STATE WILDLIFE GRANT PROJECT REPORT—INDIANA

Local and Landscape Habitat Association, Population Ecology and Future Recovery of Crawfish Frogs in Indiana

Juvenile crawfish frog with radio-transmitter at Hillenbrand Fish & Wildlife Area, July 2015. (photo by Michael Lannoo)

CURRENT STATUS

Second year of a two-year project, after an initial five-and-a-half year project

FUNDING SOURCES AND PARTNERS

State Wildlife Grant Program (T7R7)
Indiana University
Detroit Zoological Society
Indianapolis Zoo

PROJECT PERSONNEL

Dr. Michael Lannoo, Indiana University School of Medicine
Dr. Daryl Karns, Hanover College (deceased)
Dr. Joe Robb, U.S. Fish & Wildlife Service, Big Oaks National Wildlife Refuge
Dr. John Whitaker, Indiana State University
Dr. John Crawford, Lindenwood College, served on the project from January 1 to June 30, 2009
Marcy Sieggreen, Detroit Zoological Society
Rochelle Stiles, Indiana State University, graduate student
Jonathan Swan, Indiana State University, graduate student
Nate Engbrecht, Indiana State University, graduate student
Jennifer Heemeyer, Indiana State University, graduate student
Vanessa Kinney, Indiana State University, graduate student
Andrew Hoffman, Indiana State University, graduate student
Perry Williams, U.S. Fish & Wildlife Service, Big Oaks National Wildlife Refuge
Ben Walker, U.S. Fish & Wildlife Service, Big Oaks National Wildlife Refuge
Todd Gerardot, Big Oaks National Wildlife Refuge, refuge intern
Dr. Alan Pessier, San Diego Zoo, veterinarian (disease)
Dr. Irene Macallister, U.S. Army Corps of Engineers (disease)
Dr. Stephen Richter, Eastern Kentucky University (genetics)
Emily Gustin, Eastern Kentucky University (genetics)

Dr. Alisa Gallant, U.S. Geological Survey EROS Data Center (GIS)
Dr. Robert Klaver, U.S. Geological Survey EROS Data Center (ecological modeling)
Bill Peterman, consultant,
served on the project from January 1 to June 30, 2009
Kelsey Flowers, Big Oaks National Wildlife Refuge, intern
Stephanie Bishir, Big Oaks National Wildlife Refuge, intern
Angel Tang, Big Oaks National Wildlife Refuge, intern
Justin Emmons, Big Oaks National Wildlife Refuge, intern
Alex Robinson, part-time technician
John Ryan, part-time technician
Shane Stephens, part-time technician
Austin McClain, part-time technician
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Danny Schaefer, part-time technician
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Harrison Ndife, part-time technician
Michael Goode, part-time technician
Suzie Ronk, part-time technician
Susan Lannoo, consultant (unpaid)
Peter Lannoo, graphics designer (unpaid)

BACKGROUND AND OBJECTIVES

Crawfish frogs *(Lithobates [Rana] areolatus)* are large (adults are 3 inches or longer), heavy frogs that spend much of their adult life in crayfish burrows. In Indiana, crawfish frogs are 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 the focus of this work.

Typically, crawfish frogs are associated with tallgrass prairies or other native grasslands. These habitats are increasingly being fragmented by, or converted to, row-crop agriculture. Crawfish frogs also are 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. Although there is some information on general habitat use and population demographics on crawfish frogs, their fossorial nature (i.e., living in burrows) and scarcity 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. The objectives of this project are to:

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 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),

Adult post-breeding female crawfish frog at Hillenbrand Fish & Wildlife Area, April 2015. (photo by Rochelle Stiles)

Garter snake eating a juvenile crawfish frog at Hillenbrand Fish & Wildlife Area, August 2015. (photo by Jonathan Swan)

5. determine the genetic relationships of crawfish frog populations across Indiana,

6. define the role of disease, such as chytrid fungus *(Batrachochytrium dendrobatidis)* and ranavirus, in limiting crawfish frog populations in Indiana,

7. establish captive-rearing techniques that can be used for re-establishing populations across their historic range,

8. determine whether artificial burrows can headstart juveniles in newly introduced populations, and can provide additional upland habitat where populations are thought to be in decline because burrows are limiting,

9. run parallel studies at sites in southwest Indiana (Hillenbrand Fish & Wildlife Area-West, Dave's Pond) and southeast Indiana (Big Oaks National Wildlife Refuge), and

10. provide management recommendations to Indiana Department of Natural Resources (DNR) and U.S. Fish & Wildlife Service to maximize the likelihood that crawfish frog populations persist in Indiana.

