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Fitness of interspecific hybrids in the genus *Cyprinella*: An evaluation of swimming performance in stream fishes

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INTRODUCTION

- The introduction of non-native aquatic species is a major threat to aquatic biodiversity. Many introductions of non-native, freshwater fishes occurs from baitfish aquaculture and private aquarium release (1).

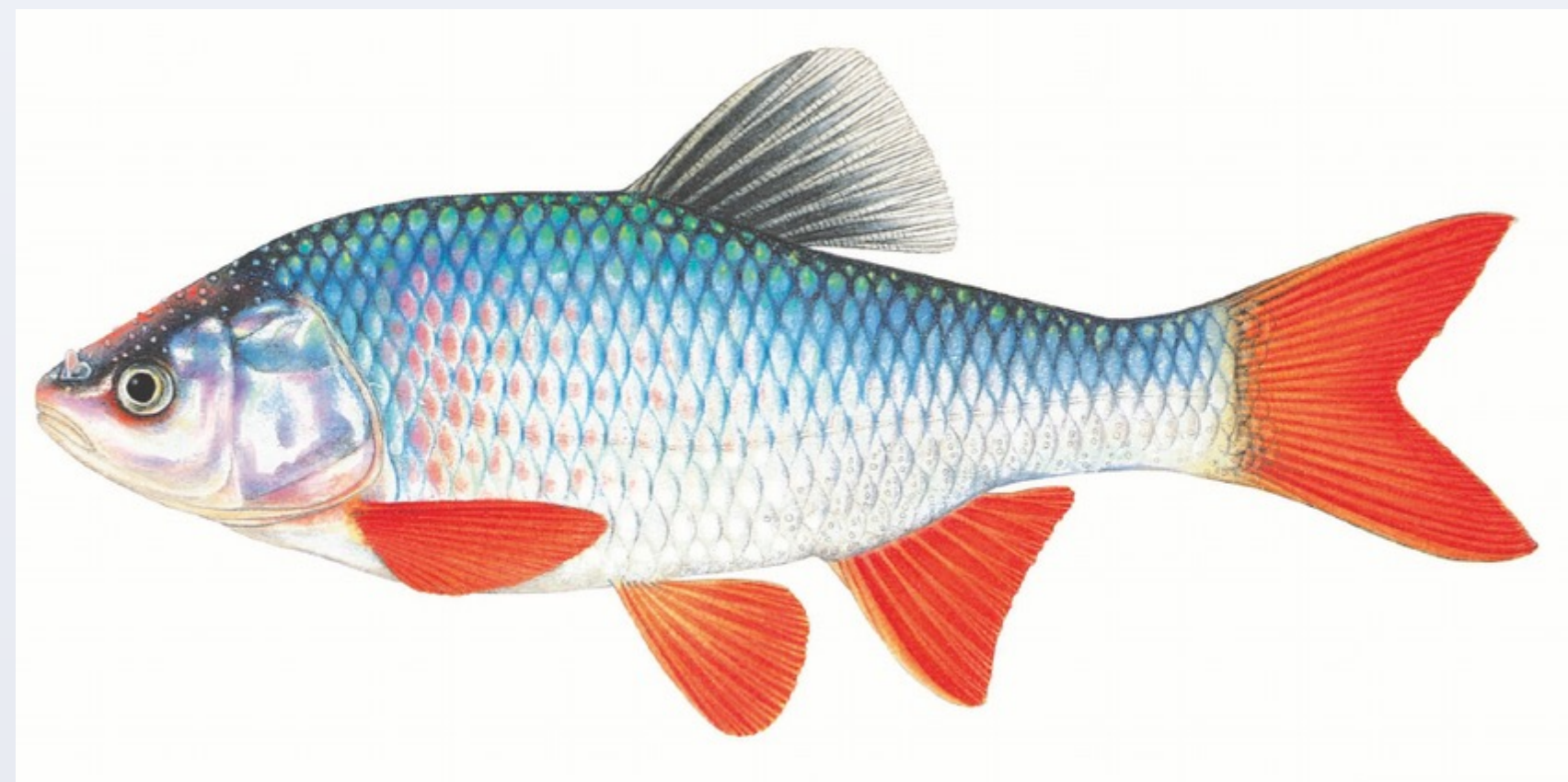


Figure 1: Photo of *Cyprinella lutrensis* (red shiner), taken by Joseph R. Tomelleri

