Scarlet Shiner (*Lythrurus fasciolaris*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, March 2023
Revised, April 2023
Web Version, 4/3/2024

Organism Type: Fish
Overall Risk Assessment Category: Uncertain

Photo: Fletcher Stone. Licensed under CC BY-NC 4.0. Available: https://inaturalist.ca/taxa/104955-Lythrurus-fasciolaris (March 2023).

1 Native Range and Status in the United States

Native Range

From Froese and Pauly (2023):

"North America: Ohio River basin from Muskingum River drainage in Ohio to southeast Illinois (extirpated in Illinois) and south to Tennessee River drainage in Georgia, Alabama and Mississippi, USA; upper Black Warrior River system (Gulf basin) in Alabama, USA."

Status in the United States

From NatureServe (2023):

"Ohio River basin from Muskingum River drainage in Ohio, where it may have been introduced, and the Tygarts Creek system in Kentucky downstream to the Green River drainage of Kentucky; widespread in upland portions of Tennessee and Cumberland drainages in Kentucky, Tennessee, Mississippi, Alabama, and Georgia; becomes increasingly rare and spotty in Ridge and Valley province at headwaters of Tennessee drainage in Virginia and Tennessee; also in several sites in close proximity in Locust Fork watershed of Black Warrior River system (Tombigbee drainage) in Alabama, where it may be introduced; formerly not uncommon in Ohio River tributaries in southeastern Indiana, and there is an old record from southern Illinois (Snelson 1990, Dimmick et al. 1996)."

From Nico (2018):

"Swift et al. (1986) listed this species as possibly introduced into the Black Warrior system in Alabama. Its presence in the Muskingum River drainage in Ohio may also be the result of past introduction (Snelson 1990)."

"In their taxonomic revision, Dimmick et al. (1996) recognized three distinct species in the *L. ardens* complex and they restricted the range of each of the species. Based on the distribution map given by Dimmick et al. (1996) for the three species, we can assume that records from the Muskingum River drainage, Ohio, represent *Lythrurus fasciolaris*. However, among the *L. ardens* complex, Dimmick et al. (1996) apparently only recognized populations found in the York River drainage (*L. ardens*) of Virginia as introduced. Snelson (1990) provided details on the distribution of native and introduced populations. However, Snelson was uncertain of the origin of the subspecies *fasciolaris* (now *L. fasciolaris*) population occurring in the Black Warrior River system of the Tombigbee River drainage, Alabama; he indicated that it may be native or simply the result of recent introduction. Similarly, Swift et al. (1986) listed this species as possibly introduced into the Black Warrior system in Alabama; however, Mettee et al. (1996) listed it as native to that river system."

This species is present in the aquarium trade in the United States. For example, Jonah's Aquarium (2023) lists *L. fasciolaris* for $12.00 per individual or $7.00 with orders of 7 or more with shipping across the United States.

Regulations

No species-specific regulations on possession or trade were found within the United States.

Means of Introductions within the United States

From Nico (2018):

"Unknown; probable bait bucket release."

Remarks

From NatureServe (2023):

"Removed from genus *Notropis* and placed in genus (formerly subgenus) *Lythrurus* by Mayden (1989) and Coburn and Cavender (1992); this change was adopted in the 1991 and 2004 AFS checklists (Robins et al. 1991, Nelson et al. 2004). *Lythrurus* was retained as a subgenus by Snelson (1990)."

"Two subspecies were recognized by Snelson (1990): *ardens* from Atlantic slope drainages and New River system of Kanawha drainage [West Virginia], and *fasciolaris* from the remainder of the Ohio basin. Snelson (1990) found no strong support for the recognition of the Tar and Neuse populations ("*matutinus*") as a distinct subspecies or species. Dimmick et al. (1996) examined morphological and allozymic variation and concluded that *L. ardens* should be divided into three species, *L. ardens*, *L. fasciolaris*, and *L. matutinus*. These changes were adopted by Nelson et al. (2004)."

According to Hopkins and Eisenhour (2008), *Lythrurus fasciolaris* hybridizes with *Lythrurus umbratilis* in the Ohio River basin.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2023):

Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Actinopterygii
Class Teleostei
Superorder Ostariophysi
Order Cypriniformes
Superfamily Cyprinoidea
Family Cyprinidae
Genus *Lythrurus* Jordan, 1876
Species *Lythrurus fasciolaris* (Gilbert, 1891)

According to Fricke et al. (2023), *Lythrurus fasciolaris* is the current valid name for this species.

The following synonym of *Lythrurus fasciolaris* from Fricke et al. (2023) was used to search for information for this report: *Notropis umbratilis* subsp. *fasciolaris*.

