

Pike Killifish (*Belonesox belizanus*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, February 2011

Revised, February 2018

Web Version, 8/30/2018



Photo: USGS. Available: <https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=843>. (February 2018).

1 Native Range and Status in the United States

Native Range

From Schofield et al. (2018):

“The species is native to the Atlantic slope from Veracruz, Mexico south to the Yucatan, Guatemala and Belize, the Atlantic drainages of Honduras and Guatemala, and to Costa Rica (Rosen and Bailey 1963; Reis et al. 2003; Miller et al. 2005).”

From Froese and Pauly (2018):

“North and Central America: Laguna San Julian, northeast of Ciudad Veracruz in Mexico to Costa Rica. Southern Gulf of Mexico, southern Yucatan and along Central American coast south to Nicaragua [Smith 1997]. Introduced in freshwater in Florida [Smith 1997].”

Status in the United States

From Schofield et al. (2018):

“This species was first documented in Florida in canals in southeastern Dade County in 1957 (Belshe 1961). It is now established or has been taken in canals, ditches, mangrove swamps, and other habitats in Dade, Monroe, and Collier counties, including parts of Everglades National Park and Big Cypress National Preserve (Belshe 1961; Courtenay et al. 1974; Miley 1978; Turner and Snelson 1984; Loftus and Kushlan 1987; Loftus et al. 2004; Lorenz et al. 1997; museum specimens). Established in Florida Panther National Wildlife Refuge (USFWS 2011). A separate population was found in a borrow pit on North Key Largo, Monroe County, Florida, in 1984 (Courtenay and Meffe 1989). A few specimens were taken from a roadside ditch in Hillsborough County, Florida, in 1997 (Nico, unpublished data), and from the Alafia and Hillsborough rivers (D. Roberts, personal communication). A population was found in Texas in a spring run of the San Antonio River, San Antonio, in the early 1960s (Barron 1964), but that population apparently has died out (Hubbs et al. 1978; Howells 1992).”

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

From AquariumFishSale.com (2018):

“Saber Toothed Killi
34.99 [...]
Scientific Name: *Belonesox belizanus*”

Means of Introductions in the United States

From Schofield et al. (2018):

“This species was introduced into south Florida in 1957 when individuals reared for medical research purposes were released into a local canal (Belshe 1961). Those found in Hillsborough County in 1997 were escapees from a nearby ornamental fish farm (Nico, personal communication). The Texas introduction was probably an aquarium release (Howells 1992).”

Remarks

From Schofield et al. (2018):

“The Florida population is descended from stock that is thought to have come from the Yucatan peninsula (Belshe 1961); it is the subspecies *B. b. maxillosus* (Rosen and Bailey 1963; Page and Burr 1991).”

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 Cyprinodontiformes
Suborder Cyprinodontoidei
Family Poeciliidae
Subfamily Poeciliinae
Genus *Belonesox*
Species *Belonesox belizanus* Kner, 1860”

“Taxonomic Status: valid”

Size, Weight, and Age Range

From Froese and Pauly (2018):

“Max length : 20.0 cm TL male/unsexed; [Lucinda 2003]; 15.0 cm TL (female); common length: 9.6 cm TL male/unsexed; [Hugg 1996]”

Environment

From Froese and Pauly (2018):

“Freshwater; brackish; demersal; pH range: 6.0 - 8.0; dH range: 9 - 19; non-migratory.”

From Schofield et al. (2018):

“In Florida, reproduction has been recorded in salinities up to at least 35 parts per thousand (Turner and Snelson 1984). Northward expansion of *B. belizanus* is likely limited by the lower limit of cold temperature tolerance ~9°C (Shafland and Pestrak 1982), but local densities are probably controlled by a variety of physiochemical variables (Kerfoot et al. 2011) and predation.”

