

Electric Eel (*Electrophorus electricus*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, August 2011

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1 Native Range and Status in the United States

Native Range

From Eschmeyer et al. (2018):

“Distribution: Amazon and Orinoco River basins and other areas in northern Brazil: Brazil, Ecuador, Colombia, Bolivia, French Guiana, Guyana, Peru, Suriname and Venezuela.”

Status in the United States

This species has not been reported as introduced or established in the United States. This species is in trade in the United States.

From AquaScapeOnline (2018):

“Electric Eel 24” (2 feet) (*Electrophorus electricus*) [...] Our Price: \$300.00”

The State of Arizona has listed *Electrophorus electricus* as restricted live wildlife. Restricted live wildlife “means wildlife that cannot be imported, exported, or possessed without a special license or lawful exemption” (Arizona Secretary of State 2006a,b).

The Florida Fish and Wildlife Conservation Commission has listed the electric eel *Electrophorus electricus* as a prohibited species. Prohibited nonnative species, "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 or used for commercial activities” (FFWCC 2018).

The State of Hawaii Plant Industry Division (2006) includes *Electrophorus electricus* on its list of prohibited animals.

From Louisiana House of Representatives Database (2010):

“No person, firm, or corporation shall at any time possess, sell, or cause to be transported into this state by any other person, firm, or corporation, without first obtaining the written permission of the secretary of the Department of Wildlife and Fisheries, any of the following species of fish: freshwater electric eel (*Electrophorus* sp.); [...]”

From Oklahoma Secretary of State (2018):

“ 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: [...] (5) Electric Eel (*Electrophorus electricus*).”

From SCDNR (2010):

“A person may not possess, sell, offer for sale, import, bring, or cause to be brought or imported into this State [of South Carolina] or release into the waters of this State the following fish or eggs of the fish: [...] (2) freshwater electric eel (*Electrophorus electricus*) ;[...]”

From Texas Parks and Wildlife (no date):

“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. [...]

[The list of prohibited nonnative species includes] *Electrophorus electricus*”

Means of Introductions in the United States

No known introductions.

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 Ostariophysi
Order Gymnotiformes
Suborder Gymnotoidei
Family Electrophoridae
Genus *Electrophorus*
Species *Electrophorus electricus* (Linnaeus, 1766)”

“Taxonomic Status: Current Standing: valid”

Size, Weight, and Age Range

From Froese and Pauly (2018):

“Max length : 250 cm SL male/unsexed; [Boujard et al. 1997]; max. published weight: 20.0 kg [Boujard et al. 1997]”

Environment

From Froese and Pauly (2018):

“Freshwater; benthopelagic. [...] 23°C - 28°C [Riehl and Baensch 1991]” (Presumed to be aquarium temperature)

Climate/Range

From Froese and Pauly (2018):

“Tropical”

Distribution Outside the United States

Native

From Eschmeyer et al. (2018):

“Distribution: Amazon and Orinoco River basins and other areas in northern Brazil: Brazil, Ecuador, Colombia, Bolivia, French Guiana, Guyana, Peru, Suriname and Venezuela.”

Introduced

No known introductions.

Means of Introduction Outside the United States

No known introductions.

Short Description

From Froese and Pauly (2018):

“Dorsal spines (total): 0; Dorsal soft rays (total): 0. Body elongated and cylindrical, almost without scales; head flattened; mouth large with one row of conical teeth on each jaw; presence of three abdominal pairs of electric organs; body color dark with anterior ventral part yellowish [Planquette et al. 1996].”

Biology

From Froese and Pauly (2018):