Size, Weight, and Age Range
From Nico (2018):

“Size**:** 8.5 cm.”

From Hopkins and Eisenhour (2008):

“The Scarlet Shiner, *Lythrurus fasciolaris*, is a small (60–90 mm TL [total length]), […]”

Environment
From Froese and Pauly (2023):

“Freshwater; benthopelagic”

From NatureServe (2023):

“Rocky pools and runs of headwaters, creeks, and small rivers with moderate flow and usually gravel and rubble bottoms. Absent from high elevation trout streams (Snelson 1990). In clear water with little or no silt deposits. In deeper quiet pools in midwinter.”

Climate
According to Froese and Pauly (2023), *Lythrurus fasciolaris* prefers a subtropical climate zone.

Distribution Outside the United States
Native
Endemic to the United States, see section 1 Native Range.

Introduced
No records were found for introduction of *Lythrurus fasciolaris* in the wild outside the United States.

Means of Introduction Outside the United States
No records were found of introduction of *Lythrurus fasciolaris* in the wild outside the United States.

Short Description
From Dimmick et al. (1996):

“[…] modally 10 anal rays; males in nuptial condition deep-bodied with a keeled nape; have orange or red on the lower head and venter, with extensive orange or red on all fins; development of tubercles strongly expressed in males only […]”

Biology
From NatureServe (2023):

"Spawns in faster currents of riffles and pools, often over nests of chubs."

From Hopkins and Eisenhour (2008):

"*Lythrurus fasciolaris* is a nest associate of *Lepomis* and *Nocomis* spp., preferring to spawn in active nests of these fishes from mid-May through late-August (Trautman, 1981; Johnston and Page, 1992; Etnier and Starnes, 1993)."

Human Uses
There is evidence of *L. fasciolaris* in the pet trade industry within the United States (e.g., Jonah's Aquarium 2023). Nico (2023) indicated that the species may be used as bait.

Diseases
No information was found associating *Lythrurus fasciolaris* with any diseases listed by the World Organisation of Animal Health (2023).

From Adrian (2009):

"They [*Lythrurus fasciolaris*] are host to at least two species of *Dactylogyrus* gill flukes, *D. crucis* and *D. lythruri*."

Threat to Humans
From Froese and Pauly (2023):

"Harmless"

3 Impacts of Introductions
There may be some introduced populations of *Lythrurus fasciolaris* but the information regarding the native or introduced status of the species in different areas is unclear (see section 1). No information was found regarding any impacts from the potential introduced populations.

There were no species-specific State regulations for this species.

4 History of Invasiveness
The History of Invasiveness for *Lythrurus fasciolaris* is classified as No Known Nonnative Population. Some authors report nonnative established populations, but other authors express uncertainty as to the native or introduced status of those populations. Furthermore, there was no information found regarding the impact of introductions. *L. fasciolaris* has been found in the aquarium trade, but no information regarding duration or volume of trade was found.

