

# Microhabitat selection and ecological niches of three cyprinid species in east Texas streams

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### Abstract

We investigated the microhabitat selection and the morphological trait space occupied by three Cyprinid (Cyprinidae family) species: Blacktail shiner (*Cyprinella venusta*), Blackspot shiner (*Notropis atrocaudalis*), and Sabine shiner (*Notropis sabiniae*) in two streams, Banita and La Nana creeks, within the La Nana watershed in east Texas. Since Blackspot and Sabine shiners are species of conservation concern in the state of Texas, we explored whether their ecological niche overlapped with the Blacktail shiner, which is a generalist and abundant species in this system. Our surveys were based on describing habitat conditions, species occurrence by habitats types (riffle, pool, and run), and morphological trait space occupied by these species. Our results suggest Blacktail shiner dominated in all habitats surveyed. Blackspot and Sabine shiner were less abundant and appear restricted to habitats with shallow and running water (e.g., riffles). The three shiners do not overlap significantly in morphological trait space. Future research will explore the trophic niche of these species.

### Introduction

Cyprinids in small streams tend to segregate spatially to reduce competitive interactions and avoid predation [1]. Herein, we examined population structure and microhabitat use of three sympatric shiners: blacktail shiner, blackspot shiner, and Sabine shiner in an urban stream in East Texas to better understand some aspects of their niche space, which may allow for coexistence in similar streams and habitat types. These three species are stream-dwelling and generalist invertivores. Both blackspot and Sabine shiners (Fig. 1) are habitat specialists with broadcast spawning, and are listed as Species of Greatest Conservation Need (SGCN) in Texas. The blacktail shiner is a crevice spawner, habitat generalist, and is tolerant to a variety of environmental conditions, which has facilitated their occurrence across all major Texas river basins.

#### Focal Species



Fig. 1. Left panel: three species of stream-dwelling shiners (Family Cyprinidae Cypriniformes) used in this study include: Sabine shiner (top photo), Blackspot shiner (middle) and Blacktail shiner (bottom photo). Right panel: three stream habitats surveyed in this study: **Riffle**: fast, shallow flow over gravel, cobble or boulders. **Pool**: area of deep, slow-flowing water, often on the outside of the bends. **Run**: smooth, unbroken flow, connecting riffles and pools.

#### Habitat Types



**Questions** 1) Given its generalist and tolerant habits, is Blacktail shiner limiting the occurrence of Blackspot and Sabine shiners? 2) Are these stream-dwelling species partitioning their niches?

**Hypothesis:** The Blacktail shiner will be the most abundant species across all microhabitats compared to the other two shiner species.

### Methods

- Surveys were conducted in La Nana Creek and Banita Creek (Fig. 2) in the Spring and Summer of 2022. Each stream was surveyed twice per season. At each survey, the chemical and physical conditions of the streams were measured (Fig. 3). Habitats were identified as a pools, riffles and runs (Fig. 3). Habitat conditions were assessed.
- Fish were collected with a seine net.
- The population abundance of each species collected was estimated by counting the number of individuals per species per habitat type.
- 23 morphological traits were measured and analyzed to identify overlap in niche trait space.
- Past.exe software was used to perform the Principal Component Analysis (PCA) and Analysis of Variance (ANOVA).

