

Fourspine Stickleback (*Apeltes quadracus*)

Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, October 2012
Revised, February 2019
Web Version, 7/19/2019



Photo: Graham Hegeman Wikimedia Commons. Licensed under Creative Commons Attribution-Share Alike 4.0 International License. Available: https://commons.wikimedia.org/wiki/File:Fourspine_Stickleback-_Apeltes_quadracus.jpg. (February 4th, 2019).

1 Native Range and Status in the United States

Native Range

From Froese and Pauly (2019):

“Western Atlantic: Gulf of St. Lawrence in Canada to North Carolina, USA. Mainly a near-shore marine species, but far inland populations occur in lakes in Nova Scotia in Canada and in Hudson, Delaware and Susquehanna River drainages [Page and Burr 1991].”

From McCleave et al. (2018):

“*Apeltes quadracus* (fourspine stickleback) ranges from southeastern Labrador (Wroblewski et al. 2007) and western Newfoundland (Melanson and Campbell 2012) to estuaries in southern Chesapeake Bay, Virginia and Maryland (Orth and Heck 1980; Weinstein and Brooks 1983) and the eastern shore of Maryland and Virginia (Murphy and Secor 2006; Love et al. 2009)”

NatureServe (2019) lists *Apeltes quadracus* (in the United States) as native to Connecticut, Washington D.C., Delaware, Massachusetts, Maryland, Maine, North Carolina, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Virginia.

NatureServe (2019) lists *Apeltes quadracus* (in Canada) as native to New Brunswick, Nova Scotia, Newfoundland, Prince Edward Island, and Quebec.

Status in the United States

From Froese and Pauly (2019):

“Western Atlantic: Gulf of St. Lawrence in Canada to North Carolina, USA. [...] far inland populations occur in lakes in Nova Scotia in Canada and in Hudson, Delaware, and Susquehanna River Drainages [northeastern United States] [Page and Burr 1991].”

NatureServe (2019) lists *Apeltes quadracus* as native to Connecticut, Washington D.C., Delaware, Massachusetts, Maryland, Maine, North Carolina, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Virginia.

Fuller et al. (2019) list *Apeltes quadracus* as nonindigenous in Alabama, Minnesota, New Jersey, and Pennsylvania.

Mahon et al. (2014) list *Apeltes quadracus* as an established non-native species to the Great Lakes basin.

From NatureServe (2019):

“It has been introduced in the Great Swamp in New Jersey; current status is unknown (Fuller et al. 1999). The species has been introduced and apparently is established in the Susquehanna River drainage in Pennsylvania, but possibly the species is native there (see Fuller et al. 1999).”

Means of Introductions in the United States

From Kelly (2007):

“The only non-Eurasian species likely introduced to the Great Lakes in ship-ballast were of North-West Atlantic origin. Both species, *G. tigrinus* and *A. quadracus*, were likely introduced from the Gulf of St. Lawrence.”

From NatureServe (2019):

“It has been introduced in the Great Swamp in New Jersey; current status is unknown (Fuller et al. 1999). Susquehanna River drainage in Pennsylvania, but possibly the species is native there (see Fuller et al. 1999).”

From Fuller et al. (2019):

“Shipping and ballast water (USEPA 2008).”

From Fuller et al. (2019):

“Bait shops in Alabama were found to be selling stickleback mixed in with fathead minnows at the time the specimens were collected (N. Nichols, pers. comm.).”

Mahon et al. (2014) list baitfish release as a potential means of introduction for *Apeltes quadracus*.

From Hatch (2015):

“They [*Apeltes quadracus*] almost certainly arrived by way of ballast water.”

Remarks

A previous version of this ERSS was published in October 2012.

Information for this assessment was search for using the valid name *Apeltes quadracus* and the synonym *Gasterosteus quadracus*.

Apeltes quadracus can survive in fresh, brackish, and marine waters. The conclusions of this ERSS are valid for only fresh and brackish water areas.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From Fricke et al. (2019):

“**Current status:** Valid as *Apeltes quadracus* (Mitchill 1815).”