- As early as the 1950's *Cyprinella lutrensis* (red shiner) has been introduced across North America and parts of Europe from bait bucket and aquarium releases (1).
- During the 1990's, invasive red shiner populations were first observed in the Coosa River, located in Northwestern Georgia, USA (2). Red shiner are known to compete and hybridize with *Cyprinella venusta* (blacktail shiner)(3).



Figure 2: Photo of *Cyprinella venusta* (blacktail shiner), from Texas Park & Wildlife

- Over the past 30 years, red x blacktail shiner hybrids have become more abundant. However, little is known about their fitness compared to parental species.
- If hybrids show a higher level of fitness compared to parental species, this could lead to the regional extinction of valuable native species.
- Critical swimming speed is an attribute that can influence Darwinian fitness (4) and is often used in lieu of traditional fitness metrics.

METHODS

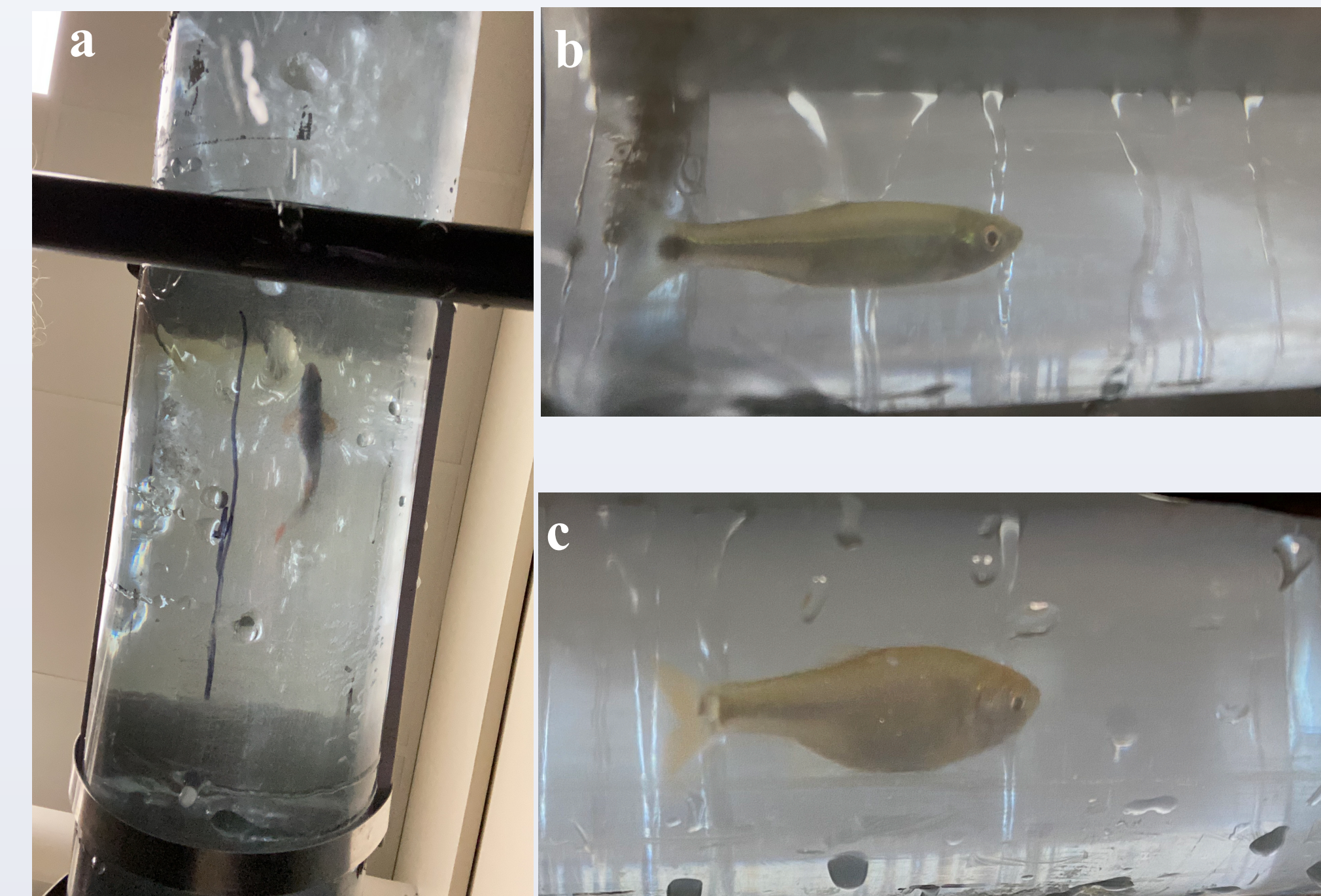
- Field collections of red, blacktail, and red x blacktail hybrid shiners were conducted during Fall 2020 and Spring 2021.
- Specimens were collected via sein net. Red shiners were collected from Sandy Creek, Atlanta, Georgia. Blacktail shiners were collected from the Conasauga River in Northwest Georgia. Red x blacktail hybrid shiners were collected from the Coosa River in Rome, Georgia.
- A recirculating flow chamber was used to measure swimming performance of the three different shiners.
- An amp/velocity curve was generated using a digital flow meter. The amps were calibrated in meter/seconds and ranged from 0.1 m/s to 1.07 m/s.



