Aquatic True Bugs of Indiana (Hemiptera: Heteroptera)

PURDUE UNIVERSITY | Entomology

Abstract

We inventoried the aquatic true bugs, predators and water quality indicators, found in Indiana using preserved specimens. It has been nearly 100 years since the last identification manual and 36 years since the last catalog of Indiana bugs, and many aquatic ecosystems in Indiana have been altered or are vulnerable.

Introduction

Hemiptera is an order of insects often called “true bugs”, easily distinguishable by their wings (= hemelytra; membranous at the tips and leathery at the base). Heteroptera is a suborder (formerly an order) of Hemiptera with ~45,000 species worldwide. Although true bugs live in many habitats, this research focused on aquatic species as these insects are predators of various invertebrates and important water quality bioindicators. However, not much information has been published about them.

The 1926 book by Willis S. Blatchley, *Heteroptera or True Bugs of Eastern North America*, is the only comprehensive identification guide to cover all Heteroptera species from Indiana. A more recent catalog was published in 1988 by Henry and Froeschner. But they only report state-level presence under distribution remarks. In the nearly 100 years since Blatchley’s manual and 36 years since Henry and Froeschner’s catalog many aquatic ecosystems in Indiana have been altered or are endangered by climate change.

The goals of the research was to inventory the aquatic true bugs that occur in Indiana and create a species checklist, to guide future conservation solutions.

Methods

3,152 specimens examined from Indiana’s largest entomological collection, the Purdue Entomological Research Collection (PERC)

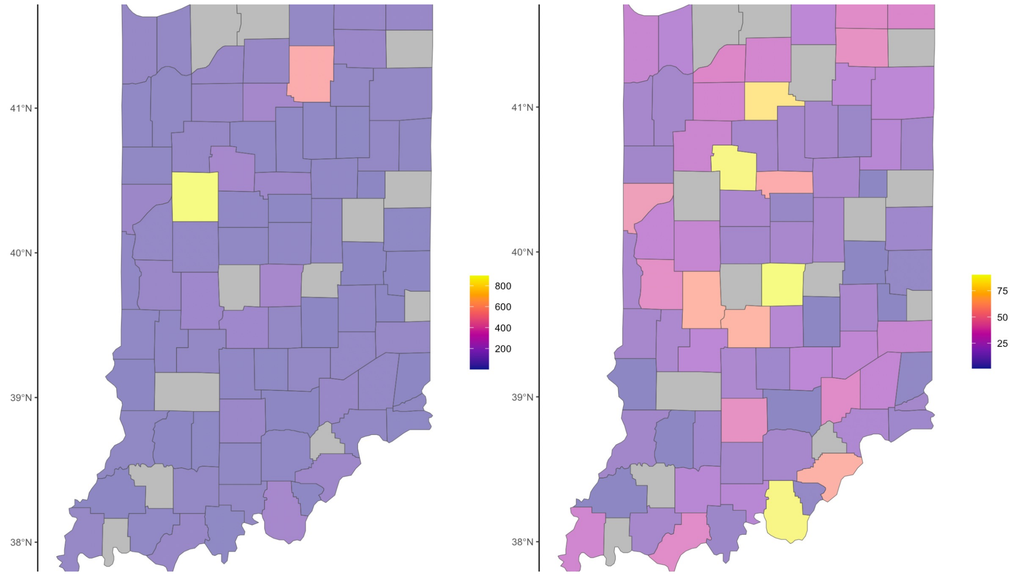
- Specimens dry, pinned or ethanol-preserved
- 2,330 specimens digitized for this project
- Plus 822 previously digitized specimens
- Except legacy PERC pinned Corixidae records; removed from the dataset as numerous errors discovered
- All specimen labels transcribed into Excel sheet
- Data recorded (on left): 1) collection locality, 2) collection date, 2) collector, 3) identifier, and 3) date of identification
- Assigned PERC label (unique series of numbers + barcode) to link specimens to data (4 on left)

