

Assessing changes in freshwater mussels a decade after significant multi-year droughts

INTRODUCTION

- The Lower Flint River Basin (LFRB) of Georgia averages ~50" of annual rainfall, but three multi-year droughts between 1999 and 2012 indicated that periods of water scarcity are possible (Figure 1).
- Surveys pre-drought (1999), during drought (2001), and after a decade of relaxed conditions (2023) allowed us to assess the impacts of severe low flows on freshwater mussel populations and their current distribution (Figure 2).



METHODOLOGY AND RESULTS

- Used 2001-2022 data from USGS gages upstream of our survey sites to calculate low flow metrics (Table 1)
- Delineated stream valley for 1-km above each survey site (Figure 3) and used aerial imagery to classify managed land (active forestry or agriculture)
- Performed a principal component analysis (PCA) utilizing our flow metrics, management area, change in abundance, and species traits (Figure 4)

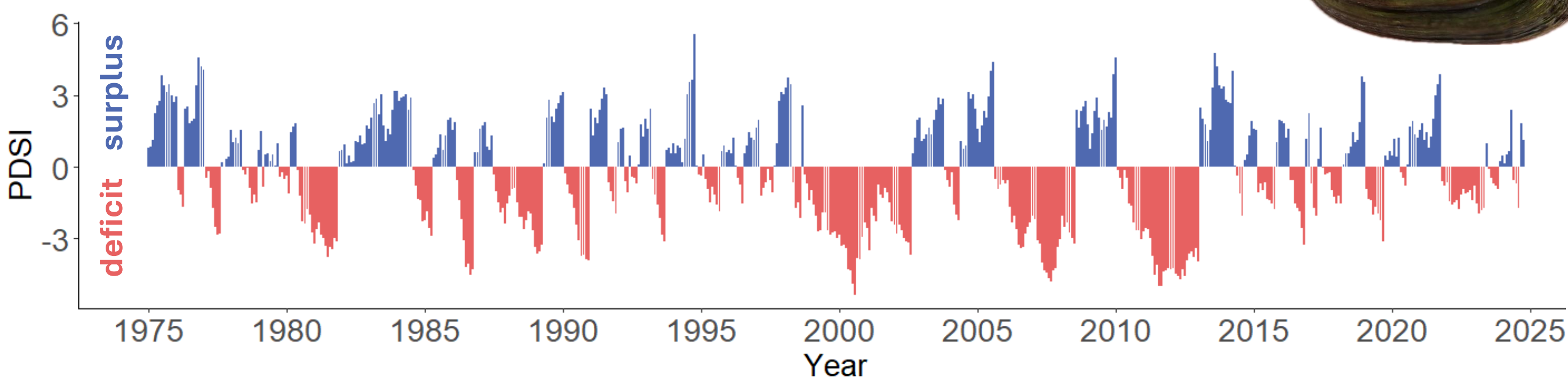
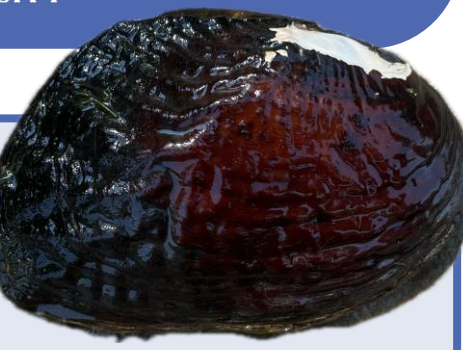


Figure 1. Palmer Drought Severity Index (PDSI) for the Southwestern Region of Georgia (data source: NOAA National Centers for Environmental Information, Region 7).

