Developing Tools to Guide Hellbender Restoration Efforts

Science to Solutions

In Brief:

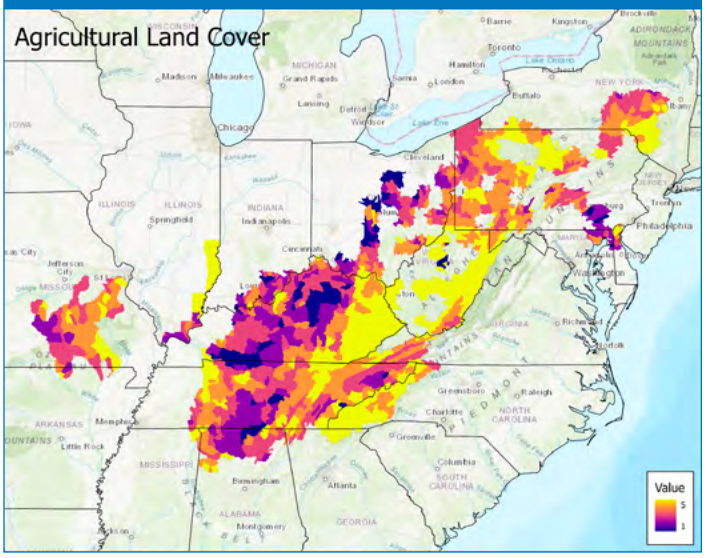
Populations of the eastern hellbender, a giant aquatic salamander found only in streams in the eastern United States, are drastically declining. In response, conservation efforts to create and restore hellbender habitat in degraded streams and rivers throughout their range are accelerating. To refine and focus these conservation efforts, geographic information system (GIS) models were developed to identify where restoration would most benefit the hellbender. These models will be used to strategically guide where conservation practices are implemented through the National Resources Conservation Service (NRCS) Working Lands for Wildlife (WLFW) partnership.

Hellbenders in Decline:

The eastern hellbender has inhabited the cool, rocky, well-oxygenated rivers and streams of the Ohio, Tennessee, and Cumberland River drainages for around 65 million years! Although hellbender populations can be found across this range, they are not uniformly distributed and are thought to be eliminated from 90% of their previous habitat. The primary drivers of this decrease are reduced breeding success and larval survival, considered to be caused by disturbance of stream habitat through non-compatible land-uses and resulting erosion and sedimentation of streams (Humphries and Pauley 2005; Nickerson 2003). Agricultural activities can also contaminate streams with pesticides or herbicides where adequate stream buffers are not in place. This reduction in quality and quantity of habitat put this species at high risk from land-use practices that degrade streambank, riverbank, and flood plain (riparian zone) integrity (Niemiller and Reynolds, 2011).

Eastern hellbenders play an important role in their habitat. As both predator and prey, adult hellbenders control the population size of crayfish, their primary food source, and young hellbenders are an important food source for many fish species. Because of their high sensitivity to pollution and erosion and sedimentation, they are also an important indicator species, with population declines providing early evidence of declining water quality. Many of the watersheds where hellbenders live are among the most biodiverse in the country and are home to other rare and imperiled species. This means environmental improvements for hellbenders will also benefit other species such as the bog turtle, Appalachian elktoe mussel, and brook trout.

FOCUS AREAS



Developing Prioritization Tools for the WLFW Program:

WLFW focuses on recovery of hellbenders in 6 states: Alabama, Georgia, North Carolina, Tennessee, Virginia, and West Virginia. WLFW provides technical and financial assistance through the Environmental Quality Incentives Program and Regional Conservation Partnership Program to help landowners install practices to restore riparian buffers, reduce stream bank erosion and sedimentation, and minimize nutrient inputs from fertilizer and livestock waste. By protecting hellbenders, the WLFW initiative is also helping to support sustainable agriculture, preserve a part of the heritage of the rural Southeast, and improve habitat for hundreds of other species in the biologically rich rivers of this region.

Eastern hellbenders have a large range in the eastern United States, but their populations are unevenly distributed. This means a strategic approach to prioritize program focus areas is required to efficiently direct resources to the right places to achieve the greatest benefit to the species. A series of spatial models were developed by researchers at Tangled Bank Conservation to identify and prioritize watersheds within the states participating in the WLFW initiative.

Assessing Current Distribution of Hellbenders:

Environmental DNA (eDNA), or DNA that is shed into the environment by a species, is an innovative approach for accurate species detection. This approach to detection is especially well-suited for hellbenders because of their rare, secretive nature that make traditional survey techniques difficult and time-consuming.

For this project, NRCS partners conducted a collection effort that pooled almost 2,000 eDNA samples throughout the range of hellbenders. They analyzed these samples for hellbender DNA and identified watersheds, sub-watersheds, and stream reaches where hellbenders were present. They combined the results with present and historic occurrence data to help create a fine-scale population model that could be incorporated into the development of an overall species habitat model.

Developing the Species Habitat Model:

The model was developed using present and historical occurrence records, eDNA data, land use characteristics, habitat availability information, and other habitat metrics. These variables were selected based on literature, expert opinion, and availability of GIS data. Additionally, the fine-scale population model generated from eDNA data was integrated into the model.

Each variable was assigned a numeric value that reflected its positive or negative relationship with hellbender presence. For example, developed land within a watershed has a negative impact on hellbender habitat, so watersheds with more agricultural land were assigned lower values, indicating lower habitat suitability. All of the variables were then considered together to assign a priority value to each identified watershed. Priority values were also assigned to the WLFW sub-watersheds so that habitats were identified at the national and local levels.

Implications for the WLFW Program:

The models developed for this project used a science-based approach to rank priority watersheds for hellbender conservation and will be used to strategically guide WLFW and EQIP efforts. Field staff will have the tools to quickly assess if a landowner possesses habitat eligible for the hellbender WLFW funding pool, and whether it is in a high priority sub-watershed. This information can also be utilized to assess range-wide spatial trends, habitat availability, restoration targets, and outcomes for the WLFW program.

Sources:

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Nickerson, Max A., Kenneth L. Krysko, and Richard D. Owen. (2003). Habitat Differences affecting Age Class Distributions of the Hellbender Salamander, Cryptobranchus alleganiensis. Southeastern Naturalist, 2(4):619-629.

Niemiller, M. L., & Reynolds, R. G. (Eds.). (2011). The amphibians of Tennessee. University of Tennessee Press.

Wineland, SM, Arrick, RF, Welch, SM, et al. 2019. Environmental DNA improves Eastern Hellbender (Cryptobranchus alleganiensis alleganiensis) detection over conventional sampling methods. Environmental DNA 1:86-96. **https://doi.org/10.1002/edn3.9**

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Additional Resources:

To learn more about Natural Resource Conservation Service's Working Lands for Wildlife eastern hellbender project, visit: **nrcs.usda.gov/programs-initiatives/eqip-working-lands-for-wildlife/eastern-hellbender**

To learn more about other Natural Resource Conservation Service's Working Lands for Wildlife projects, visit: **nrcs.usda.gov/wildlife**

To find your local NRCS service center, visit: **nrcs.usda.gov/contact/find-a-service-center**

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