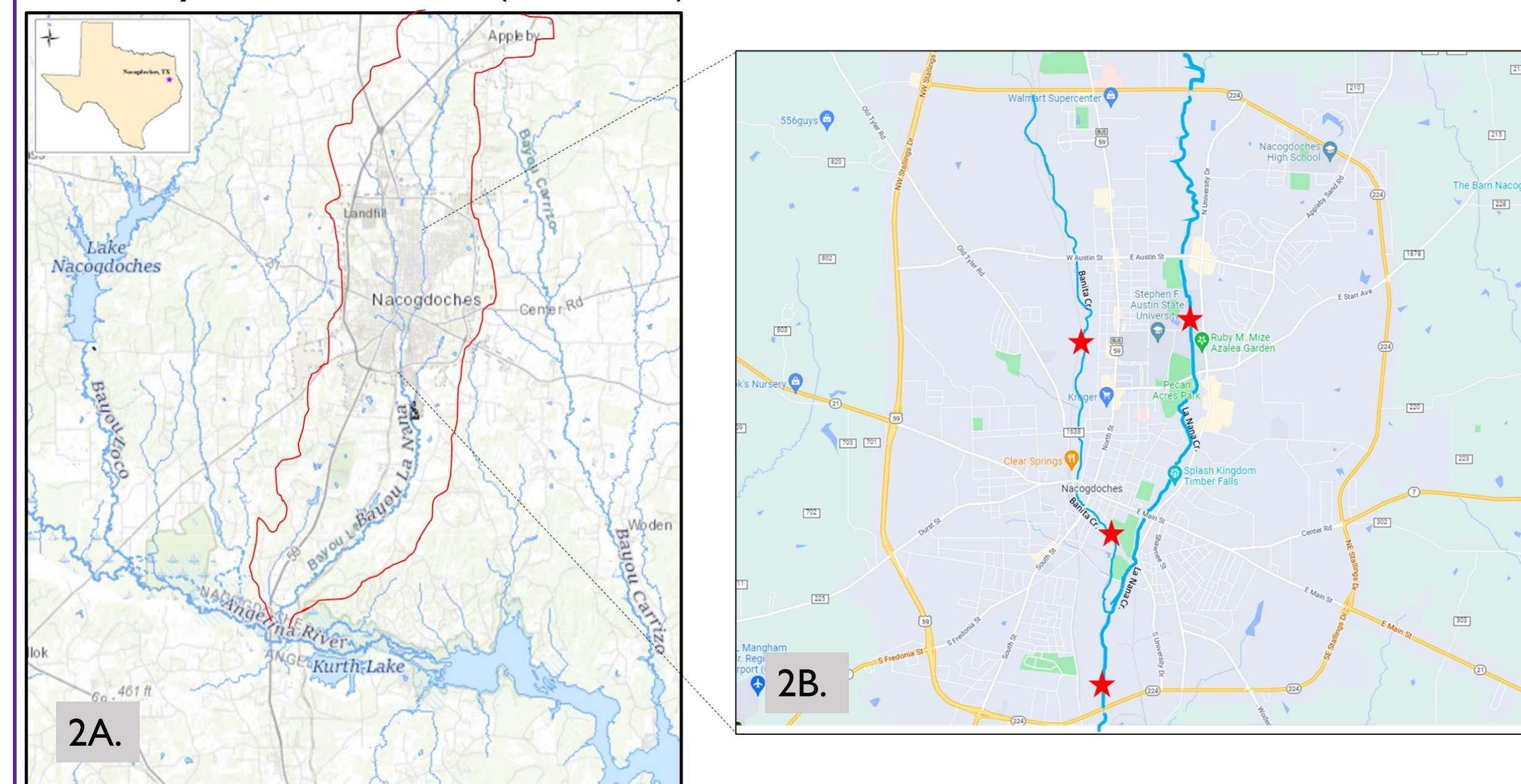


Fig. 2. Map showing La Nana Creek (LNC) watershed in Nacogdoches County (A) and the two streams surveyed LNC and Banita Creek (B). Two sites at LNC and two sites at Banita Creek (B).

### Stream & Habitat Conditions

The PCA ordination suggest differences in the environmental conditions between Banita and La Nana creeks (Fig. 3). Water conditions (turbidity, salinity, TDS) were different between streams. Habitat types within the two streams also differed in depth, flow and substrates (Fig. 4). Pools were deeper, riffles were shallower and faster, with gravel substrates, and runs had high substrate diversity.