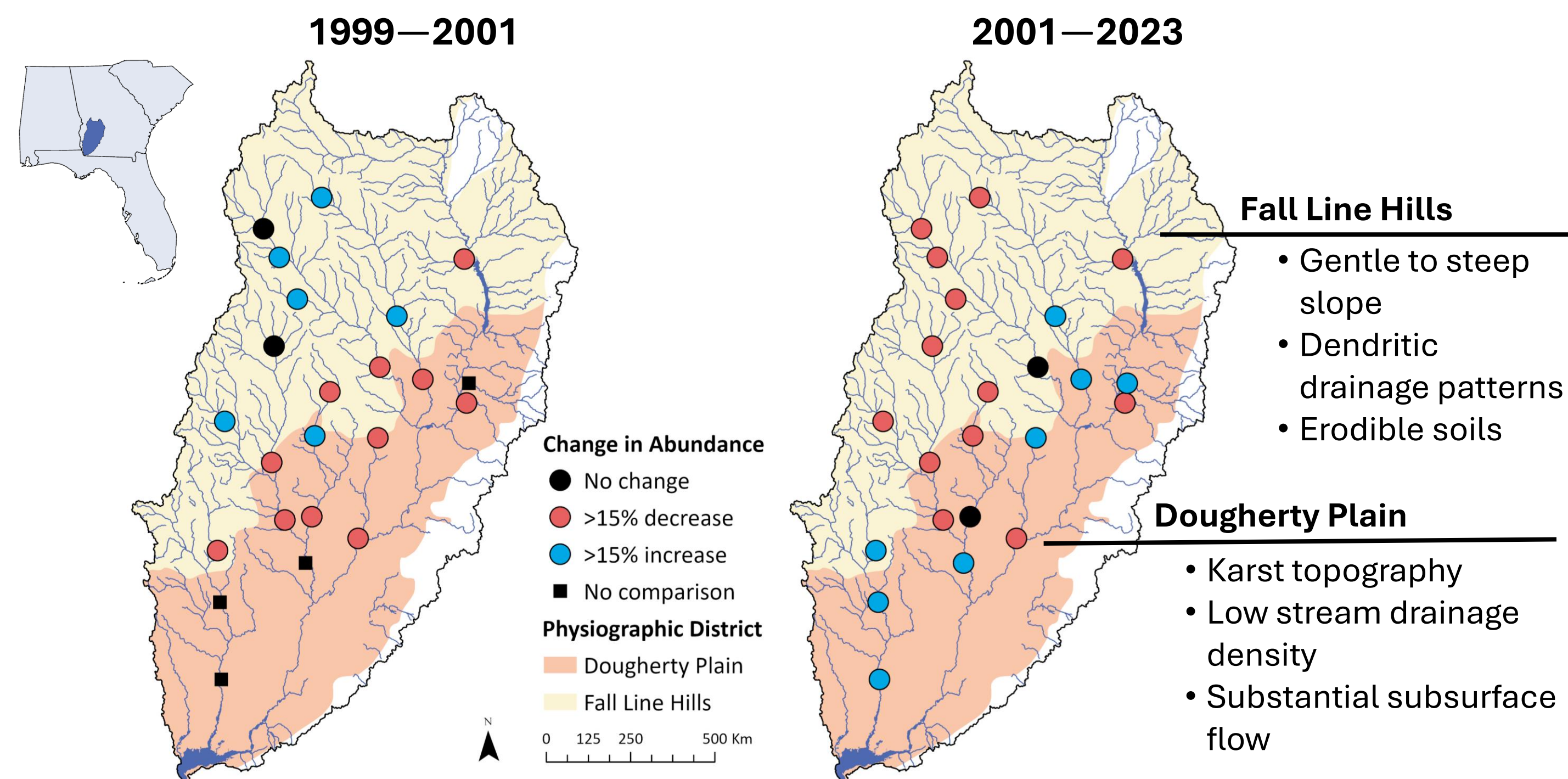


Figure 2. Change in abundance of mussels over time. The change from 1999—2001 spans the first of three multi-year droughts that occurred between 1999—2012. 2013—2023 represented a period of more normal flow conditions and the possibility of recovery from extended water scarcity.

RESEARCH GOAL

Characterize changes in mussel abundance and distribution across physiographic districts using land use and hydrologic response to water scarcity

Table 1. Hydrologic metrics calculated for use in PCA.