From ITIS (2019):

“Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata

Infraphylum Gnathostomata
Superclass Actinopterygii
Class Teleostei
Superorder Acanthopterygii
Order Gasterosteiformes
Suborder Gasterosteoidi
Family Gasterosteidae
Genus *Apeltes*
Species *Apeltes quadracus* (Mitchill, 1815)”

Size, Weight, and Age Range

From Froese and Pauly (2019):

“Max length : 6.4 cm TL male/unsexed; [Page and Burr 1991]; common length : 4.1 cm TL male/unsexed; [Hugg 1996]; max. reported age: 3 years [Hugg 1996]”

From Rowland (1974):

“The mean total length of males in this study was 36.1 mm (range 29-38 mm, n = 55). [...] The female specimens of *A. quadracus* averaged 41.6 m (range 37-51, n = 46).”

From Schwartz (1965):

“Males, 24.0-41.4 mm total length, have a one calendar year life span.”

“Females 20.0-57.6 mm total length possess a 2-3 calendar year life span.”

Environment

From Froese and Pauly (2019):

“Marine; freshwater; brackish; benthopelagic; depth range 0 - 3 m [Sargent et al. 2008]. [...]; 4°C - 20°C [assumed recommended aquarium temperature] [Baensch and Riehl 1991]; [...]”

From Fuller et al. (2019):

“Fourspine stickleback also has the widest range of salinity tolerance of any North American species of stickleback (Holm and Hamilton 1988).”

From Audet et al. (1985):

“*Apeltes quadracus*, is found principally in salt or brackish water.”

Heck et al. (1989) shows *Apeltes quadracus* is commonly found in eelgrass beds.

Climate/Range

From Froese and Pauly (2019):

“Temperate; [...]; 51°N - 35°N”

Distribution Outside the United States

Native

Part of the native range is in the United States. Please see Section 1, above, for a full description.

From Froese and Pauly (2019):

“Western Atlantic: Gulf of St. Lawrence in Canada [...]. Mainly a near-shore marine species, but far inland populations occur in lakes in Nova Scotia in Canada.”

NatureServe (2019) lists *Apeltes quadracus* as native to New Brunswick, Nova Scotia, Newfoundland, Prince Edward Island, and Quebec.

From McCleave et al. (2018):

“*Apeltes quadracus* (fourspine stickleback) ranges from southeastern Labrador (Wroblewski et al. 2007) and western Newfoundland (Melanson and Campbell 2012) [...].”

Introduced

From NatureServe (2019):

“Records from Thunder Bay, Lake Superior; [...] (Holm and Hamilton 1988, Stephenson and Momot 2000). This species also has been recorded from a freshwater lake on the Avalon Peninsula, Newfoundland, where possibly introduced (Campbell 1992).”

NatureServe (2019) lists *Apeltes quadracus* as exotic in Ontario, Canada.

Froese and Pauly (2019) report that *A. quadracus* is established in the Laurentian Great Lakes (including Lake Superior).

From Fuller et al. (2019):

“In 1995, *Apeltes* were also taken from the Black and Nipigon Rivers [Canada] (Stephenson and Momot 2000).”

Means of Introduction Outside the United States

From Fuller et al. (2019):

“In 1986, an introduced population was discovered on the Canadian side of Lake Superior in Thunder Bay; the suggested means of introduction in that case was ballast water (Holm and Hamilton 1988).”

From NatureServe (2019):

“Records from Thunder Bay, Lake Superior; probably are based on fishes introduced in bilge discharge from a sea-faring ship (Holm and Hamilton 1988, Stephenson and Momot 2000).”