5 Global Distribution

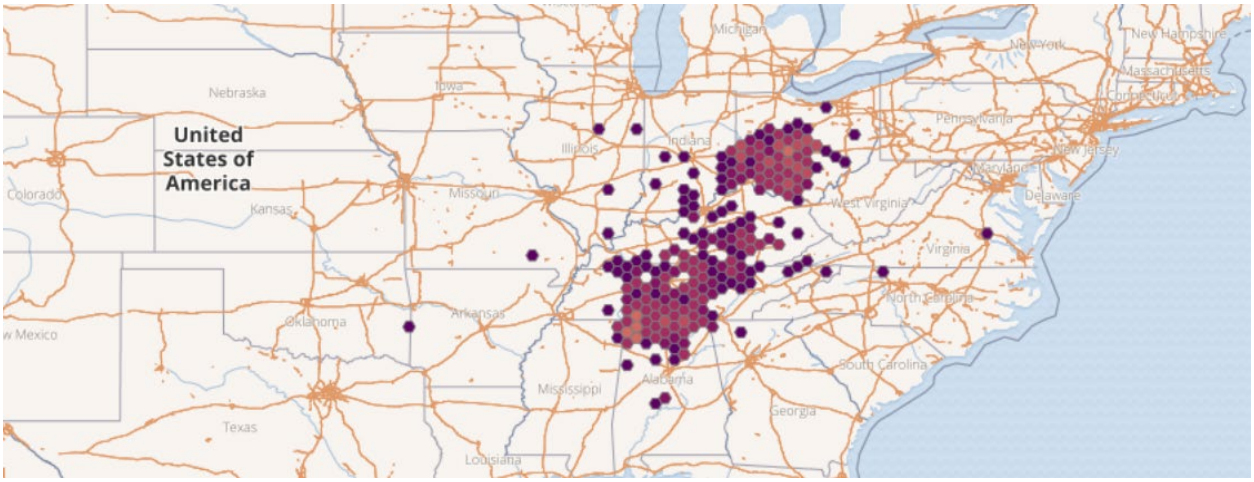

Figure 1. Reported global distribution of *Lythrurus fasciolaris*. Map from GBIF Secretariat (2022). Observations are reported from Alabama, Tennessee, Kentucky, Ohio, Mississippi, Illinois, Georgia, Indiana, North Carolina, Missouri, Oklahoma, and Virginia.

Several outliers in Georgia, Ohio, Indiana, Oklahoma, Missouri, Virginia, Illinois, and North Carolina were not used to select source locations for the climate match. There was no evidence found that suggested these points represented established populations of *L. fasciolaris*.

6 Distribution Within the United States

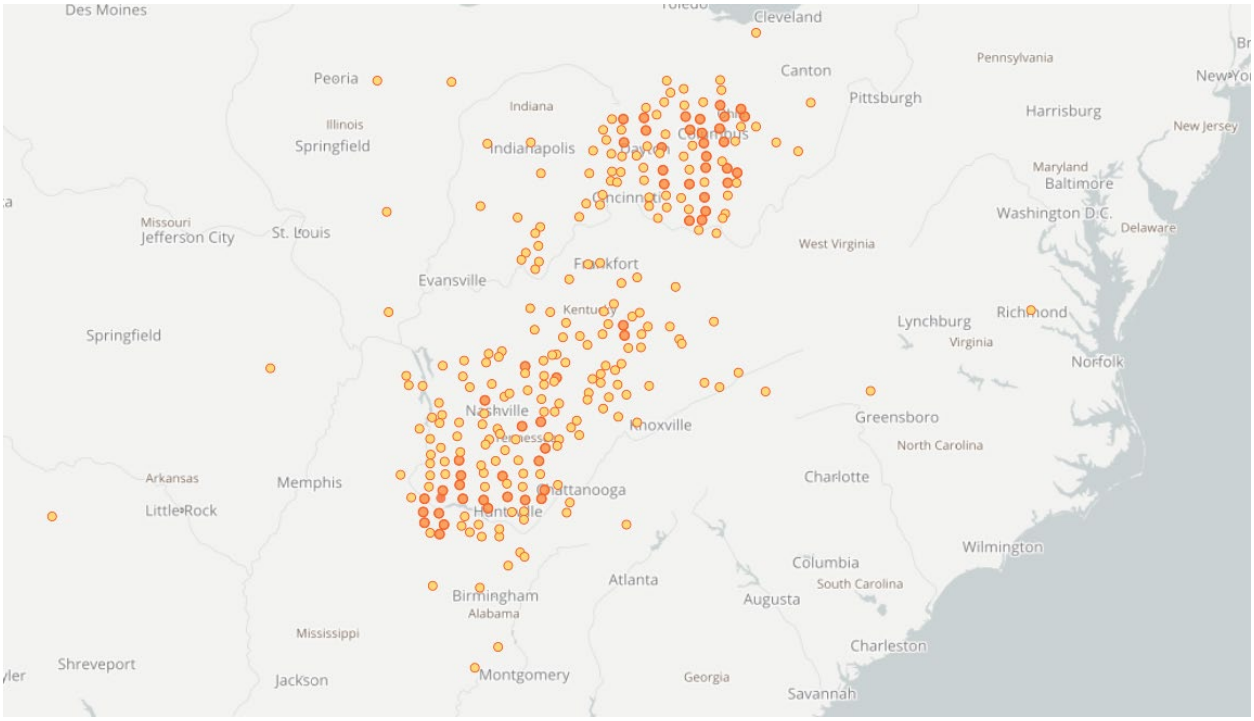

Figure 2. Reported distribution of *Lythrurus fasciolaris* in the United States. Map from GBIF-US (2023). Majority of observations are reported from Alabama, Tennessee, Kentucky, Ohio, Mississippi, and Indiana with few occurrences in Illinois, Georgia, North Carolina, Missouri, Oklahoma, and Virginia.

Occurrences in Oklahoma, Missouri, Virginia, Illinois, North Carolina, northern Ohio, and northern Georgia do not represent established populations of *Lythrurus fasciolaris* and were not used to select source locations for the climate match.