Climate/Range

From Froese and Pauly (2018):

“Tropical; 25°C - 37°C [Bussing 1998]; 29°N - 11°N, 100°W - 79°W [Florida Museum of Natural History 2005]”

Distribution Outside the United States

Native

From Schofield et al. (2018):

“The species is native to the Atlantic slope from Veracruz, Mexico south to the Yucatan, Guatemala and Belize, the Atlantic drainages of Honduras and Guatemala, and to Costa Rica (Rosen and Bailey 1963; Reis et al. 2003; Miller et al. 2005).”

From Froese and Pauly (2018):

“North and Central America: Laguna San Julian, northeast of Ciudad Veracruz in Mexico to Costa Rica. Southern Gulf of Mexico, southern Yucatan and along Central American coast south to Nicaragua [Smith 1997]. Introduced in freshwater in Florida [Smith 1997].”

Introduced

This species has not been reported as introduced outside of the United States.

Means of Introduction Outside the United States

This species has not been reported as introduced outside of the United States.

Short Description

From Froese and Pauly (2018):

“Slender, elongate fish with elongate jaws forming a prominent pointed beak. Scales very small and numerous [Smith 1997].”

Biology

From Froese and Pauly (2018):

“Occurs in weedy canals and tolerates poorly oxygenated waters and salinity to 40 ppt. Occurrence in saline (34-37 ppt.) water in Florida seems to be a case of local acclimatization. Formerly used in medical research. Total length 14 cm [Smith 1997]. Mostly freshwater, sometimes brackish [Smith 1997]. Piscivore [Hassan-Williams et al. 2007].”

From Schofield et al. (2018):

“Most females larger than 75 mm SL and males larger than 55 mm SL are sexually mature. Average brood size is approximately 99, and larger females tend to have larger broods (up to

about 320). In south Florida, reproduction continues year-round, and females are able to store viable sperm for several months [...] The young are remarkably precocial; within one day of their birth, they pursue, capture, and eat prey. Adults are primarily piscivorous, and in south Florida eat mosquitofish, mollies, and other pike killifishes as their primary diet (Turner and Snelson 1984).”

Human Uses

From Froese and Pauly (2018):

“Aquarium: commercial”

Diseases

From CABI (2018):

“*B. belizanus* has been found to host the parasites *Ascocotyle leighi* (Trematoda) (Hoffman, 1967) and *Salsuginus neotropicalis* (Mendoza-Franco and Vidal-Martínez, 2001).”

Threat to Humans

From Froese and Pauly (2018):

“Harmless”

3 Impacts of Introductions

From Schofield et al. (2018):

“The pike killifish is a piscivore that has been reported to reduce populations of eastern mosquitofish *Gambusia holbrooki* and other native poeciliid and cyprinodontoid populations in areas where it has been introduced (Belshe 1961; Courtenay and Meffe 1989; Greenwood 2012), and potentially competing for food resources with juvenile snook. Harms and Turingan (2012) found that pike killifish will consume shrimp in addition to fish, and suggest that this dietary flexibility has contributed to invasion success in south Florida.”

From CABI (2018):

“*B. belizanus* is a piscivore that has been reported to reduce populations of *Gambusia holbrooki* and other native poeciliid and cyprinodontoid populations, and [sic] well as decapod crustaceans (Belshe 1961; Greenwood 2012; Harms and Turingan, 2012; Texas State University 2014).”

“Hensley and Courtenay (1980) considered *B. belizanus* to be in trophic competition with native piscivores *Micropterus salmoides* (largemouth bass) and *Lepomis gulosus* (warmouth). Miley (1978) found an 84% dietary overlap between *B. belizanus* and the Florida largemouth bass, *Micropterus floridanus*, with the predominant diet taxa consisting of fish and decapod crustaceans.”

“In Tampa Bay, Florida, three resident nonmigratory or potamodromous small-bodied species (*Poecilia latipinna*, *Gambusia holbrooki* and *Cyprinodon variegatus*) were 2-6 times less abundant or frequently occurring in the presence of, or after invasion by, *B. belizanus*. However, migratory species showed little evidence of negative effects, most probably because these species recruit from larger source populations and are not year-round residents of *B. belizanus* habitat (Greenwood, 2012).”

