



LOCAL AND LANDSCAPE HABITAT ASSOCIATION, POPULATION ECOLOGY AND FUTURE RECOVERY OF CRAWFISH FROGS (*RANA AREOLATA*) IN INDIANA



Crawfish frog (Lithobates areolatus), breeding male, from Hillenbrand Fish and Wildlife Area

Current Status

Second year of 3 ½-year project

Funding Sources and/or Partners

State Wildlife Grant, Indiana University

Project Personnel

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Hillenbrand FWA, west section, looking east



Southwest corner of west section of Hillenbrand FWA, Willow Pond with drift fence

Background and Objectives

Crawfish frogs are large (adults are 3 inches or longer), heavy frogs that spend much of their adult life in crayfish burrows. In Indiana, crawfish frogs (*Lithobates* [*Rana*] *areolatus*) are considered State Endangered, and their declining status across much of their range has caused broad concern about their conservation. According to Sherman Minton, crawfish frogs were locally plentiful in southwestern Indiana until about 1970. The reasons for their recent and rapid decline are unknown.

Typically, crawfish frogs are associated with tallgrass prairies or other native grasslands; however, these habitats are increasingly being fragmented by, or converted to, row-crop agriculture. Crawfish frogs are also considered weak larval competitors, which likely results in reduced recruitment into populations. Local and regional declines may be further enhanced by interactions with exotic species and the emergence of infectious diseases. While there is some information on general habitat use and population demographics, the fossorial nature and scarcity of crawfish frogs has made detailed investigations difficult and recovery plans ineffective.

If the ultimate goal for an endangered species is the recovery of populations, then distribution, habitat use, and mechanisms of decline must be investigated. The status of the crawfish frog in Indiana presents a unique opportunity for this type of study.

Objectives

1. Determine the status of crawfish frog populations in Indiana.
2. Develop methods to monitor the status of crawfish frog populations in Indiana.
3. Determine population parameters of crawfish frogs on public lands in an effort to delimit potential life-history bottlenecks that affect in the survival of this species.
4. Define natural history features such as movement patterns (across the landscape), activity patterns (daily and seasonally), and habitat use features (burrow location) of crawfish frogs, and identify threats to this species from current landscape

attributes (roads, agricultural fields) and land-use practices (frequency of plowing, prescribed burning).

5. Determine the genetic relationships among Indiana crawfish frog populations.
6. Define the role of disease (chytrid fungus) in limiting Indiana crawfish frog populations.
7. Determine how practical captive rearing can be for augmenting populations.
8. Run parallel studies at sites in southwest Indiana (Hillenbrand Fish and Wildlife Area, Dave's Pond) and southeast Indiana (Big Oaks National Wildlife Refuge)
9. Provide management recommendations to Indiana DNR and U.S. Fish and Wildlife Service to maximize the likelihood that crawfish frog populations persist in Indiana.

Methods

We use a wide variety of methods and techniques, including drift fences/pitfall traps, call surveys, seining, minnow trapping, radio telemetry, museum and literature searches, wildlife cameras, song meters, digital videography, pit tagging, toe clipping, microsatellite arrays, histology, PCR analyses, visual surveys, disease surveys, tissue sampling for genetic analysis, and captive rearing, as follows:

- 1) Status: Literature searches, museum searches, call surveys, seining, minnow trapping, song meters;
- 2) Monitoring: Song meters, minnow trapping;
- 3) Population parameters: Drift fences/pitfall traps, radio telemetry, pit tagging, histology;
- 4) Natural history: Drift fences/pitfall traps, radio telemetry, wildlife cameras, videography;
- 5) Genetics: Toe clipping, microsatellite arrays;
- 6) Disease: Swabs for chytrid fungus, histology, PCR;
- 7) Population augmentation: Captive rearing pools, diet, timing;
- 8) Statewide comparison: Two crews, one in southwest Indiana led by Lannoo, the other at Big Oaks led by Karns and Robb.

Progress

Papers submitted:

- Kinney, V.C., J.L. Heemeyer, A.P. Pessier, and M.L. Lannoo. Seasonal Pattern of *Batrachochytrium dendrobatidis* Infection and Mortality in *Lithobates areolatus*: Affirmation of Vredenburg's "10,000 Zoospore Rule" *PloS One*: Nov. 24, 2010.
- Heemeyer, J.L. and M.J. Lannoo. *Lithobates areolatus circulosus* (northern crawfish frog). Winterkill. *Herpetological Review*. Submitted Nov. 30, 2010.
- Engbrecht, N.J., S.J. Lannoo, J.O. Whitaker and M.J. Lannoo. Comparative morphometrics in rapid frogs (Nenirana clade): Are apomorphic elongation and a blunt snout responses to deep, small-bore burrow dwelling in crawfish Frogs (*Lithobates areolatus*) Copeia. Submitted revised version 23 Nov. '10.

