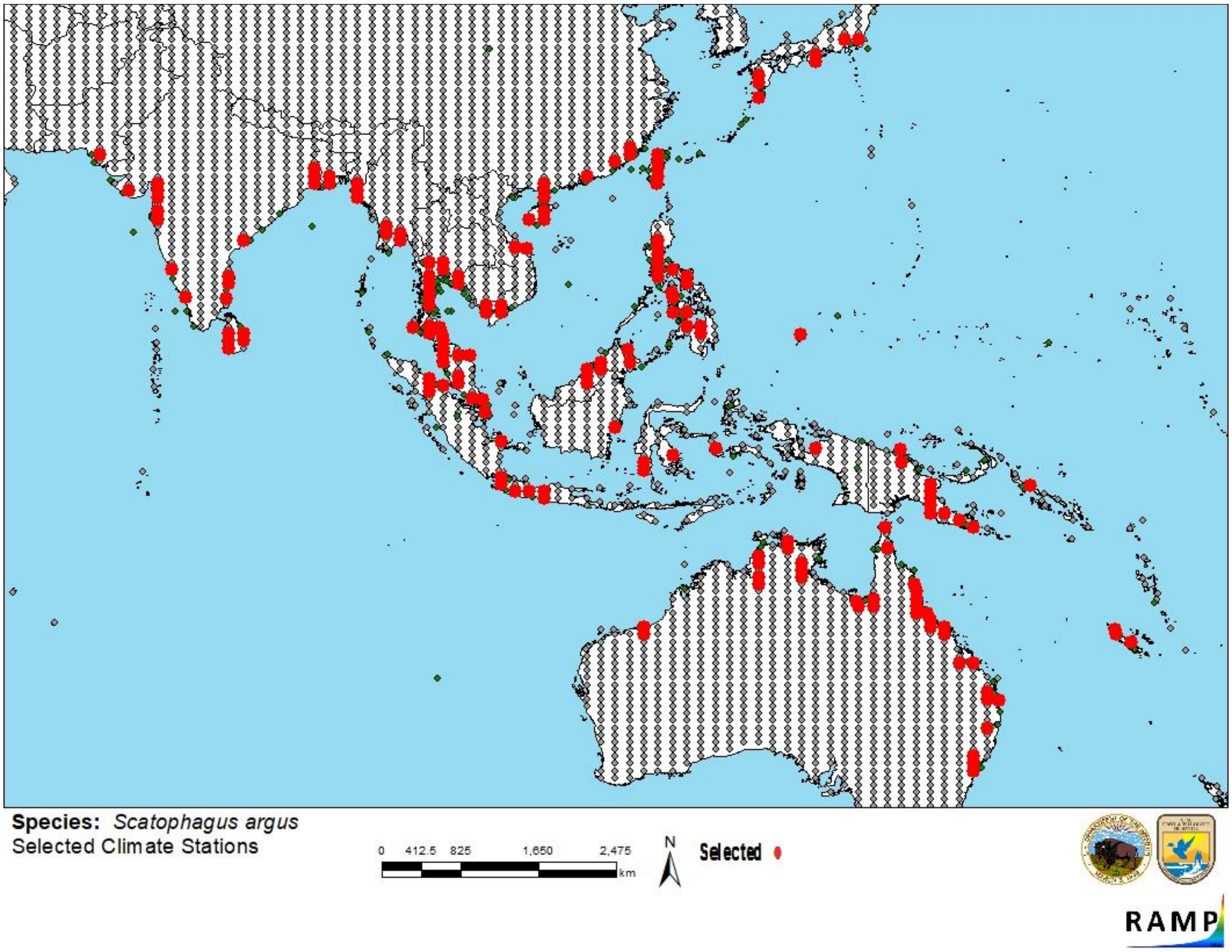

Figure 3. RAMP (Sanders et al. 2018) source map showing weather stations in southeastern Asia and Oceania selected as source locations (red; Pakistan, India, Bangladesh, Myanmar, Thailand, Cambodia, Vietnam, China, Japan, the Philippines, Indonesia, Malaysia, Brunei, Papua New Guinea, Australia, Palau, New Caledonia) and non-source locations (gray) for *Scatophagus argus* climate matching. Source locations from GBIF Secretariat (2019).