Short Description

From Fuller et al. (2019):

“The fourspine stickleback has a bony ridge on each side of the abdomen, making it triangular in cross-section, with flat belly and sharp back; it is fusiform from the side view, tapering to a pointed nose and to a slim caudal peduncle. There are two to four free dorsal spines standing close one behind the other, inclining alternately to one side or the other; another spine is attached to the dorsal fin by the fin membrane; the anal fin is similarly preceded by an attached spine, and each ventral fin is represented by a stouter curved spine, strongly saw-edged, followed by about two slender rays. The dorsal fin stands over the anal as in the nine-spined species, but both these fins are more rounded in outline, while the caudal fin is relatively longer and narrower than in any of our other stickleback species.”

From Rowland (1974):

“The male *A. quadracus* possesses red pelvic fins and a body color varying from light tan to olive brown, with darker blotches dorsally and with a ventral region of a light silvery cream color.”

“Reproductive females were somewhat darker than males, possessed white pelvic fins and showed the gravid abdomen common to all ripe female sticklebacks.”

From Krueger (1961):

“A typical or modal fourspine stickleback has 32 vertebrae, 12 dorsal rays, nine anal rays, and four dorsal spines, with one spine attached to the anterior edge of the soft dorsal fin and three free spines in front.”

From Rowland (1998):

“Reproductive male fourspine stickleback, *Apeltes quadracus*, possess red pelvic spines which they raise and lower during courtship and agonistic encounters (Rowland 1974, Willmott & Foster 1995).”

Biology

From Froese and Pauly (2019):

“Adults occur mainly along weedy bays and backwaters, entering brackish water and to a limited extent, fresh water [Robins et al. 1991]. Feed along the bottom, primarily on diatoms, worms and

crustaceans by sucking in the prey with a pipetting action [Murdy et al. 1997]. Males build, guard and aerate the nest where the eggs are deposited [Breder and Rosen 1966].”

From NatureServe (2019):

“Spawns in late spring and early summer. Males have a one-year lifespan. Some females live through 2nd winter to spawn the following season. Male aerates and guards eggs.”

“This stickleback generally occurs in quiet vegetated marine and estuarine waters. It can be abundant in grass flats in summer and channels in winter. It has a greater range of salinity tolerance than other North American sticklebacks. Occasionally it is found in freshwater lakes. Eggs are deposited in a plant-material nest constructed by the male in shallow water.”

“Eats mainly planktonic plants and animals in eastern Canada (Scott and Crossman 1973). Freshwater population ate chironomid and ephemeropteran larvae, and cladocerans (Lee et al. 1980).”

“Bay/sound, Lagoon, River mouth/tidal river.”

From Fuller et al. (2019):

“The fourspine stickleback can be found in fresh and brackish water from 0 to 3 m deep. Adults inhabit weedy bays and backwaters (Delbeek and Williams, 1988).”

“*Apeltes quadracus* often live sympatrically with other species of stickleback throughout their native range, though they are generally solitary with regard to other members of their own species. Individuals are often observed perched among bottom debris and vegetation, never in open water, hovering over a patch of substrate, picking at it frequently, then moving on to another patch (Delbeek and Williams 1987). Delbeek and Williams (1987) also found that fourspine stickleback fed exclusively on the bottom, wither among benthic vegetation or from the substrate, the most abundant organisms in their diets being diatoms, nauplii, nematodes, ostracods, and cyclopods. During spawning, the males of this species establish territories and build small nests in which females lay their eggs (Courtenay 1985). Them [*sic*] male then chases the female away and cares for the eggs until they hatch. Courtenay (1985) also found that, unlike other stickleback species, male *Apeltes* tend multiple nests at one time in both laboratory and natural breeding site observations.”

From Craig and Fitzgerald (1982):

“*A. quadracus* are in breeding condition from the beginning of May to the end of July.”

Human Uses

From Fuller et al. (2019):

“Bait shops in Alabama were found to be selling stickleback mixed in with fathead minnows at the time the specimens were collected (N. Nichols, pers. comm.).”

Mahon et al. (2014) list baitfish release as a potential means of introduction for *Apeltes quadracus*.

Diseases

No records of OIE reportable diseases (OIE 2019) were found for *Apeltes quadracus*.

