

Early detection and range expansion of the Mohawk watershed's newest aquatic invader, the bloody red shrimp: A citizen science and survey-based approach

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Invasion History and Call for Citizen Science

In 2006, a small aquatic invertebrate with an ominous-sounding name, the bloody-red shrimp (BRS), invaded Great Lakes waters. The species most likely hitchhiked in the ballast of western bound ships from Europe where they had become most recently established. Since that time, BRS have been reported in several inland New York Lakes and canals including Seneca, Oneida and Cayuga Lakes as well as the Seneca-Cayuga and Erie Canal (Brown et al., 2014). Most of these reports have resulted from incidental encounters or targeted research studies by colleges and universities. However, these studies and casual public reportings can be erratic both spatially and temporally due to the realistic budget constraints of the grants funding the research or the limited number of experts or public observers involved in the reporting.

If we want to better understand the rate of spread of BRS and other aquatic invaders, a citizen-based survey approach offers many advantages over classical research studies in both early detection and prevention work. For one, citizen science volunteers may be able to access sampling sites on private and protected lands that most scientists are not permitted access to. Secondly, citizen education and outreach initiatives help to empower those members of the public that are interested in preserving the integrity of their local ecosystems by actively contributing to a larger research project and helping to protect local waterways. With robust public participation, research experts are then able to consolidate the data received to develop more detailed and thorough invasion history maps and predictive models of range expansion potential. Through ongoing communication and cooperation between researchers and the public, we are able to see the bigger picture of how an invasion is impacting/likely to impact our native aquatic ecosystems' structure and function and how institutions and the general public can work together in management and awareness efforts.

In this study, we evaluate the efficacy of low-budget, "self-assembled" plankton nets and experimental light traps (when distributed to local volunteers and regional partners, in addition to university-led sampling efforts), to help (1) with the early detection and control of the spread of BRS in NYS and (2) establish the invasion front as the species expands throughout the Hudson-Mohawk River basin.

Early detection and monitoring of the bloody red shrimp (BRS)

In June-July of 2016, our team fully completed an expansive plankton net survey of all Finger Lakes and canals within the Finger Lakes that built upon our previously published work (Brown et al., 2014). No significant changes were observed in terms of further spread in the Finger Lakes region. However, we found BRS as far east as Lock 2 on the Erie Canal in Waterford, NY, less than 1 mile from the Hudson River. We consistently found BRS at every major lock site and marina along the Waterford stretch of the Erie Canal, in high numbers and with individuals of multiple age classes. In 2013, no BRS were observed at any sites east of Herkimer, NY. This is a noteworthy finding as it suggests that BRS is capable of moving through canals very quickly and is rapidly moving eastward towards the Hudson River.