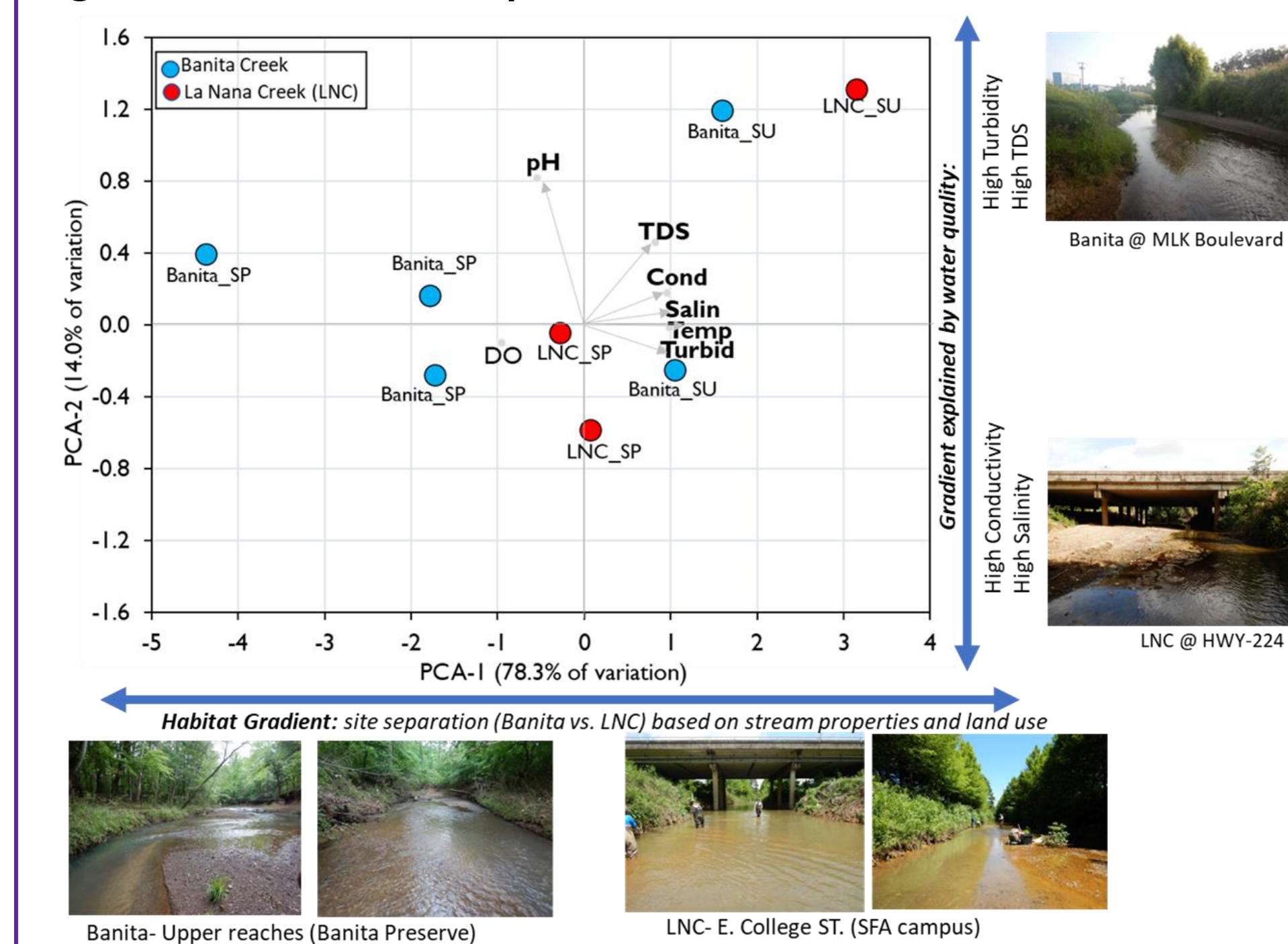