Abbreviation	Definition
freq10	Frequency of days in year below 10 th percentile flow
day-min	Lowest flow in year corrected for watershed area
BFI	Base flow index

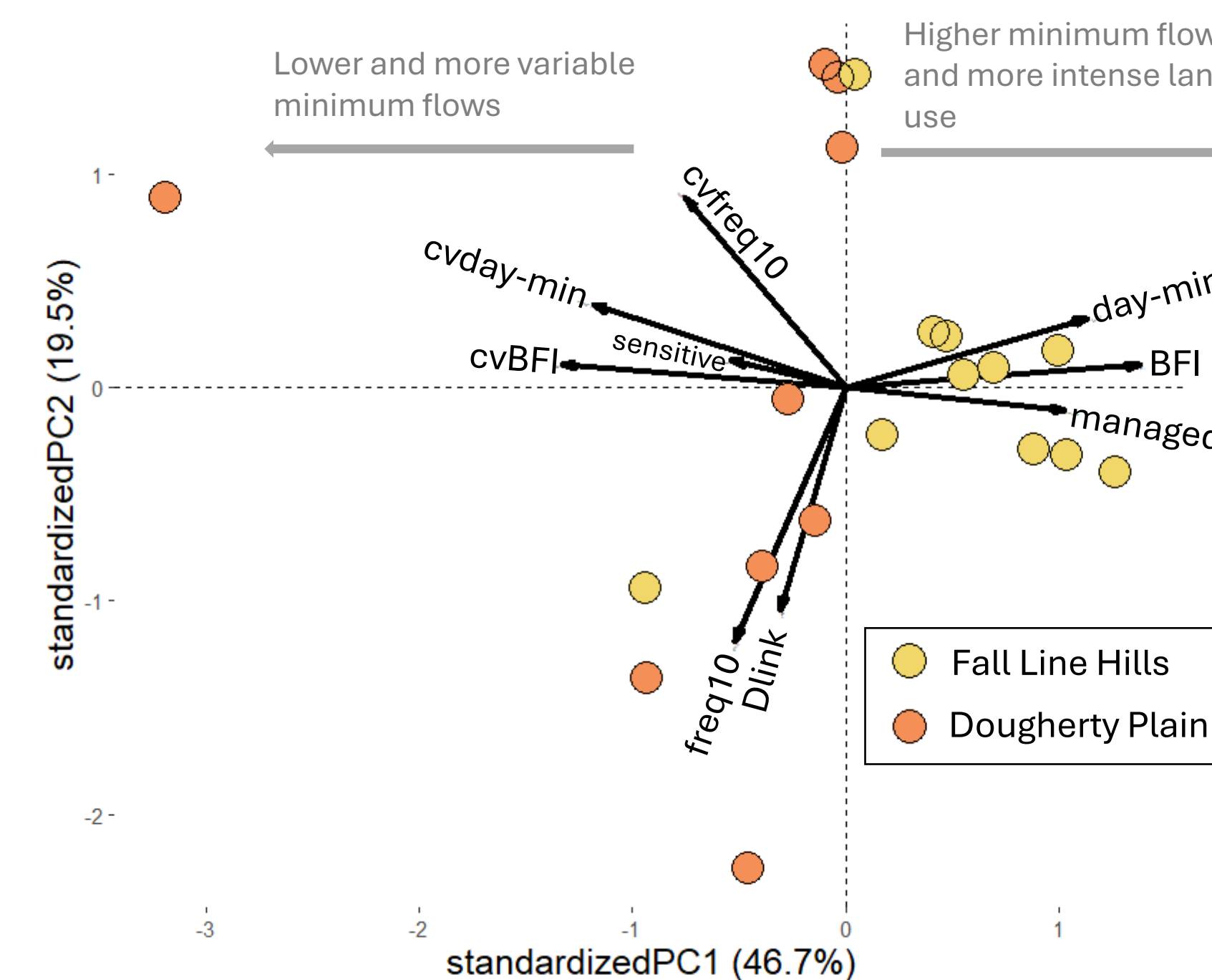


Figure 4. Principal component analysis. “cv” is coefficient of variation, “Dlink” is a measure of the stream functional size/position, “managed” is managed area, and “sensitive” is the change is proportion of drought sensitive mussels at the site from 2001-2023.



Figure 6. Three endangered species that live in tributaries of the Flint River: (from left) *Hamiota subangulata*, *Pleurobema pyriforme*, and *Medionidus penicillatus*.