Generated a heat map

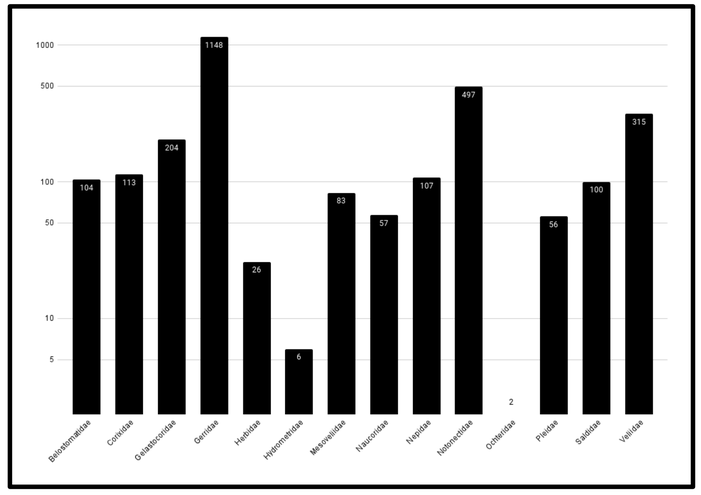
- Data columns for family, genus, species, counties
- Counted specimens/county in Rstudio with dplyr, ggplot2, maps, and sf packages
- We generated two heat maps due to large differences in the number of specimens/county

Created species list

- Combined family: taxon names (Excel: CONCATINATE function) and filtered out duplicate taxa
- Compared our list to an unpublished Indiana aquatic insect inventory (Hellenthal et al. 2003) to detect possible new state records



Graph of Family (log scale)



Results and Discussion

We recorded 14 families, 36 genera, and 83 species of aquatic true bugs from Indiana (above). The most commonly collected families were Gerridae (1,148 specimens), Notonectidae (497), and Veliidae (315). And we found 11 possible new state records (4 Gerridae, 1 Naucoridae, 3 Notonectidae, 3 Veliidae).

12 counties were not represented in the PERC (heat map, on left). The most collected county is Tippecanoe (895, in yellow), where Purdue is located. The second highest was Kosciusko (540, in pink). The other counties did not surpass 100 specimens.

Our second heat map (on right) was created without Tippecanoe and Kosciusko as they were skewing the scale. Without these outliers, this map shows greater number of insects were collected in counties around Tippecanoe and southern part of Indiana, presumably due to both Wabash and Ohio Rivers. Another source of sampling bias can be seen in Marion County as it is a major population center (Indianapolis). And the map shows east-central and south-western portion of the state are under-collected.

For future directions we hope to 1) correct pinned Corixidae data for further analysis/updated species list, 2) publish specimen data to online aggregators, 3) analyze seasonality, source of sampling bias.

Erykah Poster References

Blatchley, W. S. *Heteroptera or True Bugs of Eastern North America*. Nature Pub., 1926.

Becker, R.A., Wilks, A.R., Brownrigg, R., & Minka, T.P. maps: Draw GeographicalMaps, 2023. URL http://CRAN.R-project.org/package=maps R package version 3.4.2

Carnahan, Sue. "Gerridae? Water Strider - Aquarius Remigis." *Welcome to BugGuide.Net! - BugGuide.Net*, bugguide.net/node/view/1663257. Accessed 25 Apr. 2024.

Hellenthal, R. A., R. D. Waltz, A. V. Provonsha, and J. D. Haddock. 2003. Preliminary Checklist of Indiana Aquatic Insects. Indiana Academy of Science Aquatic Macroinvertebrates Workshop: Overview of the State of Science. October 17, 2003. Anderson, Indiana. iv + 73 pp.

Henry, Thomas J., and Richard C. Froeschner. *Catalog of the Heteroptera, or True Bugs, of Canada and the Continental United States*. St. Lucie Press, 2018.

Heteropteran Systematics Lab, heteroptera.ucr.edu/. Accessed 25 Apr. 2024.

H. Wickham. ggplot2: Elegant Graphics for Data Analysis. Springer-Verlag New York, 2016.

Pebesma E, Bivand R (2023). *Spatial Data Science: With applications in R*. Chapman and Hall/CRC. doi:10.1201/9780429459016, https://r-spatial.org/book/.

"Veliidae." *Wikidata*, www.wikidata.org/wiki/Q1262432. Accessed 25 Apr. 2024.

Wickham H, François R, Henry L, Müller K, Vaughan D (2023). *dplyr: A Grammar of Data Manipulation*. R package version 1.1.4, https://github.com/tidyverse/dplyr, https://dplyr.tidyverse.org.