7 Climate Matching

Summary of Climate Matching Analysis

Areas with high climate matches for *Lythrurus fasciolaris* in the contiguous United States were located throughout the eastern United States from Maine to Louisiana, centered around the native range of the species. West of the Mississippi River Basin had more low and medium climate matches. The medium matches were mostly found in patches in the Rocky Mountains. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.441, indicating that Yes, there is establishment concern for this species outside its native range. The Climate 6 score is calculated as: (count of target points with scores ≥ 6)/(count of all target points). Establishment concern is warranted for Climate 6 scores greater than or equal to 0.002 based on an analysis of the establishment success of 356 nonnative aquatic species introduced to the United States (USFWS 2024).

Projected climate matches in the contiguous United States under future climate scenarios are available for *Lythrurus fasciolaris* (see Appendix). These projected climate matches are provided as additional context for the reader; future climate scenarios are not factored into the Overall Risk Assessment Category.

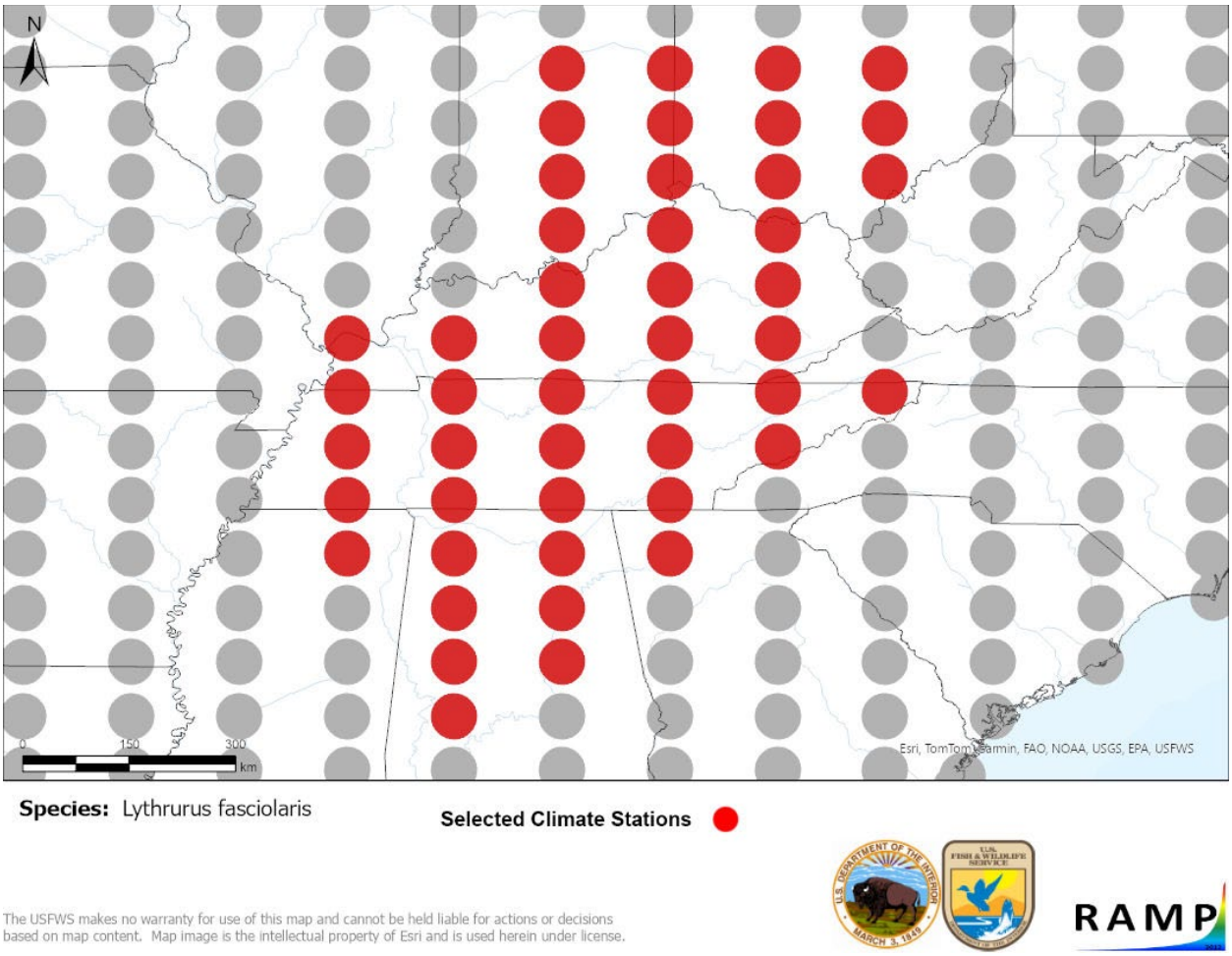

Figure 3. RAMP (Sanders et al. 2023) source map showing weather stations in the mid-west and eastern United States selected as source locations (red; Indiana, Ohio, Kentucky, Tennessee, Georgia, Mississippi, Alabama) and non-source locations (gray) for *Lythrurus fasciolaris* climate matching. Source locations from GBIF Secretariat (2022). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