“*B. belizanus* seriously impairs the natural control of mosquitoes in southern Florida by preying on *Gambusia* sp. and other native poeciliids and cyprinodontoid fishes that would otherwise eat mosquito larvae and pupae (Belshe, 1961; Greenwood, 2012; Texas State University, 2014).”

“However, due the temperature restrictions of suitable habitat in northern Florida and elsewhere in the USA, it is reasonable to conclude that *B. belizanus* may remain restricted to southern Florida. Given these inconsistencies, certainty of this assessment is medium.”

“Although a number of studies have considered the potential environmental impacts of introduced populations of *B. belizanus*, the specific mechanisms and/or ecological impacts need to be more closely examined.”

4 Global Distribution



Figure 1. Known global occurrences of *Belonesox belizanus*, reported from the United States, Mexico, and several countries in Central America. Map from GBIF Secretariat (2017).

5 Distribution Within the United States



Figure 2. Distribution map of *Belonesox belizanus* within the contiguous United States. Established populations (found only in Florida) are represented by yellow diamonds and were included in the climate match analysis. Other known occurrences are represented by orange diamonds and were omitted in the climate match analysis. Map from Schofield et al. (2018).

6 Climate Matching

Summary of Climate Matching Analysis

The climate match (Sanders et al. 2014; 16 climate variables; Euclidean distance) was medium for the contiguous United States, with a Climate 6 score of 0.024. Scores of 0.005 to 0.103 indicate a medium climate match. Climate match was highest in Florida and a small portion of southern Georgia. South Carolina and Texas represent a medium match, while all other locations within the contiguous United States are low.