Poelen et al. (2014) list *Gyrodactylus avaloniae*, *Gyrodactylus canadensis*, *Gyrodactylus cameroni*, *Stephanostomum tenue*, *Podocotyle atomon*, *Proteocephalus macrocephalus*, *Bothriocephalus claviceps*, *Paracuaria adunca*, *Cosmocephalus obvelatus*, *Diplocotyle olrikii*, *Bothriocephalus scorpii*, *Diphyllobothrium dendriticum*, *Diphyllobothrium ditremum*, and *Pseudoterranova decipiens* as parasites of *Apeltes quadracus*.

Threat to Humans

From Froese and Pauly (2019):

“Harmless”

3 Impacts of Introductions

From Fuller et al. (2019):

“Rapid increases of *Apeltes* in Thunder Bay suggests the species is displacing native stickleback species at a rapid rate (Stephenson and Momot 2000).”

From Hatch (2015):

“Fourspine Stickleback (*Apeltis* [sic] *quadracus*), has turned up nowhere outside of the Thunder Bay area, a little over 40 miles from the Minnesota border. According to Fritz Fischer of the Ontario Ministry of Natural Resources, this species continues to be collected there on a fairly regular basis but seems to have no inclination to move [sic] our direction.”

4 Global Distribution

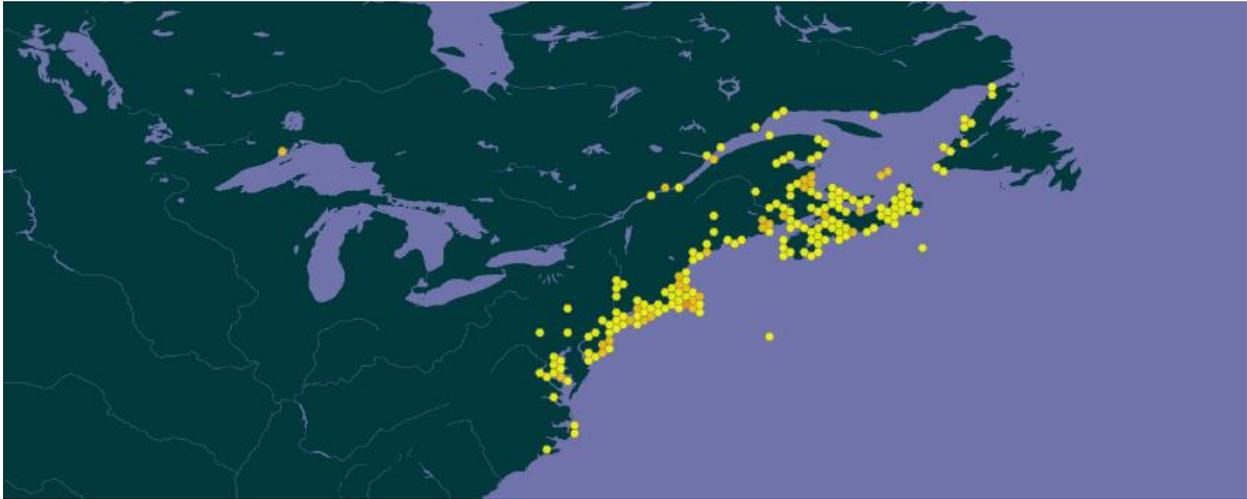


Figure 1. Known global distribution of *Apeltes quadracus*. Locations are in Canada and the United States. Map from GBIF Secretariat (2019). Marine locations were not used to select source points for the climate match.