“Prefer muddy bottoms and calm waters; frequently found in coastal plains, swamps and creeks but is also found inland where a favorable biotope exist. Juveniles feed on invertebrates, adults feed on fish and small mammals [Planquette et al. 1996], first-born larvae prey on other eggs and embryos coming from late spawning batches [Assuncao et al. 1995]. The electric organ of this species consists of flattened electrocytes, numbering to about hundreds of thousands, connected in series [Bennett 1971; Møller 1995]. Generates two type of electric organ discharges (EODs) from different electric organs which are of myogenic derivation: 1) low-voltage EODs (about 10 V) emitted by the Sach's organ at rates of up to 25 Hz, and 2) high-voltage EODs (about 50-fold) emitted by the main and Hunter's organs at peak rates of up to several hundred Hz. Low-voltage EOD has been associated with electro location whereas high-voltage EOD has been noted during predatory attacks [Møller 1995]. An EOD of 500 V was recorded from a 1 m specimen [Cox 1938], making it a potentially dangerous species. Incorporation of this species in fish-based house security systems has been suggested [Dunnit and Kneesun-Boompsadaisy 1994]. Also possesses high-frequency sensitive tuberous receptors patchily distributed over the body that seems useful for hunting other gymnotiforms [Westby 1988]. A nocturnal species; captive specimens showed higher low-voltage EOD activity during the night compared to daytime [Møller 1995]. This cycle seems to be free-running (internally controlled) [Halperin 1979]. Probably a fractional spawner; fecundity count was 17,000 eggs [Assuncao et al. 1992]. An obligatory air breather [Møller 1995] and can withstand poorly oxygenated water [Mago-Leccia 1994].”

“Males construct foam nests and guard the growing larvae until mid-January when the first seasonal rains flood the breeding area, causing the about 10 cm long young eels to disperse [Assuncao et al. 1995]. Males outnumber females (3:1) and are considerably larger than females [Assuncao et al. 1995]. There are three successive batches of eggs deposited in a spawning period. Not all eels with fully developed gonads (in Goiapi drainage) participated in the annual spawning activity suggesting that mating success depends in part on finding suitable breeding sites [Assuncao et al. 1995].”

Human Uses

From Froese and Pauly (2018):

“Used in experimental studies.”

“Fisheries: commercial; aquarium: public aquariums”

Diseases

No OIE reportable diseases. No information found.

Threat to Humans

From EOL (2018):

“Depending on circumstances, the shock generated [by *E. electricus*] is potentially strong enough to pose a serious danger even to a large animal such as a human.”

3 Impacts of Introductions

There are no reports of *E. electricus* being introduced in the wild outside of its native range.

The following states have prohibited or restricted importation, sale, or possession of *E. electricus*: Arizona (Arizona Secretary of State 2006b), Florida (FFWCC 2018), Hawaii (State of Hawaii Plant Industry Division 2006), Louisiana (Louisiana House of Representatives Database 2010), Oklahoma (Oklahoma Secretary of State 2018), South Carolina (SCDNR 2010), and Texas (Texas Parks and Wildlife, no date).

4 Global Distribution



Figure 1. Known global distribution of *Electrophorus electricus*, reported from northern South America (French Guiana, Suriname, Guyana, Venezuela, Colombia, Ecuador, Peru, Brazil, Bolivia). Map from GBIF Secretariat (2017).

5 Distribution Within the United States

No known occurrences.

6 Climate Matching

Summary of Climate Matching Analysis

The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for *Electrophorus electricus* in the contiguous United States was 0.003, which is a low score. The range for a low climate match is from 0.0 to 0.005, inclusive. Florida was the only state to record a high score; every other state recorded a low score. Locally, there were high matches in extreme southern Florida, and medium matches in much of the rest of peninsular Florida, coastal Louisiana, coastal Texas, parts of coastal California, and northwestern Washington. The remainder of the contiguous United States showed low matches.