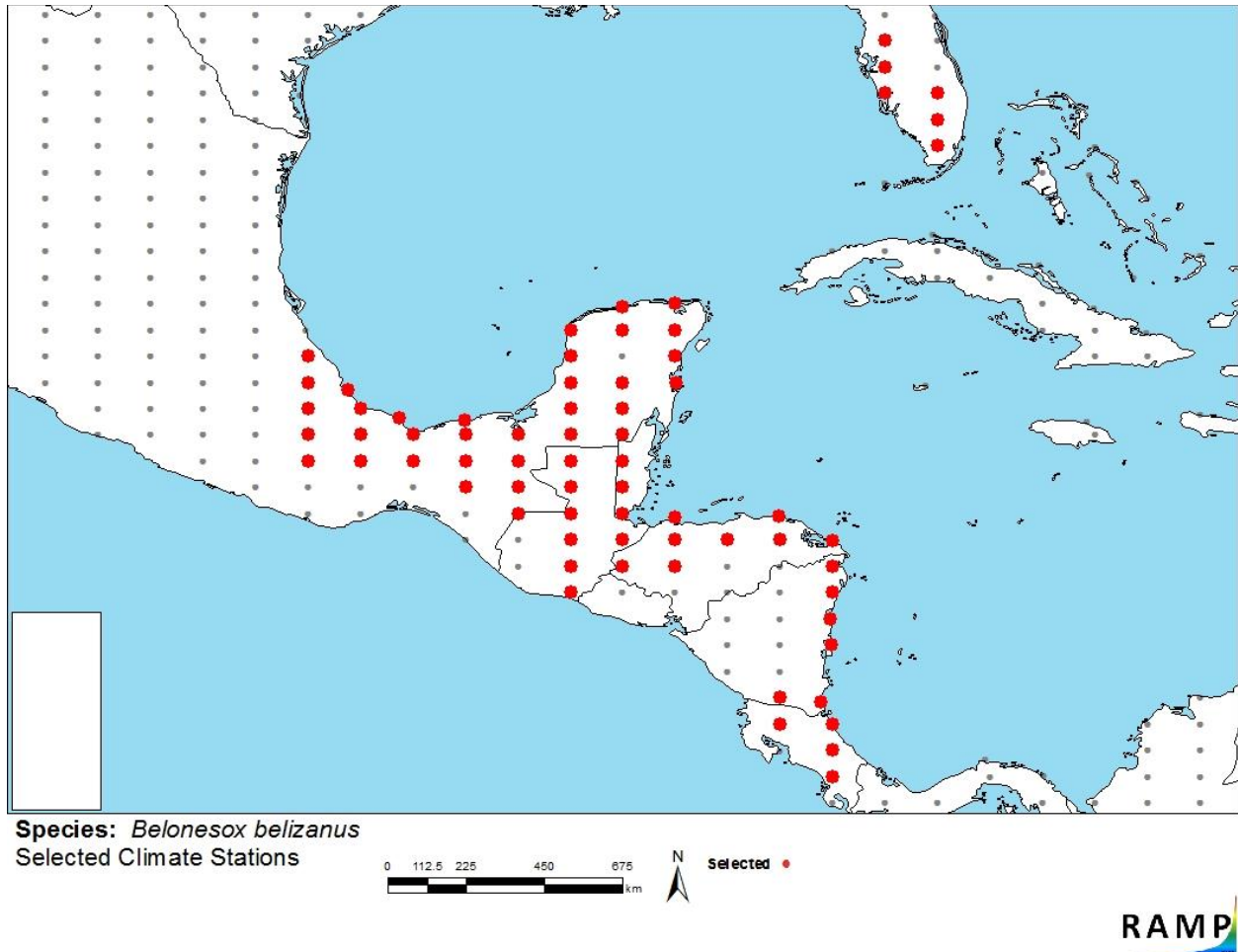


Figure 3. RAMP (Sanders et al. 2014) source map showing weather stations in Florida and Central America selected as source locations (red; Florida (U.S.), Mexico, Belize, Guatemala, Honduras, Nicaragua, Costa Rica) and non-source locations (gray) for *B. belizanus* climate matching.