5 Distribution Within the United States

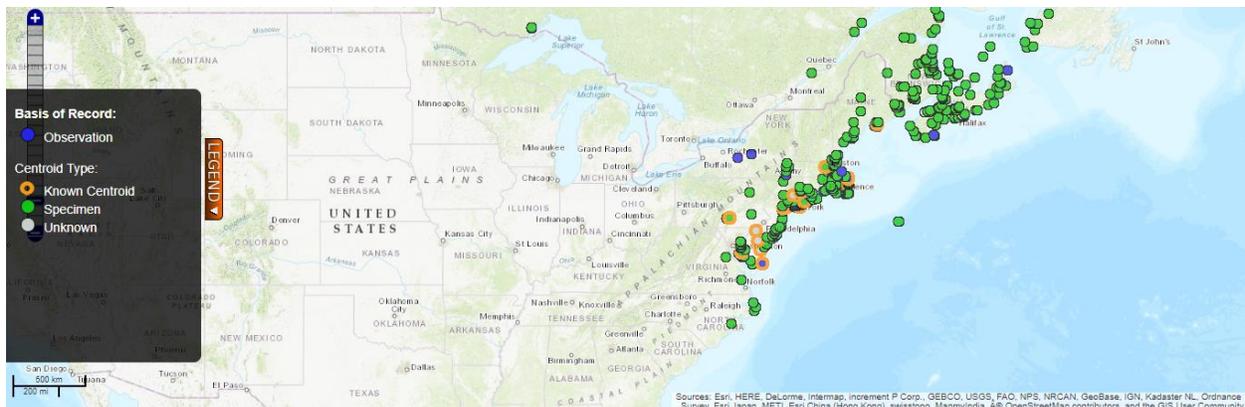


Figure 2. Known distribution of *Apeltes quadracus* in the contiguous United States. Map from BISON 2019. Marine locations were not used to select source points for the climate match.

Apeltes quadracus is known to be established in the Great Lakes basin but the only georeferenced observations available for that region are in central New York and northern Lake Superior.

6 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Apeltes quadracus* varied greatly throughout the contiguous United States. The area of high match stretched from the Northeast into the Midwest, and also a section on the northern border of the Gulf of Mexico. Then moving west, the climate match decreased. The vast majority of the central United States had a low to medium climate match and the Southwest and West Coast had a mostly low climate match. The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for the contiguous United States was 0.342, high (scores 0.103 and greater are considered high). Climate match results are valid for freshwater and brackish water locations only and not for marine waters (Sanders et al. 2018).