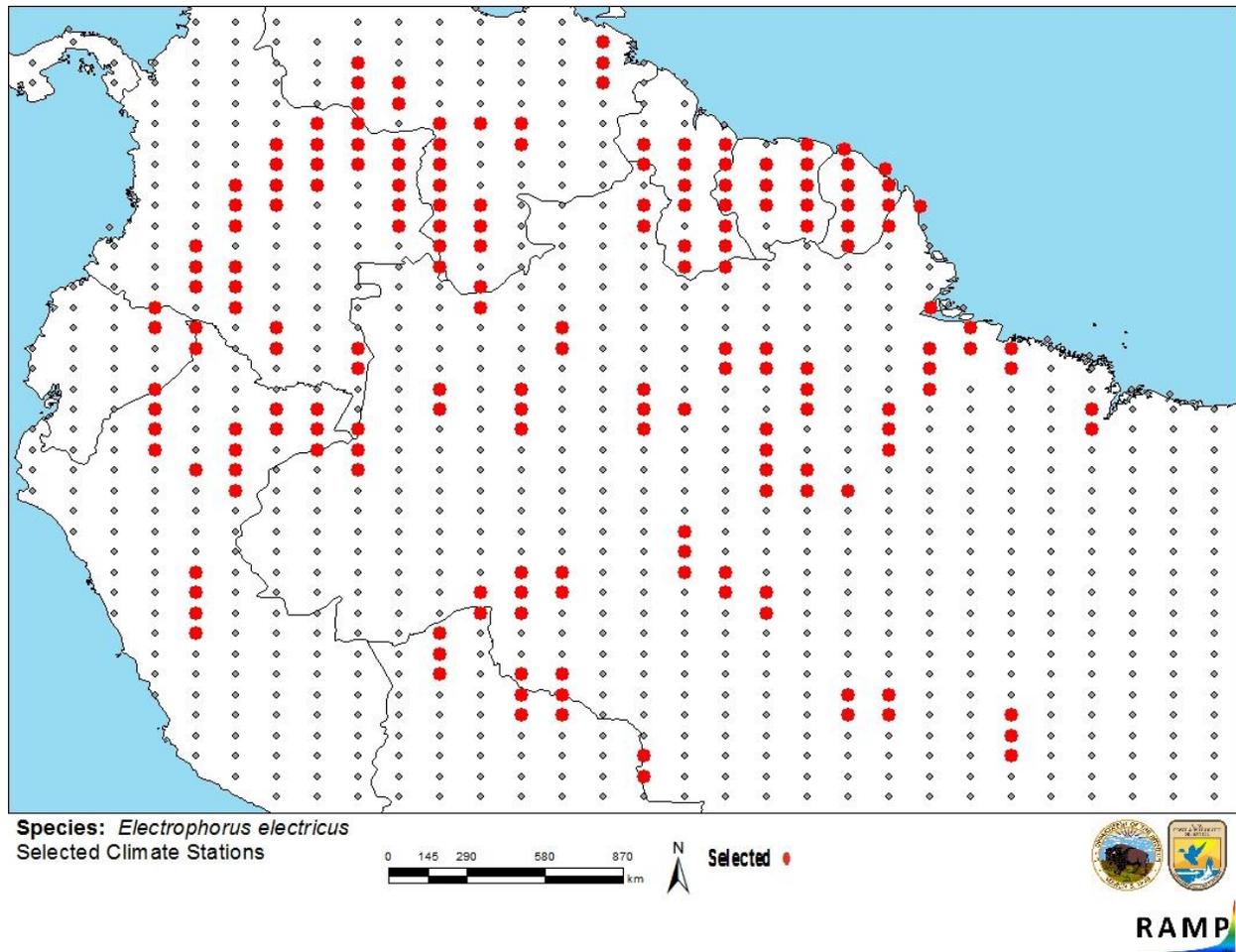


Figure 2. RAMP (Sanders et al. 2018) source map showing weather stations selected as source locations (red; Brazil, Bolivia, Peru, Ecuador, Colombia, Venezuela, Guyana, Suriname and French Guinea) and non-source locations (gray) for *Electrophorus electricus* climate matching. Source locations from GBIF Secretariat (2017).