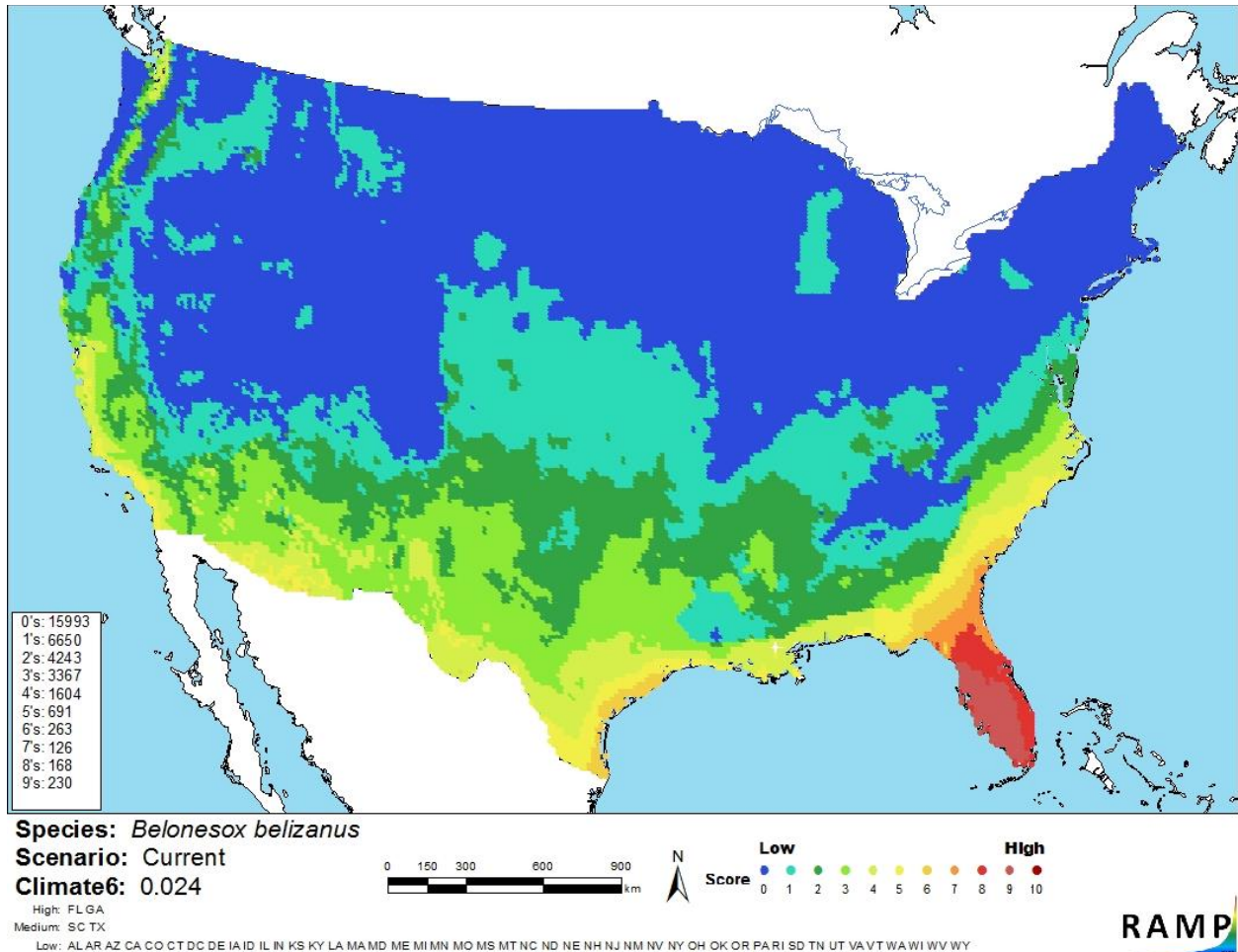


Figure 4. Map of RAMP (Sanders et al. 2014) climate matches for *Belonesox belizanus* in the contiguous United States based on source locations reported by GBIF Secretariat (2017). 0=Lowest match, 10=Highest match. Counts of climate match scores are tabulated on the left.

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

A considerable amount of information on the biology, ecology, and distribution of *Belonesox belizanus* is available for review. Historically, this species was introduced and established in Texas and Florida. Today, the Texas population is extirpated, while several populations still thrive within Florida. While their presence has had negative impacts in Florida, “the specific mechanisms and/or ecological impacts need to be more closely examined” (CABI 2018). Also,

environmental tolerances may limit spread of *B. belizanus* beyond Florida. Given all factors, the certainty of assessment is medium.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Belonesox belizanus, commonly known as the pike killifish, is a freshwater species native to Central America. This piscivorous species prefers the surface waters of slow-flowing freshwater systems where it can feed on poeciliid and cyprinodontoid populations, but is euryhaline and can thrive in brackish environments. Introductions into south Florida waters included specimens released from medical research facilities, escapees from aquaculture farms, and aquarium releases. *B. belizanus* now thrives in several water systems within southern Florida. These populations have negatively impacted native poeciliid and cyprinodontoid abundances, which has also seriously impaired the natural control of mosquitoes in southern Florida. Climate match within the contiguous United States was medium, with Florida and southern Georgia representing high match areas. However, “due to the temperature restrictions of suitable habitat in northern Florida and elsewhere in the USA, it is reasonable to conclude that *B. belizanus* may remain restricted to southern Florida” (CABI 2018). Given the history of negative impacts of introduction and the medium overall climate match to the contiguous United States, the overall risk assessment category for *B. belizanus* is high.

Assessment Elements

- **History of Invasiveness (Sec. 3): High**
- **Climate Match (Sec. 6): Medium**
- **Certainty of Assessment (Sec. 7): Medium**
- **Remarks/Important additional information: Carrier of *Ascocotyle leighi* and *Salsuginus neotropicalis*.**
- **Overall Risk Assessment Category: High**

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.

AquariumFishSale.com. 2018. Saber toothed killi. AquariumFish, Reno, Nevada. Available: <https://www.aquariumfishsale.com/products/saber-toothed-killi>. (August 2018).