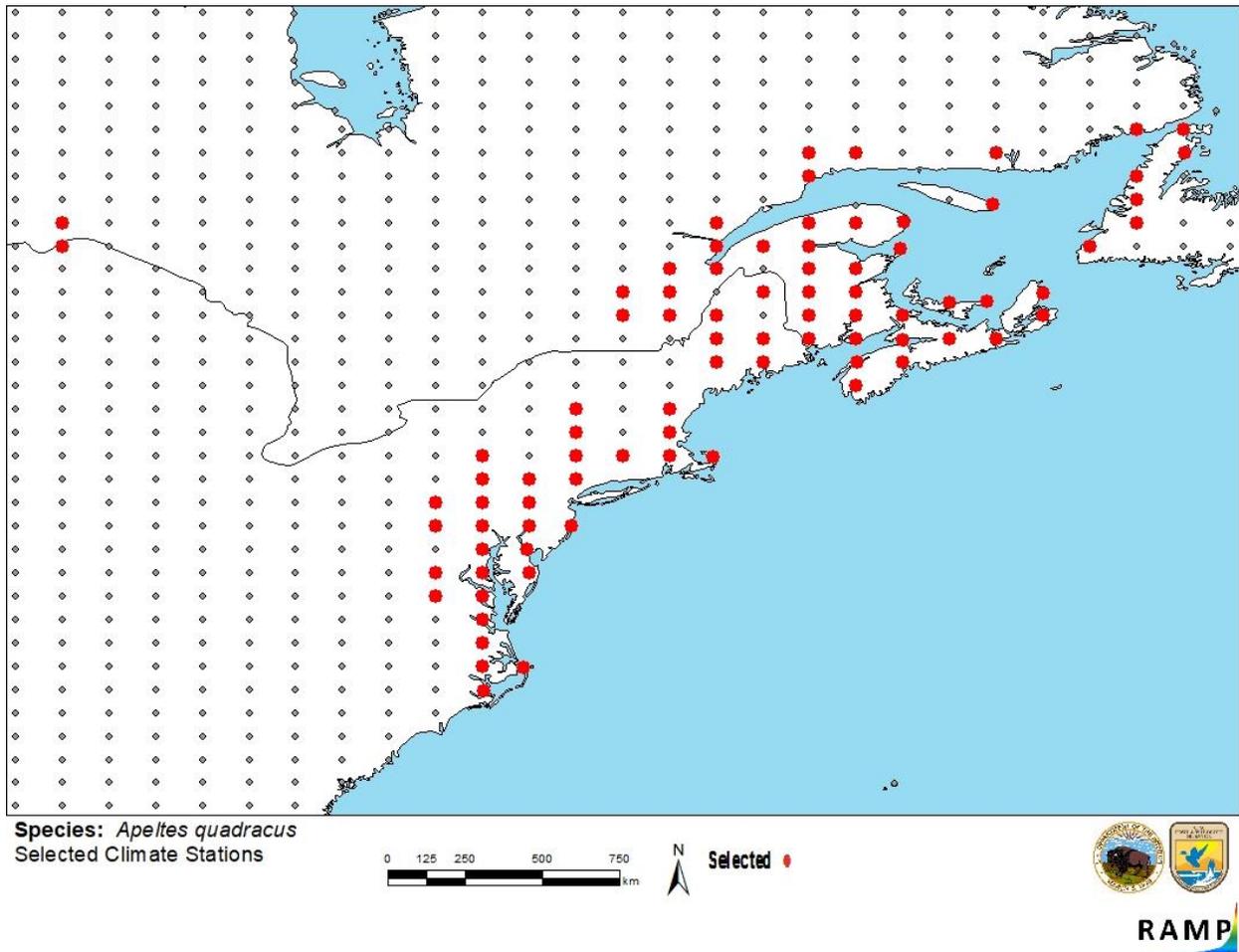


Figure 3. RAMP (Sanders et al. 2018) source map showing weather stations in Canada and the United States selected as source locations (red) and non-source locations (gray) for *Apeltes quadracus* climate matching. Source locations from GBIF Secretariat (2019).