Papers published:

- Lannoo, M.J., V.C. Kinney, J.L. Heemeyer, N.J. Engbrecht, A.L. Gallant, and R.W. Klaver. 2009. Mine Spoil Prairies Expand Critical Habitat for Endangered and Threatened Amphibian and Reptile Species. *Diversity* 1:118–132.
- Engbrecht, N.J. and J.L. Heemeyer. 2010. *Lithobates areolatus circulosus* (northern crawfish frog). *Heterodon platyrhinos* (eastern hog-nosed snake). Predation. *Herpetological Review* 41:197.
- Kinney, V.C. and M.J. Lannoo. 2010. *Lithobates areolatus circulosus* (northern crawfish frog). Breeding. *Herpetological Review* 41:197–198.
- Heemeyer, J.L. and M.J. Lannoo. 2010. A new technique for capturing burrow-dwelling anurans. *Herpetological Review* 41:168–170.
- Heemeyer, J.L., V.C. Kinney, N.J. Engbrecht, and M. J. Lannoo. 2010. The biology of crawfish frogs (*Lithobates areolatus*) prevents the full use of telemetry and drift fence techniques. *Herpetological Review*. 41:42–45.
- Engbrecht, N. J. and M.J. Lannoo. 2010. A review of the status and distribution of crawfish frogs (*Lithobates areolatus*) in Indiana. *Proceedings of the Indiana Academy of Sciences* 119:64–73.
- Kinney, V.C., N.J. Engbrecht, J.L. Heemeyer, and M.J. Lannoo. 2010. New county records for amphibians and reptiles in southwest Indiana. *Herpetological Review* 41:387.
- Hoffman, A.S., J.L. Heemeyer, P.J. Williams, J.R. Robb, D.R. Karns, V.C. Kinney, N.J. Engbrecht, and M.J. Lannoo. 2010. Strong site fidelity and a variety of imaging techniques reveal around-the-clock and extended activity patterns in crawfish frogs (*Lithobates areolatus*). *Bioscience* 60:829–834.



Newly metamorphosed crawfish frog from Hillenbrand FWA.



Crawfish frog in primary burrow at Hillenbrand FWA. Feeding platform is bare muddy area located in front of animal.



This amplexed pair of crawfish frogs at Hillenbrand FWA arrived at drift fence on May 1, three weeks after breeding pulse.



Crawfish frog female at Hillenbrand FWA with a chytrid fungus infection. This frog died within 72 hours and was necropsied by Dr. Alan Pessier, San Diego Zoo.



Juvenile crawfish frog with belt radio attached.

Presentations:

- Lannoo, M.J. The Biology of Crawfish Frogs. Association of Zoos and Aquariums Workshop (Keynote). April '10.
- Lannoo, M.J. The Conservation Biology of Crawfish Frogs. Iowa lakeside Lab, June '10.
- Lannoo, M.J. The Conservation Biology of Crawfish Frogs. Hoosier Herp Society, Sept. '10.
- Engbrecht, N.J. Status and Distribution of Crawfish Frogs (*Lithobates areolatus*) in Indiana. Indiana Academy of Science, October '09.
- Heemeyer, J.L. Post-breeding Migration and Habitat Selection of the Crawfish Frog (*Lithobates areolatus*). Indiana Academy of Science, October '09.
- Hoffman, A.S., P.J. Williams, J.R. Robb, and Daryl R. Karns. Activity Patterns of the Crawfish Frog (*Lithobates [Rana] areolatus*) at Crayfish Burrows in Big Oaks National Wildlife Refuge, Southeastern Indiana. Indiana Academy of Science, October '09
- Kinney, V.C. Breeding Biology of Crawfish Frogs (*Lithobates areolatus*) in Southwestern Indiana. Indiana Academy of Science. October '09.
- Lannoo, M.J. Habitats lost and habitats found. Association of Zoos and Aquariums Workshop (Keynote). Toledo Zoo, April 2009.
- Williams, P.J., A.S. Hoffman, J.R. Robb, and D.R. Karns. Burrow Selection by the Crawfish Frog (*Lithobates [Rana] areolatus*) in Southeastern Indiana. Indiana Academy of Science, October '09.



Nocturnal activity of crawfish frog documented by wildlife camera.



Graduate students Kinney and Heemeyer work up a breeding crawfish frog at Hillenbrand FWA.

Narrative

We have made substantial progress in understanding the life history and natural history features of crawfish frogs in Indiana.

We understand much of their historic distribution and their current distribution. We understand when they breed, and have identified a large percentage of their known breeding sites in Indiana. We understand survivability in both egg and larval stages, and in postbreeding adults.

We have successfully reared large numbers of tadpoles to metamorphosis. We have now tracked crawfish frogs for nearly 8,000 “frog days” and from these data understand where adult burrows are located, and have made a distinction between primary and secondary burrows. We understand activity patterns and habitat use.

We now understand pattern of infection by the chytrid fungus (*Batrachochytrium dendrobatidis*), which exhibits seasonal waxing and waning and kills about 7% of adults during or immediately after breeding.

We have developed a technique for estimating crawfish frog population size based on call characteristics. There are likely fewer than 1,000 crawfish frog adults in Indiana, a figure that confirms their endangered status in the state.

Despite efforts to track juveniles, we do not understand much about what juveniles do or where they go—this will be a major focus in 2011. We understand the role that management techniques such as prescribed burning, mowing, and establishing food plots have on populations. We have made arrangements to have genetic analyses done.

Workers within the state communicate frequently. In addition we have set up (sevosa@listserve.eku.edu) as a listserve to communicate with people working on this species group (three species: Crawfish Frogs, Gopher Frogs [*L. capito*], and Dusky Gopher Frogs [*L. sevosus*, which are federally endangered]).

Cost: \$820,518