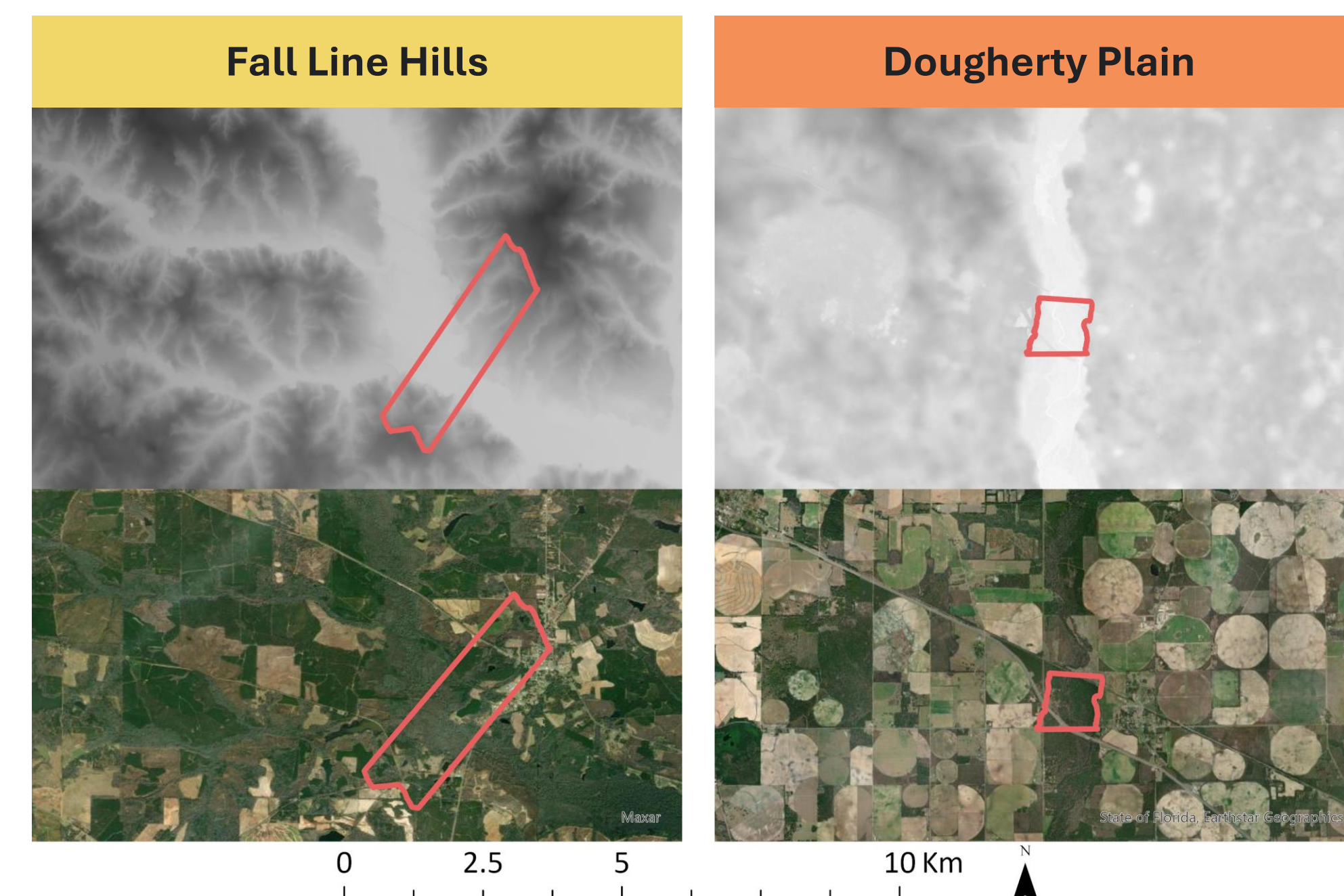


Figure 3. A comparison of relative elevation maps created from digital elevation maps and aerial imagery.

IMPLICATIONS FOR CONSERVATION

- Conservation initiatives are in progress in the LFRB to prevent extreme low flows during the agricultural growing season. Visit ga-fit.org for an overview.
- Efforts to prevent extreme low flows in the Dougherty Plain will likely be effective.
- The Fall Line Hills had higher minimum flows and significantly higher managed area in the stream valley (Kruskal-Wallis, p=0.001). In the field, we observed large areas of coarse sand that represented poor mussel habitat. Declines could be related to excessive sedimentation, and additional conservation efforts to reduce soil erosion may be required.

ACKNOWLEDGEMENTS

We'd like to thank Brian Clayton, Natalie Horn, Emma Greenberg, and Jenna Jackson for their contributions to mussel surveys. Our understanding of mussel distribution is greatly improved by the landowners who give us access to their property.