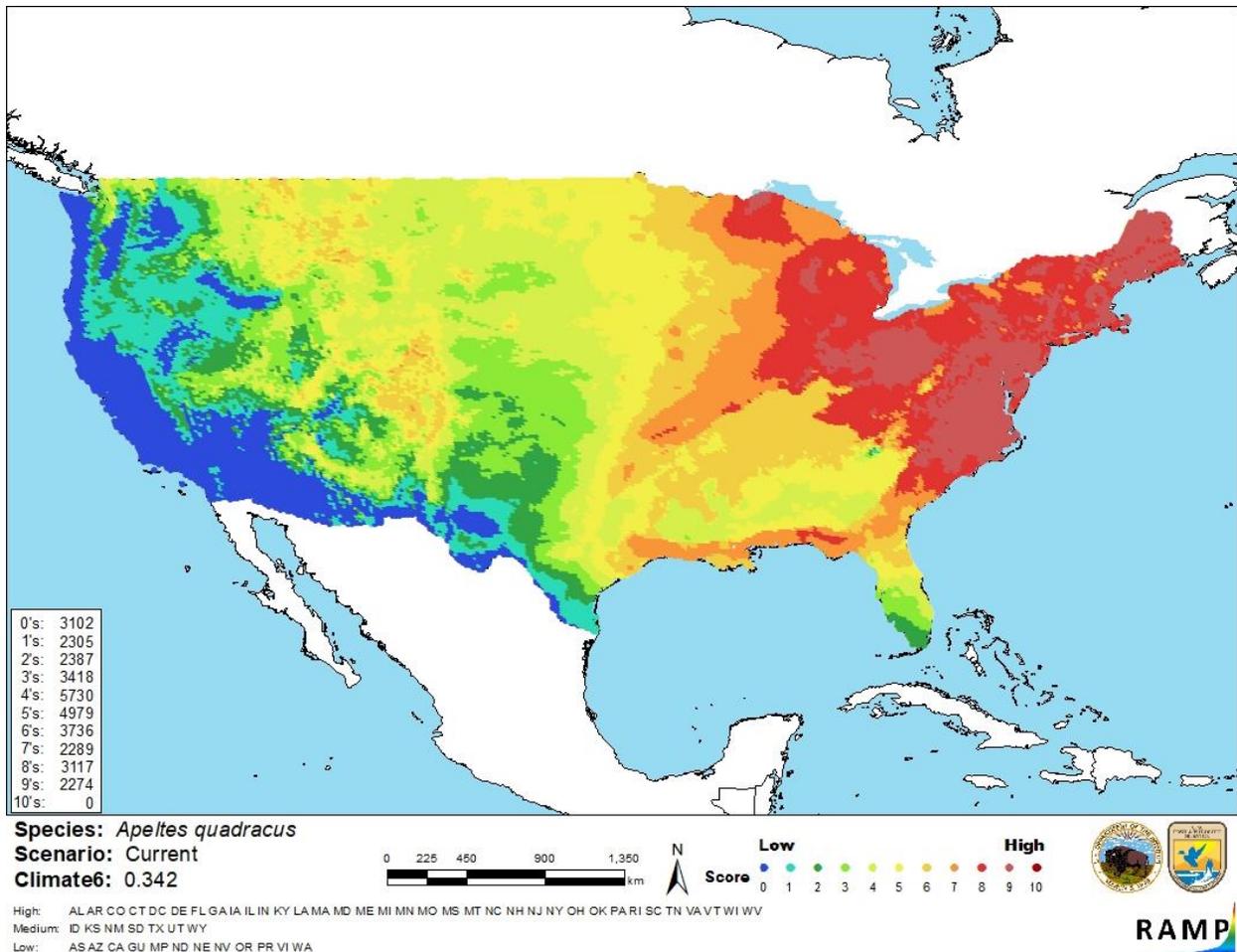


Figure 4. Map of RAMP (Sanders et al. 2018) climate matches for *Apeltes quadracus* in the contiguous United States based on source locations reported by GBIF Secretariat (2019). 0 = Lowest match, 10 = Highest match.

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
$0.000 \leq X \leq 0.005$	Low
$0.005 < X < 0.103$	Medium
≥ 0.103	High

7 Certainty of Assessment

Apeltes quadracus has been documented as established outside of its native range in a number of areas within Canada and the United States. There needs to be more research regarding the impacts of these introductions; currently there is no information on observed impacts. The certainty of assessment is low. There is adequate information regarding the biology of this species, description, and certain diseases it carries. Climate match results are valid for freshwater and brackish water locations only and not for marine waters

8 Risk Assessment

Summary of Risk to the Contiguous United States

The fourspine stickleback (*Apeltes quadracus*) is a small fish native to the Atlantic Coastal areas in northeast North America. This species can survive in fresh, brackish, and marine waters. The climate match for this ERSS is valid for only fresh and brackish water areas. The history of invasiveness is none documented. There have been introductions outside the native range of the fish and at least one introduction resulted in an established population. No records of actual, observed impacts were found but there are indications that it may be displacing native sticklebacks. Introductions are likely via the ballast water of ships, including intra-lake ballast, and possibly through mixing with fish sold as bait. The overall climate match was high for the contiguous United States. The Northeast region to the Midwest region of the United States had a high climate match, as well as the Gulf Coast. The climate match decreased heading west. Part of the high climate match was in the species' native range. The certainty of assessment is low. The overall risk assessment category is uncertain.

Assessment Elements

- **History of Invasiveness (Sec. 3): None Documented**
- **Climate Match (Sec. 6): High**
- **Certainty of Assessment (Sec. 7): Low**
- **Remarks/Important additional information: No additional information.**
- **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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