CABI. 2018. *Belonesox belizanus* [original text by M. Madden]. *In* Invasive Species Compendium. CAB International, Wallingford, U.K. Available: <https://www.cabi.org/isc/datasheet/91274>. (February 2018).

Froese, R., and D. Pauly, editors. 2018. *Belonesox belizanus* Kner, 1860. FishBase. Available: <http://www.fishbase.org/summary/Belonesox-belizanus.html>. (February 2018).

GBIF Secretariat. 2017. GBIF backbone taxonomy: *Belonesox belizanus* Kner, 1860. Available: <https://www.gbif.org/species/2350149>. (February 2018).

ITIS (Integrated Taxonomic Information System). 2018. *Belonesox belizanus* Kner, 1860. Integrated Taxonomic Information System, Reston, Virginia. Available: https://it.is.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=165913#null. (February 2018).

Sanders, S., C. Castiglione, and M. H. Hoff. 2014. Risk Assessment Mapping Program: RAMP. U.S. Fish and Wildlife Service.

Schofield, P. J., L. Nico, and M. Neilson. 2018. *Belonesox belizanus* Kner, 1860. U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, Florida. Available: <https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=843>. (February 2018).

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.

Barron, J. L. 1964. Reproduction and apparent over-winter survival of the sucker-mouth armoured catfish, *Plecostomus* sp., in the headwaters of the San Antonio River. Texas Journal of Science 16:449.

Belshe, J. F. 1961. Observations of an introduced tropical fish (*Belonesox belizanus*) in southern Florida. Master's thesis. University of Miami, Coral Gables, Florida.

Bussing, W. A. 1998. Freshwater fishes of Costa Rica, second edition. Editorial de la Universidad de Costa Rica, San José, Costa Rica.

Courtenay, W. R., Jr., and G. K. Meffe. 1989. Small fishes in strange places: a review of introduced poeciliids. Pages 319-331 in G. K. Meffe, and F. F. Snelson, Jr., editors. Ecology and evolution of livebearing fishes (Poeciliidae). Prentice Hall, Englewood Cliffs, New Jersey.

Courtenay, W. R., Jr., H. F. Sahlman, W. W. Miley, II, and D. J. Herrema. 1974. Exotic fishes in fresh and brackish waters of Florida. Biological Conservation 6:292-302.

Florida Museum of Natural History. 2005. Biological profiles: pike killifish. Ichthyology at the Florida Museum of Natural History: Education-Biological Profiles. FLMNH, University of Florida, Gainesville, Florida. Available: www.flmnh.ufl.edu/fish/Gallery/Descript/PikeKillifish/PikeKillifish.html. (August 2005).