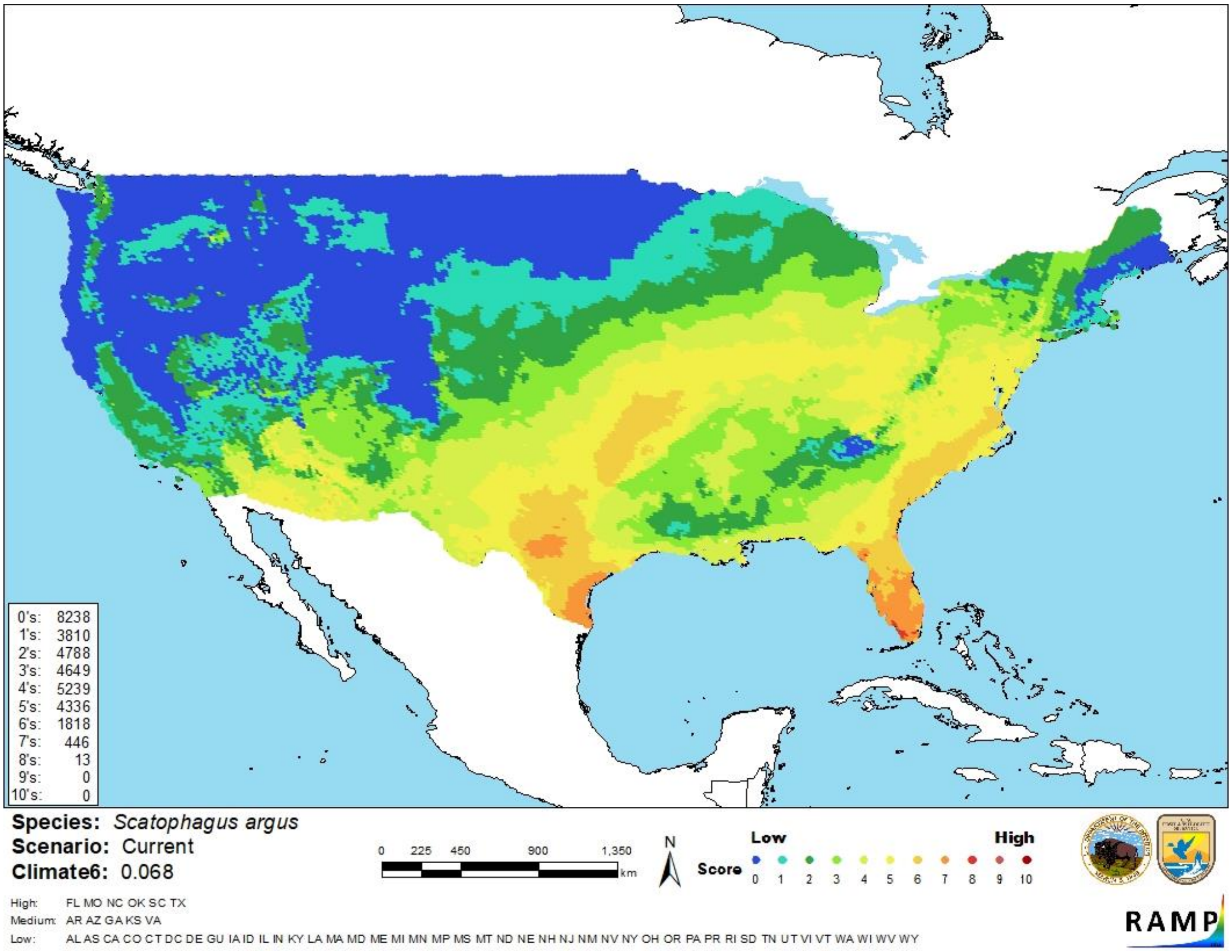

Figure 4. Map of RAMP (Sanders et al. 2018) climate matches for *S. argus* in the contiguous United States based on source locations from GBIF Secretariat (2019). 0= Lowest match, 10= Highest match.

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

Information is available on the biology, ecology, and distribution of *Scatophagus argus*, particularly within its native range. Of the introductions that have occurred outside the native range, establishment has not been confirmed. No information is available on the impacts of these introductions. Furthermore, because this is a euryhaline species that appears to require salt water for at least part of the reproductive cycle, the climate matching analysis applies only to locations where this species can survive in fresh and brackish waters of the contiguous United States, and not necessarily to where the species can establish a population. The certainty of this assessment is low.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Scatophagus argus, Spotted Scat, is a euryhaline fish native to the Indo-Pacific, from the Middle East to Oceania. It inhabits harbors, natural embayments, brackish estuaries and the lower reaches of freshwater streams, frequently occurring among mangroves. It has dorsal, anal and pelvic spines that are venomous and capable of inflicting wounds. *S. argus* is present in the aquarium trade in the United States and internationally, and is also used for human consumption and in Chinese medicine. *S. argus* has known occurrences in the United States at two separate locations in Florida. However, it is not considered established in Florida. Overall climate match with the contiguous United States is medium, with a high match in parts of Florida and Texas. The climate matching analysis applies only to fresh and brackish waters, so it can only predict where the species can survive and not necessarily where it can establish a self-sustaining population. *S. argus* has also been introduced to Malta (Mediterranean Sea), but it is unclear whether that introduction has resulted in establishment. No information is available about impacts from introductions of this species, and history of invasiveness is classified as uncertain. Certainty of this assessment is low. Overall risk posed by *S. argus* is uncertain.

Assessment Elements

- **History of Invasiveness (Sec. 3): Uncertain**
- **Climate Match (Sec. 6): Medium**
- **Certainty of Assessment (Sec. 7): Low**
- **Remarks/Important additional information: Venomous; susceptible to 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.

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10 References Quoted But Not Accessed

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