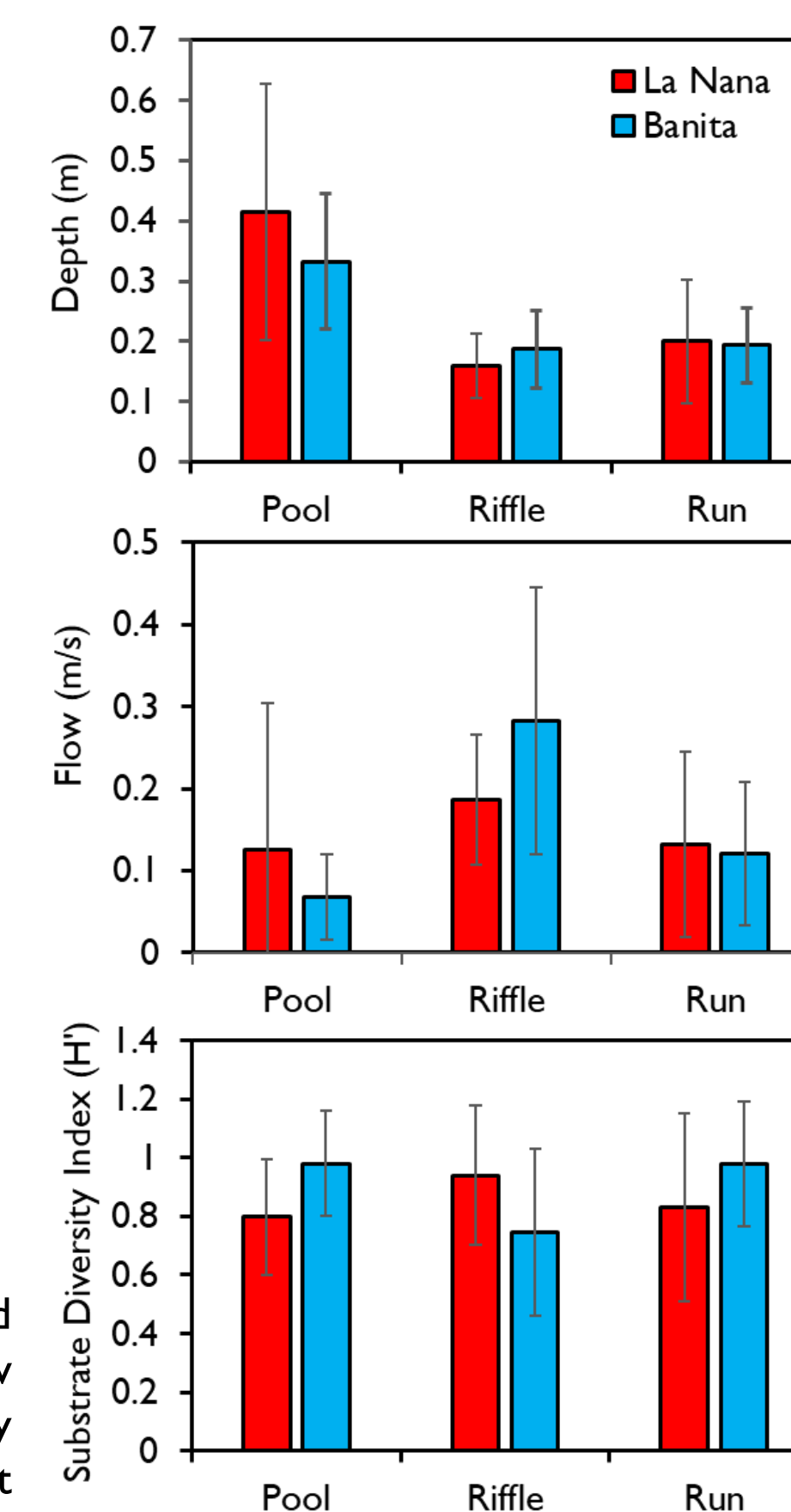