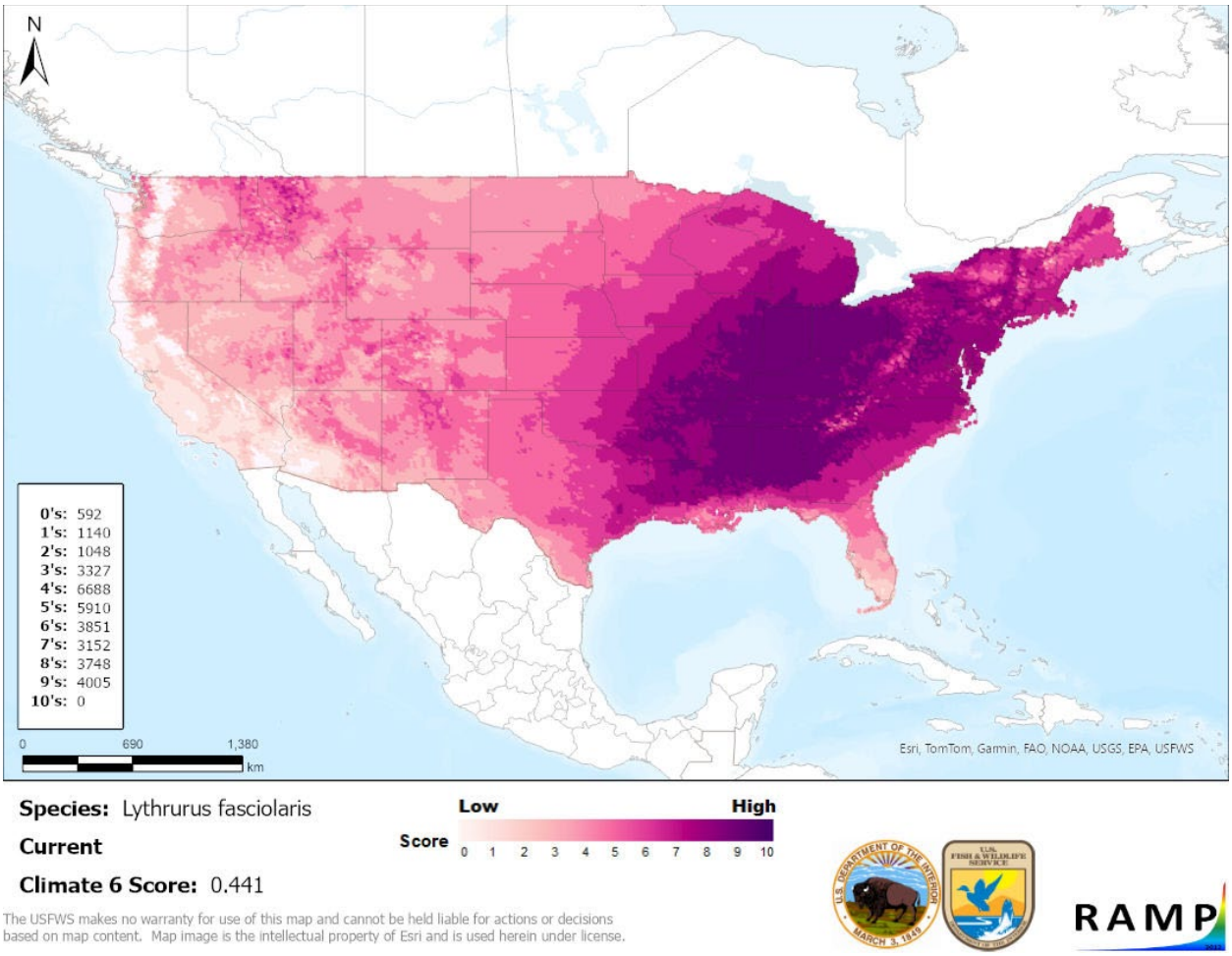

Figure 4. Map of RAMP (Sanders et al. 2023) climate matches for *Lythrurus fasciolaris* in the contiguous United States based on source locations reported by GBIF Secretariat (2022). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