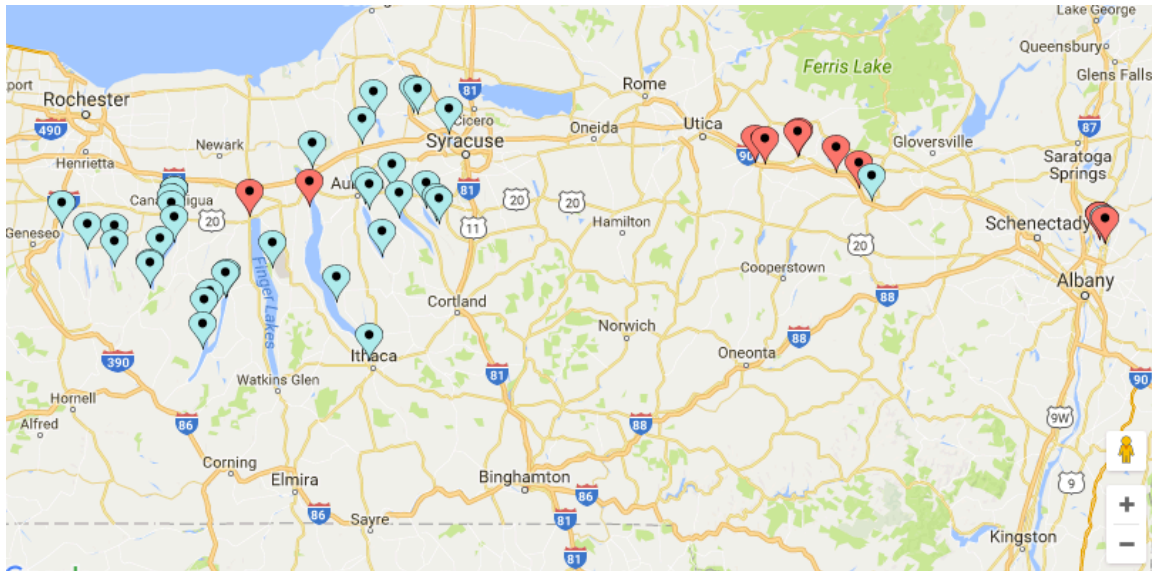


Figure 1. Results of our 2016 BRS survey, including all research scientist and citizen science sampling efforts. Red placemarks indicate presence of the species and blue represent absence. In 2013, there were no reported instances of BRS east of Herkimer, NY. Our current study reveals their presence on the doorstep of the Hudson River.

Citizen Science Surveys

Experimental Light Traps

Our team also deployed BRS-specific light traps as possible rapid response and control mechanisms in areas of known and suspected BRS infestation. Through the help of the Finger Lakes Watercraft Stewards Program, we focused on developing a robust and accurate method of reporting BRS through citizen volunteers that have deployed these traps. Sampling and reporting combined both capturing video of BRS behavior and preserving samples obtained from the traps. The distinctive swimming pattern of BRS makes video footage an ideal method for identifying the presence and abundance of the species. The species has two very large, distinctive eyes and a darkened stomach just behind the eyes that is relatively simple to identify through video capture. In cases in which video capture is inconclusive, we also developed a low-budget method of capturing the contents of the trap by sieving the contents through a coffee filter and preserving the remains in rubbing alcohol. This technique will hopefully be used in future citizen science surveys to further track the spread and detect BRS in the Mohawk-Hudson River basin.



Figure 2. A BRS-specific light trap deployed by Poughkeepsie Day School SCUBA diver, Erik Hedlund. The device emits a preferred light level for BRS that draws the invasive species into the funnel trap where they cannot escape. These trap sampling devices can be deployed from most marinas and piers and are weighed down with a brick and are a highly effective early detection tool for BRS.

Cost-Effective Plankton Nets

One of the more effective methods of identifying BRS presence/absence is sampling the water column with a plankton net during twilight/nighttime when the species inhabits the open waters. Given that BRS are a species that do not arise from the bottom depths until twilight, it is impingent upon citizen volunteers to help sample for the species at these times in areas of suspected invasion. Towards this goal, we assembled and distributed 50 low budget (< \$10 apiece) student plankton nets and created educational brochures and collection instructions, and distributed these materials to citizen volunteers. Through the help of these volunteers, we sampled several private piers and marinas throughout the Finger Lakes that currently-funded research projects are not/have not been able to sample. The results of these deployments can be seen in Figure 1. This technique will hopefully be used in future citizen science surveys to further track the spread and detect BRS in the Mohawk-Hudson River basin.



Figure 3. Leigh Williams Grinnell of Poughkeepsie, NY sewing together homemade plankton nets for distribution to citizen science volunteers. Volunteers sampled various marinas, boat launches and piers across NYS to look for the presence/absence of the aquatic invasive species, the bloody-red shrimp (BRS). Photo credit: Richard Grinnell



Figure 4. Plankton nets developed by student researchers from the Poughkeepsie Day School were distributed to citizen science volunteers to help with monitoring the spread and population dynamics of BRS. The nets were constructed with lightweight materials that could commonly be purchased at local stores for less than \$10. Photo credit: Julia Roellke

References

Brown M, Boscarino B, Roellke J, Stapylton E, & Driller-Colangelo A. 2014. Fifteen miles on the Erie Canal: the spread of *Hemimysis anomala* G.O. Sars, 1907 (bloody red shrimp) in the New York State canal system *BioInvasion Records* 3: 261-267.