

Reconstructing historical patterns of stonefly (Insecta: Plecoptera) diversity with species distribution modeling

Jason L. Robinson*, Massimo Pessino, Tari Tweddale, Leon Hinz, Ed DeWalt and Yong Cao
 Illinois Natural History Survey, Prairie Research Institute
 University of Illinois Urbana-Champaign, Champaign IL 61820
 *jrob@illinois.edu

- Aquatic insects are critical for many ecosystem processes (e.g., leaf decomposition), main food for many fishes, and indicators of water quality
- Many species have lost geographic range in the 20th century as a result of anthropogenic stressors
- We used species distribution models to estimate the historic geographic range of 82 stonefly species in IL, IN, OH, MI & WI.



♀ *Acroneuria* sp. (Plecoptera: Perlidae) with egg mass



- We used GIS to compile data on soils, land-cover, geological features, temperature and precipitation
- These data were aggregated at the scale of HUC12 watersheds

Darkly shaded states are study area, where we compiled environmental data and predicted species distributions.

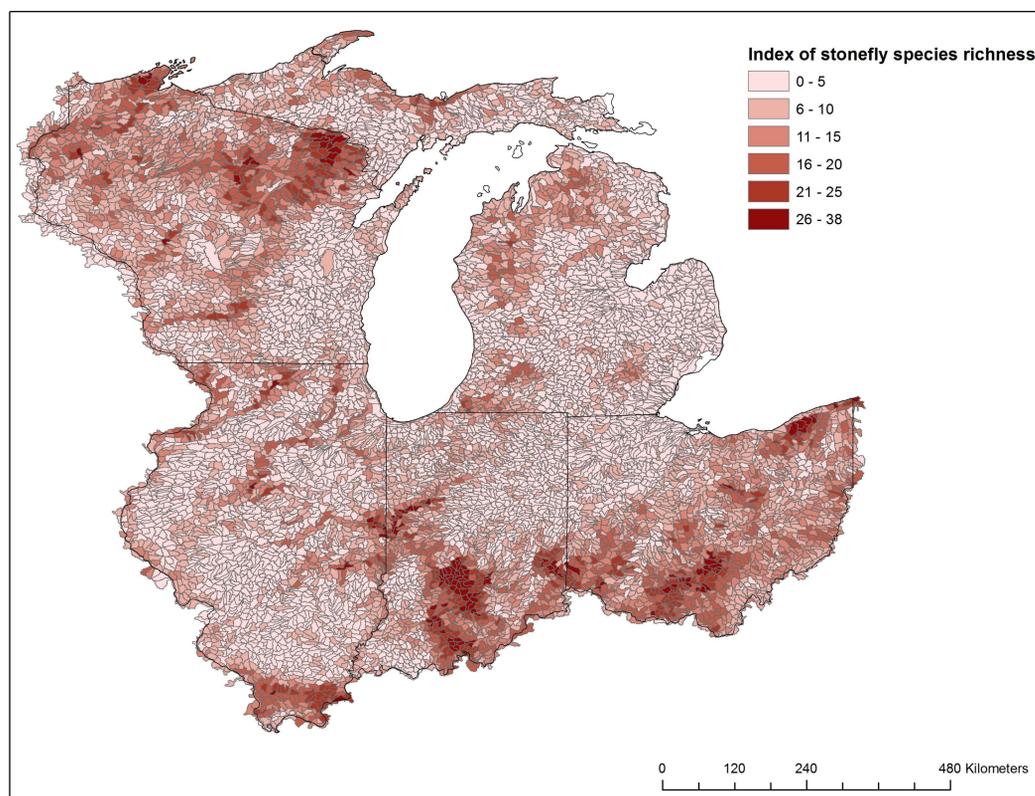
- More than 20,000 individual occurrence records from specimens in institutional collections, museum holdings, verifiable literature references and from new collections
- Species distribution models predict the presence/absence of individual species used to describe regional patterns of richness.



Isoperla sp. nymph



Stonefly specimens in individual vials, each contains labels with specimen data (Genus and species, sex, etc) and locality information (site, county, state where collected, methods, dates, etc)

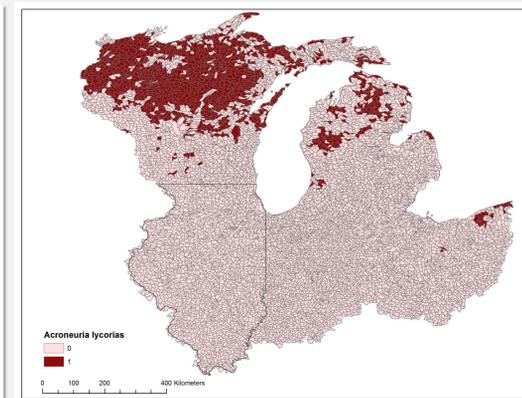
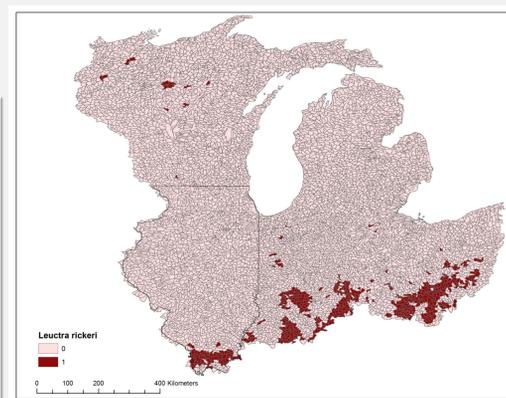


147 species are known from the study area, and 82 species have enough records for reliable application of Maxent. The diversity hotspots predicted include southern parts of IL, IN, OH, and northern WI. The maximum richness predicted for any individual watershed was 38.



Helopicus subvarians (Perlodidae)

Stoneflies spend most of their life in the stream, as a wingless “nymph”. Upon maturity, stoneflies climb out of the water, shed the last skin and expand their new wings to fly away and live a few more days or weeks.



Areas with similar species richness across the study region may have distinct faunal composition. Many species ranges have their northern (left, *Leuctra rickeri*) or southern (right, *Acroneuria lycorias*) range margins in the study area. Geographic areas where the range margins of many species coincide are reservoirs of biodiversity and offer the opportunity to conserve many unique ecological communities, interactions and species distributions.

Applications



Perlesta sp. (Perlidae) ♂♀ in copula. *Perlesta* species fly in warmer months and may be attracted to and collected from lights (like these specimens)

- Refining assessments of stream health based on measures of the deviation from expected richness
- Inform conservation plans for species which have been extirpated from large fractions of the range
- Search for new populations of rare or imperiled species
- Developing methodology for extracting the spatial signal from species-environment relationships in these types of data
- Understand spatial patterns of species-environment relationships as macroevolutionary outcome in geologic time
- Examining niche conservatism and other evolutionary relationships among species or clades
- Predicting effects of climate change on aquatic insect habitats, populations, species and communities.

Acknowledgements:

This study is supported by NSF grant (DEB-0918805 ARRA) and Department of Interior grant (X-1-R-1).