The Certainty of Assessment for *Lythrurus fasciolaris* is classified as Low. There is a reasonable amount of information regarding this species' biology, ecology, and distribution. However, for some areas of the range, it is undetermined if the species is native or introduced. No information was found regarding impacts from any of the potential introductions.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Lythrurus fasciolaris, Scarlet Shiner, is a fish native to the Ohio River basin, from Ohio to southeast Illinois, the Tennessee River drainage in Georgia, Alabama, and Mississippi. It may be either native or introduced in the Muskingum River drainage in Ohio and the Black Warrior system in Alabama. *L. fasciolaris* can be found in rocky pools, creeks, small rivers, and headwaters with gravel bottoms. They nest near *Lepomis* and *Nocomis* spp. with their spawning

season typically from May to August. *L. fasciolaris* hybridizes with the redfin shiner, *Lythrurus umbratilis*. No State regulations were found for this species. Because of the uncertainty around whether certain populations are introduced or native, the History of Invasiveness for *Lythrurus fasciolaris* is classified as No Known Nonnative Population. The climate matching analysis for the contiguous United States indicates establishment concern for this species outside its native range. The highest climate match could be found in the eastern United States and around the Great Lakes from Maine to Louisiana including where this species is native or currently established. The Certainty of Assessment for this ERSS is classified as Low due to the uncertainty in understanding the species' range and the lack of information on impacts from introductions. The Overall Risk Assessment Category for *Lythrurus fasciolaris* in the contiguous United States is Uncertain.

Assessment Elements

- **History of Invasiveness (see section 4): No Known Nonnative Population**
- **Establishment Concern (see section 7): Yes**
- **Certainty of Assessment (sec. 8): Low**
- **Remarks, Important additional information:** Hybridizes with *Lythrurus umbratilis*.
- **Overall Risk Assessment Category: Uncertain**

10 Literature Cited

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in section 11.

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11 Literature Cited in Quoted Material

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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Appendix

Summary of Future Climate Matching Analysis

Future climate projections represent two Shared Socioeconomic Pathways (SSP) developed by the Intergovernmental Panel on Climate Change (IPCC 2021): SSP5, in which emissions triple by the end of the century; and SSP3, in which emissions double by the end of the century. Future climate matches were based on source locations reported by GBIF Secretariat (2022).

Under the future climate scenarios (figure A1), on average, high climate match for *Lythrurus fasciolaris* was projected to occur in the Appalachian Range, Great Lakes, Mid-Atlantic, Northeast, and Southeast regions of the contiguous United States. Small areas of high match were also projected in the Rocky Mountains. These areas of high match were smaller in extent in 2085 than in 2055 and in SSP5 than in SSP3. Areas of low climate match were projected to occur in California, the Northern Pacific Coast, Southern Florida, and Southwest regions as well as much of the western Plains. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.244 (model: UKESM1-0-LL, SSP5, 2085) to a high of 0.443 (model: IPSL-CM6A-LR, SSP5, 2055). All future scenario Climate 6 scores were above the Establishment Concern threshold, indicating that Yes, there is establishment concern for this species under future scenarios. The Climate 6 score for the current climate match (0.441, figure 4) falls within the range of scores for future projections. The time step and climate scenario with the most change relative to current conditions was SSP5, 2085 (figure A3). Under one or more time step and climate scenarios, areas within the Colorado Plateau, Great Lakes, Northeast, and Western Mountains saw a moderate increase in the climate match relative to current conditions. Small areas of large increase were also found in those areas under some scenarios, mainly 2085 SSP5. Under one or more time step and climate scenarios, areas within the Appalachian Range and Southeast saw a large decrease in the climate match relative to current conditions. Additionally, areas within California, the Colorado Plateau, Great Lakes, Gulf Coast, Mid-Atlantic, Southern Atlantic Coast, Southern Plains, and Southwest saw a moderate decrease in the climate match relative to current conditions. The degree of change increased with time and from SSP3 to SSP5.