Fig. 3. PCA ordination on environmental variables measured at each stream during spring (SP) and summer (SU) of 2022. Each variable represents the average of two measurements during each sampling event.

Fig. 4. Means and Standard deviations of depth, flow and substrate diversity measured at each habitat type within each stream.



### Species Occurrence & Habitat Type

Occurrence of the three cyprinids was different between streams and the microhabitats types (Fig. 5). Overall, the occurrence of Blacktail shiner was higher among habitat and streams.

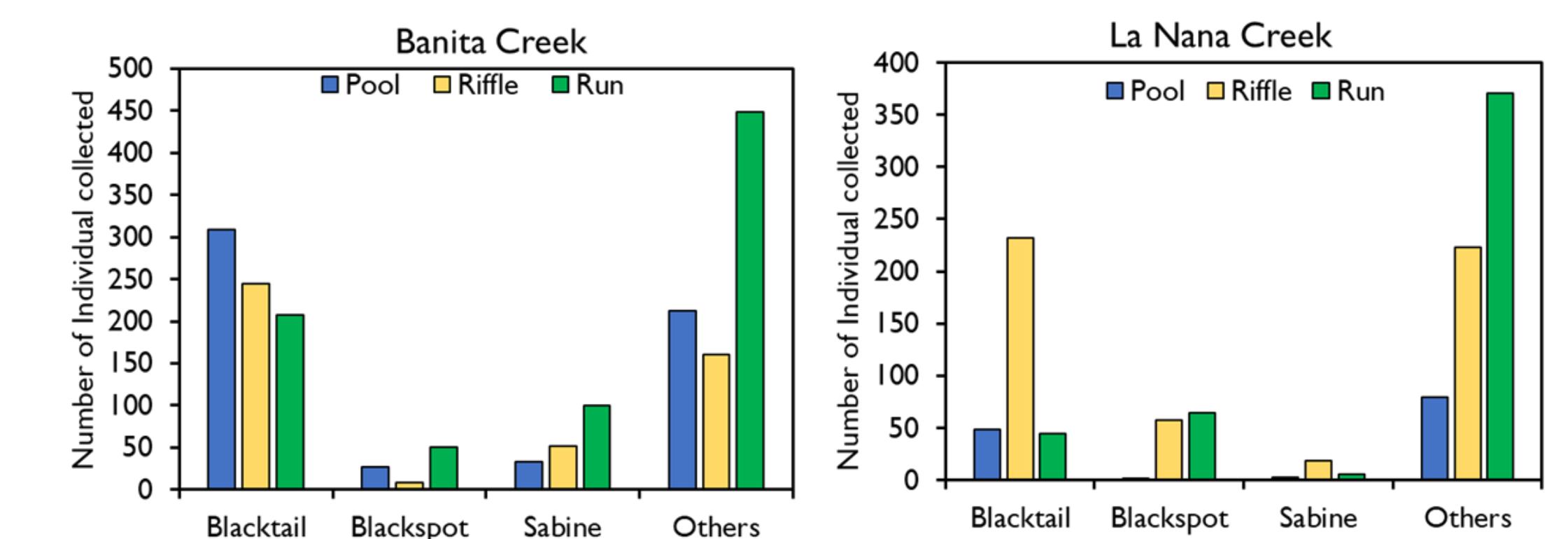


Fig. 5. Occurrence of individual species according to habitat types in both Banita and La Nana creeks. Occurrence of shiners were significantly different in Banita Creek (ANOVA test:  $F_{(3,136)}=11.32, P = 0.0006$ ), La Nana Creek (ANOVA test:  $F_{(3,60)}=7.82, P = 0.0001$ ).

### Niche -Trait Space

The three shiner species differed significantly in body size (Fig. 6). Blacktail shiner was significantly larger than Blackspot and Sabine shiners.

The PCA ordination suggested little overlap in morphological trait space (Fig. 7). Species appeared separate based on body shapes and traits associated with trophic ecology.