Figure 3: Photo of the flow chamber from the top looking down. Photos taken by Jessica Wilks

- 20 red shiners, 5 blacktail shiners, and 3 hybrids were randomly selected for swimming trials. Before each trial, individuals were acclimated in the flow chamber for 20 minutes.
- During the trial, water velocity was gradually increased in increments of 0.05 m/s every 10 seconds until the fish could no longer maintain its position in the water column.

METHODS CONTINUED



Figures 4-6: Below photo of a red shiner mid swim trial (a), side photo of blacktail shiner mid swim trial (b), side photo of hybrid mid swim trial (c). Photos taken by Jessica Wilks

- After each swimming trial individuals were euthanized using Tricane-S and then stored in 95% ethanol for later morphological analysis.

RESULTS

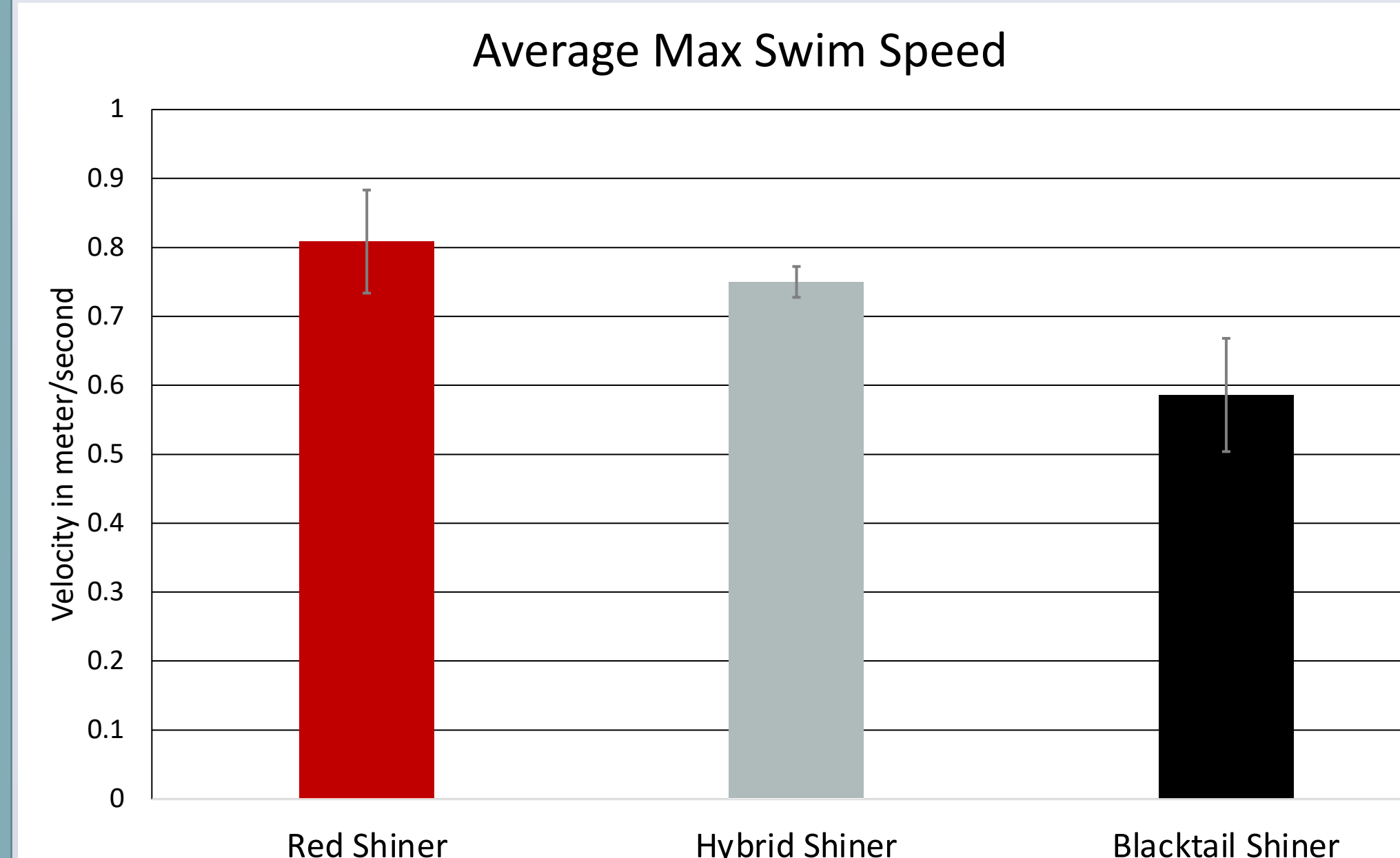


Figure 7: Comparing the average max swim velocities of red shiners, blacktail shiners, and hybrids.

- Red shiners appear to have a higher critical swimming speed compared to blacktail shiners and hybrid shiners.
- Blacktail shiners exhibited the lowest critical swimming speed of the three groups.
- Hybrid shiners display an intermediate critical swimming speed.

DISCUSSION

- Preliminary data suggests that invasive red shiner and hybrid shiner may have higher fitness compared to some native species.
- Swimming ability is a critical attribute of fishes that helps them avoid predators and obtain food (4).
- We plan to test more blacktail and hybrid shiners when we are able to collect more individuals.
- In the future we plan to use landmark geomorphometrics to compare the body shapes of the red, blacktail, and hybrid shiners.
- Body shape could potentially play a role in explaining the observed differences in swimming speed among species/groups.

SIGNIFICANCE

- Invasive red and hybrid shiners having a higher critical swimming speed than native shiners could potentially lead to native species loss.
- Invasive red and hybrid shiner may have the ability to out compete native blacktail shiners throughout much of the Southeastern U.S.
- Invasive red and hybrid shiner may also have the ability to negatively impact other native *Cyprinella* species.

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