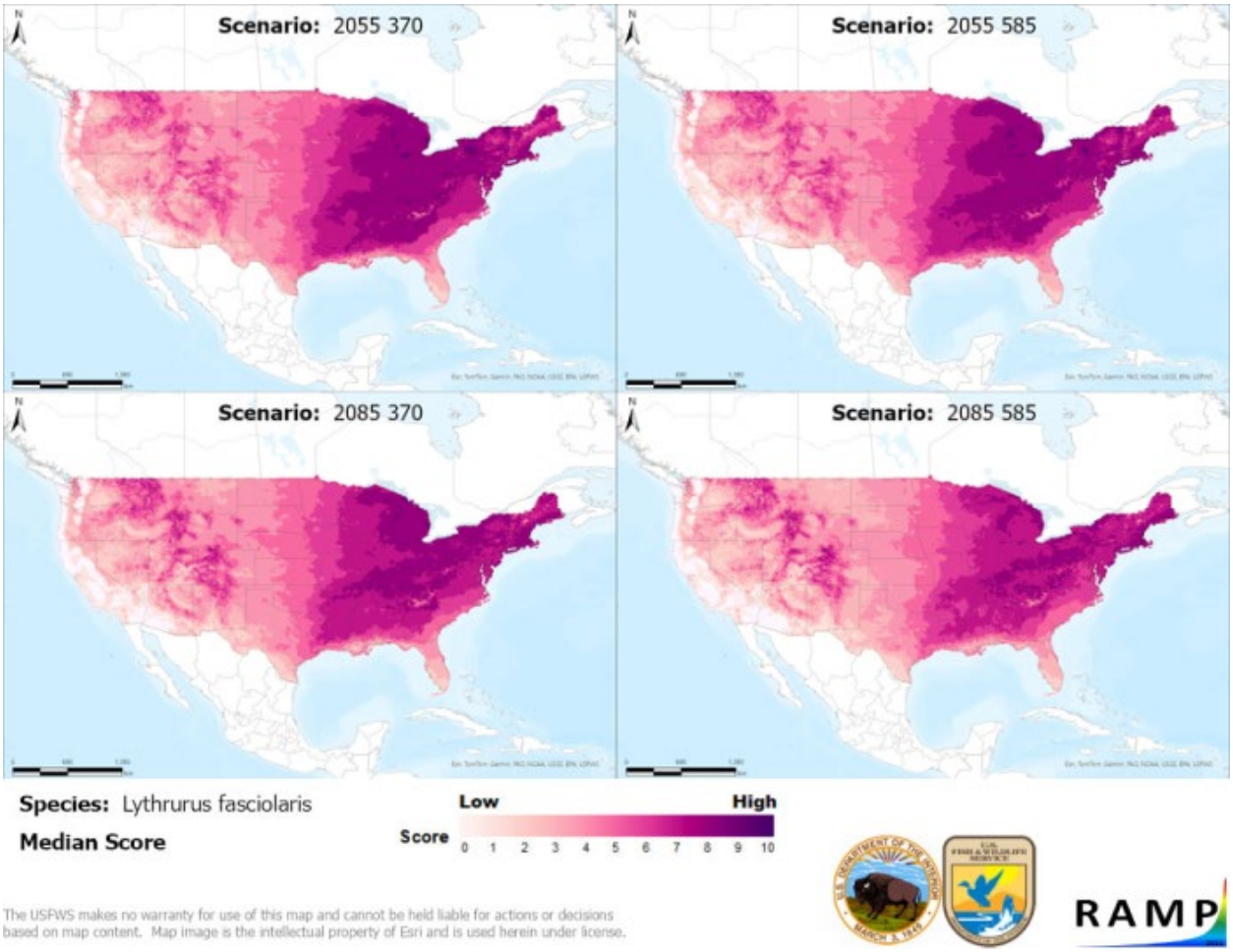

Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Lythrurus fasciolaris* in the contiguous United States. Climate matching is based on source locations reported by GBIF Secretariat (2022). Shared Socioeconomic Pathways (SSPs) used (from left to right): SSP3, SSP5 (IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global climate models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

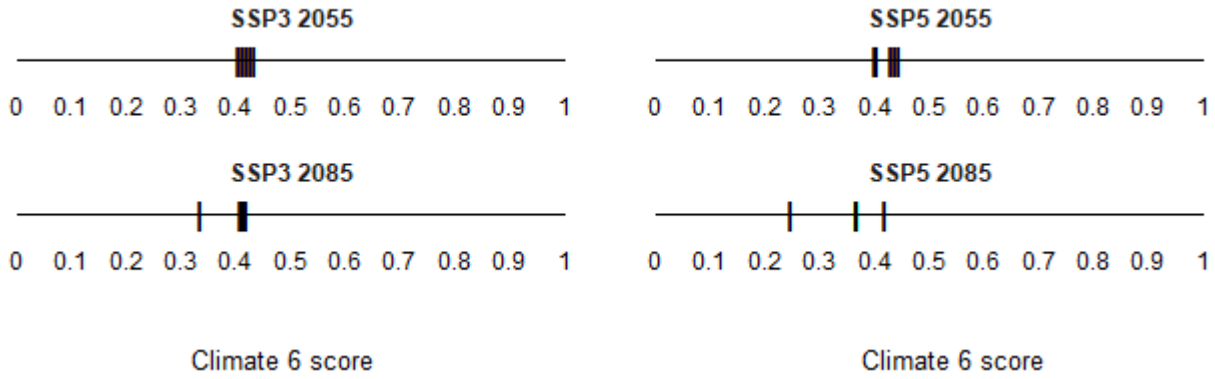

Figure A2. Comparison of projected future Climate 6 scores for *Lythrurus fasciolaris* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018; IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global climate models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0.