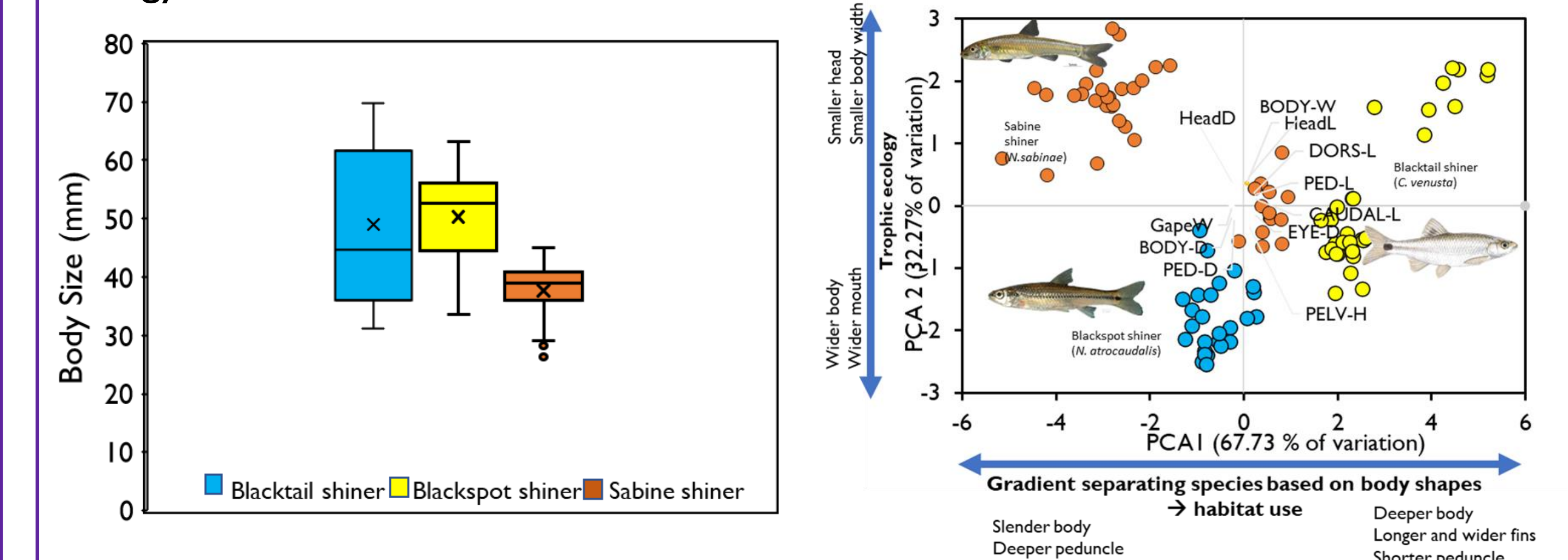


Fig. 6. Overall average and standard deviation of the three shiner examined in this study. ANOVA test:  $F_{(2,95)}=20.54, P = 0.0003$

Fig. 7. PCA ordination on morphological traits measured in the three shiner species from Banita and La Nana creeks. PERMANOVA showed high variation in morphology among species ( $F = 20.25, P = 0.0001$ )

### Discussion & Conclusion

- Sabine and blackspot shiners had low occurrence across seasons and habitat types compared to blacktail shiner. Blacktail shiner is considered a habitat and trophic generalist. Therefore, high abundances of this species could potentially influence resources availability for Sabine and blackspot shiner, which are habitat specialists.
- While the three species co-occurred, morphological differences were observed among them suggesting that co-existence can be maintained by morphologically segregating in space and exploiting resources differently. For instance, Sabine shiner was more common in riffles while blacktail was in pools.

Overall, the three shiners co-occurred together, although significant differences were observed in their abundances. Further research is needed to clarify whether high abundance of Blacktail shiner or the degree of urbanization is affecting abundances of Sabine and Blackspot shiners.

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### References

- [1] Dibble E.D. & S. Harrel. (2000). Microhabitat selection by three stream dwelling cyprinids: Blacktail shiner (*Cyprinella venusta*), Bluntnose shiner (*C. camura*), and Stripped shiner (*Luxilus chrysocephalus*). J. Freshw. Ecol. 15(4):455-462.