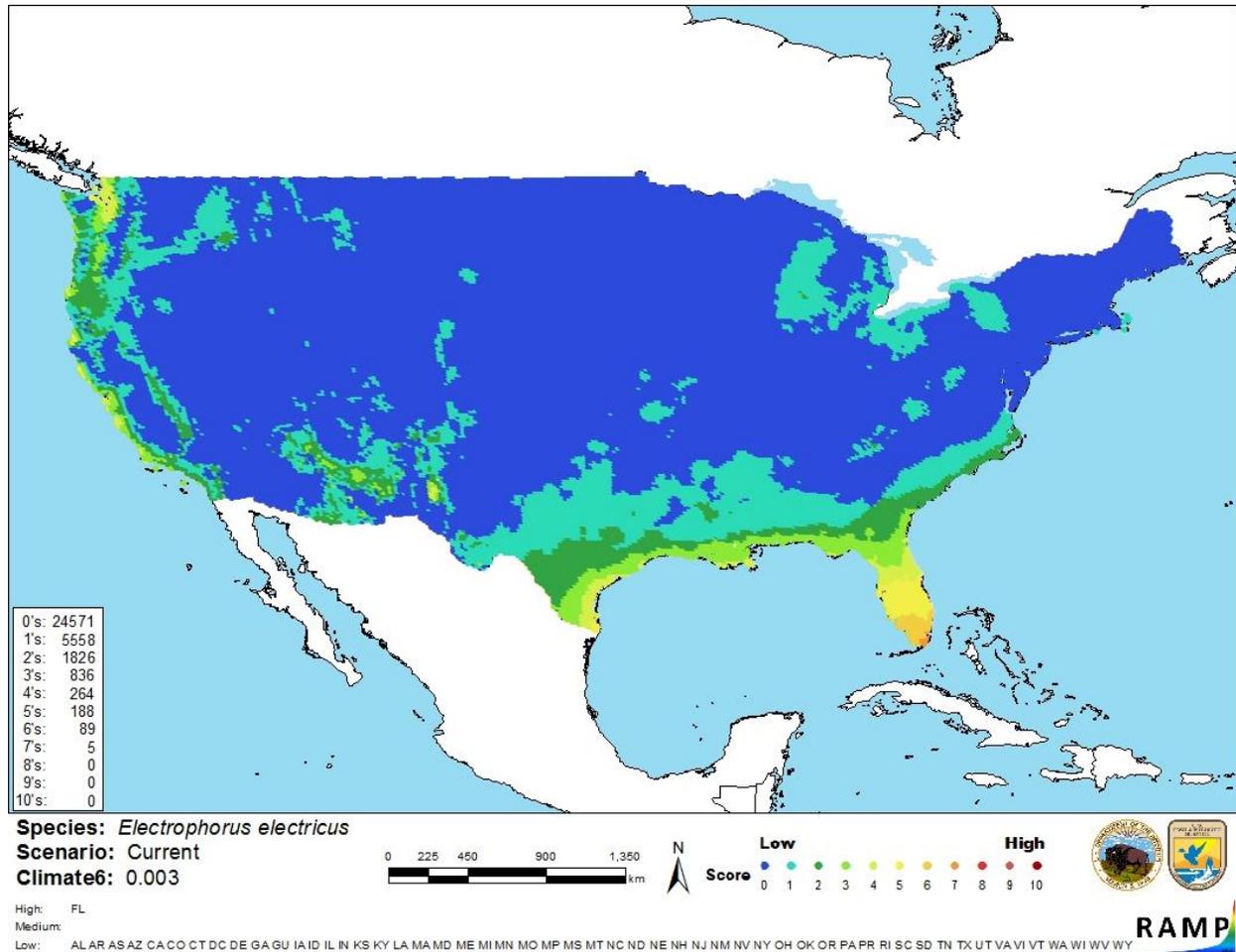


Figure 3. Map of RAMP (Sanders et al. 2018) climate matches for *Electrophorus electricus* in the contiguous United States based on source locations reported by GBIF Secretariat (2017). 0=Lowest match, 10=Highest match.

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

A lot is known about the biology and ecology of *Electrophorus electricus* as it is a commonly studied fish. This fish has not been reported as introduced outside of its native range. No information is available on its potential impacts if it were to be introduced. Due to lack of information, the certainty of assessment is low. More information is needed to increase the certainty of assessment.

8 Risk Assessment

Summary of Risk to the Contiguous United States

The electric eel (*Electrophorus electricus*) is native to the Amazon and Orinoco River basins of Brazil, Bolivia, Peru, Ecuador, Colombia, Venezuela, Guyana, Suriname and French Guinea in South America. *E. electricus* is used in research and public aquariums, and fished commercially for human consumption. Numerous states have prohibited or restricted importation of *Electrophorus electricus*. It has not been reported outside of its native range and therefore no information is available on impacts of introduction. The climate match with the contiguous United States was low overall, but there were local, mostly coastal, areas with medium and high match. The highest match was in southern Florida. Due to lack of introduction history, the certainty of assessment is low, and overall risk for this species is uncertain.

Assessment Elements

- **History of Invasiveness (Sec. 3): Uncertain**
- **Climate Match (Sec. 6): Low**
- **Certainty of Assessment (Sec. 7): Low**
- **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

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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