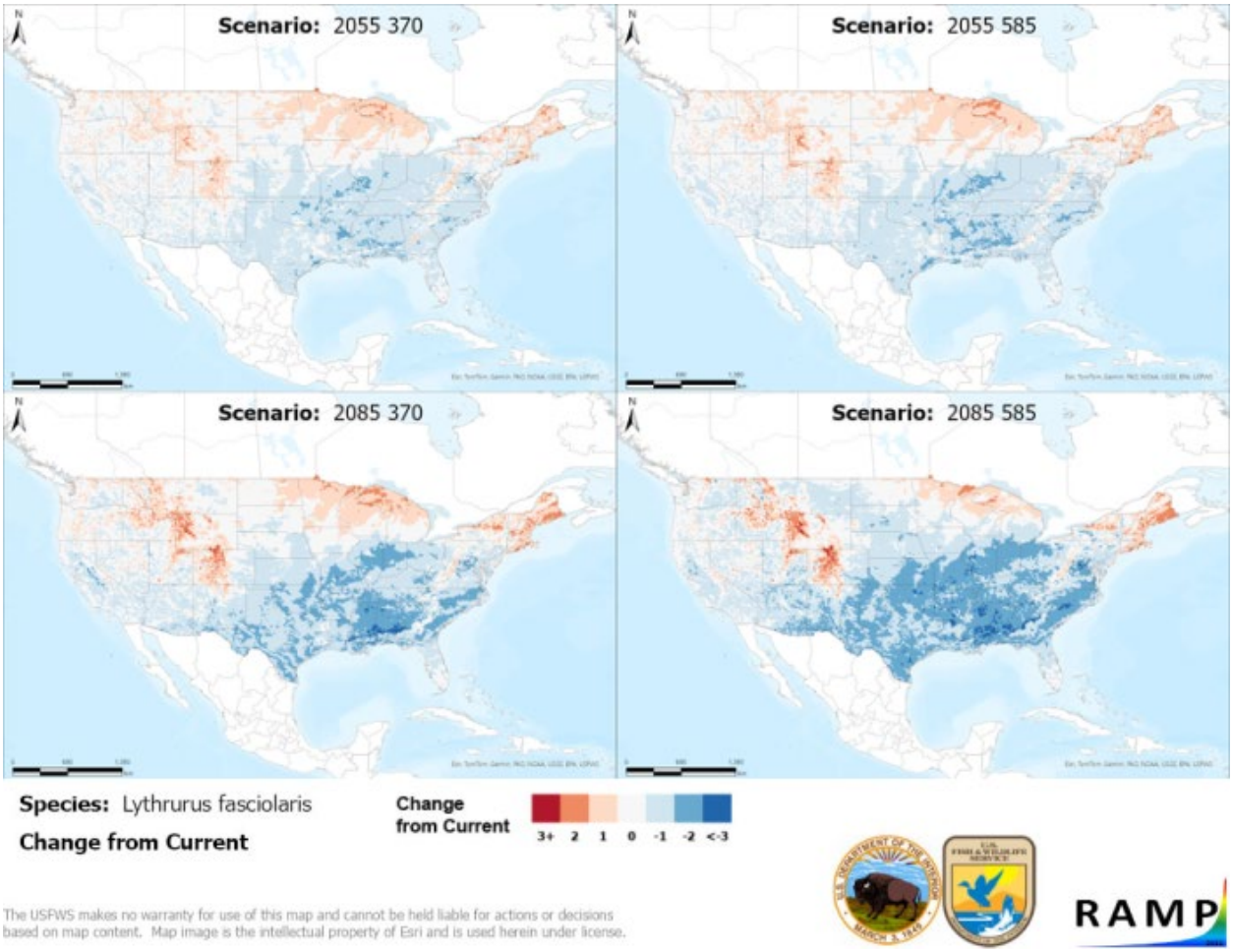

Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *Lythrurus fasciolaris* based on source locations reported by GBIF Secretariat (2022). Shared Socioeconomic Pathways (SSPs) used (from left to right): SSP3, SSP5 (IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0. Shades of blue indicate a lower target point score under future scenarios than under current conditions. Shades of red indicate a higher target point score under future scenarios than under current conditions. Darker shades indicate greater change.

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