- Greenwood, M. F. D. 2012. Assessing effects of the nonindigenous pike killifish on indigenous fishes in Tampa Bay, Florida, using a weighted-evidence approach. *Transactions of the American Fisheries Society* 141:84-99.
- Harms, C. A., and R. G. Turingan. 2012. Dietary flexibility despite behavioral stereotypy contributes to successful invasion of the pike killifish, *Belonesox belizanus*, in Florida, USA. *Aquatic Invasions* 7(4):547-553.
- Hassan-Williams, C., T. H. Bonner and C. Thomas (photographer). 2007. Texas freshwater fishes. Biology Department/ Aquatic Station, Texas State University-San Marcos, Texas.
- Hensley D. A., and W. R. Courtenay. 1980. *Belonesox belizanus* (Kner) Pike Killifish. In D. S. Lee, editors. *Atlas of North American Freshwater fishes*. North Carolina Museum of Natural Sciences, Raleigh, North Carolina.
- Hoffman G. L. 1967. *Parasites of North American freshwater fishes*. University of California Press, Berkeley, California.
- Howells, R. G. 1992. Annotated list of introduced non-native fishes, mollusks, crustaceans and aquatic plants in Texas waters. Texas Parks and Wildlife Department, Management Data Series 78, Austin, Texas.
- Hubbs, C., T. Lucier, G. P. Garrett, R. J. Edwards, S. M. Dean, E. Marsh, and D. Belk. 1978. Survival and abundance of introduced fishes near San Antonio, Texas. *Texas Journal of Science* 30:369-376.
- Hugg, D. O. 1996. MAPFISH georeferenced mapping database. Freshwater and estuarine fishes of North America. Life Science Software, Edgewater, Maryland.
- Kerfoot, J. R. Jr., J. J. Lorenz, and R. G. Turingan. 2011. Environmental correlates of the abundance and distribution of *Belonesox belizanus* in a novel environment. *Environmental Biology of Fishes* 92:125-139.
- Loftus, W. F., and J. A. Kushlan. 1987. Freshwater fishes of southern Florida. *Bulletin of the Florida State Museum of Biological Science* 31:147-344.
- Loftus, W. F., G. Ellis, M. Zokan, and J. Lorenz. 2004. Inventory of freshwater fish species within the Big Cypress National Preserve: the basis for a long-term sampling program. U.S. Geological Survey fact sheet 2004-3131.
- Lorenz, J. J., C. C. McIvor, G. V. N. Powell, and P. C. Frederich. 1997. A drop net and removable walkway for sampling fishes over wetland surfaces. *Wetlands* 17:346-359.
- Lucinda, P. H. F. 2003. Poeciliidae (livebearers). Pages 555-581 in R. E. Reis, S. O. Kullander, and C. J. Ferraris, Jr., editors. *Checklist of the Freshwater Fishes of South and Central America*. EDIPUCRS, Porto Alegre, Brazil.

- Mendoza-Franco, E. F., V. M. Vidal-Martínez. 2001. *Salsuginus neotropicalis* n. sp. (Monogenea: Ancyrocephalinae) from the pike killifish *Belonesox belizanus* (Atheriniformes: Poeciliidae) from southeastern Mexico. *Systematic Parasitology* 48(1):41-45.
- Miley, W. W. 1978. Ecological impact of the pike killifish, *Belonesox belizanus* Kner (Poeciliidae), in southern Florida. Master's thesis. Florida Atlantic University, Boca Raton, Florida.
- Miller, R. R., W. L. Minckley, and S. M. Norris. 2005. *Freshwater fishes of Mexico*. The University of Chicago Press, Chicago.
- Page, L. M., and B. M. Burr. 1991. *A field guide to freshwater fishes of North America north of Mexico*. The Peterson Field Guide Series, volume 42. Houghton Mifflin Company, Boston.
- Reis, R. E., S. O. Kullander, and C. J. Ferrais, Jr. 2003. Check list of the freshwater fishes of South and Central America. Museu de Ciências e Tecnologia, Pontifícia Universidade Católica do Rio Grande do Sul. EDIPUCRS, Porto Alegre, Brazil.
- Rosen, D. E., and R. M. Bailey. 1963. The poeciliid fishes (Cyprinodontiformes), their structure, zoogeography, and systematics. *Bulletin of the American Museum of Natural History* 126:1-176.
- Shafland, P. L., and J. M. Pestrak. 1982. Lower lethal temperatures for fourteen non-native fishes in Florida. *Environmental Biology of Fishes* 7(2):149-156.
- Smith, C. L. 1997. *National Audubon Society field guide to tropical marine fishes of the Caribbean, the Gulf of Mexico, Florida, the Bahamas, and Bermuda*. Alfred A. Knopf, Inc., New York.
- Texas State University. 2014. *Belonesox belizanus* pike killifish. Texas State University, Texas. Available: <http://txstate.fishesoftexas.org/belonesox%20belizanus.htm>. (December 2014).
- Turner, J. S., and F. F. Snelson, Jr. 1984. Population structure, reproduction and laboratory behavior of the introduced *Belonesox belizanus* (Poeciliidae) in Florida. *Environmental Biology of Fishes* 10:89-100.
- USFWS. 2011. U.S. Fish and Wildlife National Wildlife Refuge System Invasive Species Survey Information. Available: <http://www.nwrinvasives.com/index.asp>. (July 2011).