METHODS

We have used 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: Occupancy modeling, song meters, minnow trapping, egg mass counts,

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, ranavirus, histology, PCR,

7) population re-establishment: Captive-rearing, diet, timing, determining rates of cannibalism and predation,

8) artificial burrows: Auger, wildlife cameras, telemetry, and

9) statewide comparison: Two crews, one in southwest Indiana led by Dr. Michael Lannoo, the other at Big Oaks National Wildlife Refuge, led by Dr. Robb

PAPERS IN PREPARATION/SUBMITTED

Engbrecht, N.J., J.L. Heemeyer, C.G. Murphy, R.M. Stiles and M.J. Lannoo. Upland calling behavior in crawfish frogs *(Lithobates areolatus)* and calling triggers caused by noise pollution. Copeia. In press.

Stiles, R.M., M.J. Sieggreen, A. Preston, A.P. Pessier, S.J. Lannoo and M.J. Lannoo. First report of ranavirus in crawfish frogs *(Lithobates areolatus),* a species of conservation concern, and in Indiana, USA. Herpetological Review. In press.

Stiles, R.M., M.J. Sieggreen, R.A. Johnson, K. Pratt, M. Vassallo, M. Perry, J.W. Swan and M.J. Lannoo. First attempt to captive-rear state endangered crawfish frogs *Lithobates areolatus* from Indiana, USA. Conservation Evidence. In press.

Stiles, R.M., J.W. Swan, J.L. Klemish and M.J. Lannoo. Amphibian habitat creation on post-industrial landscapes (Invited). Canadian Journal of Zoology. Submitted.

Terrell, V.C.K., J.C. Maerz, R.M. Stiles and M.J. Lannoo. Population dynamics of threatened crawfish frogs informs targets for management. Journal of Wildlife Management. Submitted.

Klemish, J.L., S.P. Aldrich, R.M. Stiles, N.J. Engbrecht, J.L. Heemeyer and M.J. Lannoo. Habitat use in a host-dependent system. In prep.

Stiles, R.M., V.C.K. Terrell and M.J. Lannoo. Larval survivorship, size, and fitness metrics in crawfish frogs *(Lithobates areolatus),* a species of conservation concern. In prep.

Stiles, R.M., T.R. Halliday, N.J. Engbrecht, J.W. Swan and M.J. Lannoo. Wildlife cameras reveal behavioral responses to climate variables in a threatened frog species. In prep.

Swan, J.W., and M.J. Lannoo. Artificial burrow use by juvenile crawfish frogs *(Lithobates areolatus)*. In prep.

Swan, J.W., and M.J. Lannoo. Do northern and southern crawfish frogs have different breeding calls?: a phylogenetic comparison within the Nenirana clade. In prep.

PAPERS PUBLISHED

Engbrecht, N.J., P.J. Williams, J.R. Robb, D.R. Karns, M.J. Lodato, T.A. Gerardot and M.J. Lannoo. 2013. Is there hope for the Hoosier Frog? An update on the status of crawfish frogs *(Lithobates areolatus)* in Indiana, with recommendations for their conservation. Proceedings of the Indiana Academy of Science 121:147–157.

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.

Engbrecht, N.J., J.L. Heemeyer and M.J Lannoo. 2012. *Lithobates areolatus circulosus* (northern crawfish frog). *Coluber constrictor* (black racer). Thwarted predation. Herpetological Review 43:323–324.

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.

Engbrecht, N.J., S.J. Lannoo, J.O. Whitaker and M.J. Lannoo. 2011. Comparative morphometrics in ranid frogs (subgenus *Nenirana*): Are apomorphic elongation and a blunt snout responses to deep, small-bore burrow dwelling in crawfish frogs *(Lithobates areolatus)*. Copeia 2011:285–295.

Engbrecht, N.J. and M.J. Lannoo. 2012. Crawfish frog behavioral differences in postburned and vegetated grasslands. Fire Ecology 8:63–76.

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.

Heemeyer, J.L. and M.J. Lannoo. 2010. A new technique for capturing burrow-dwelling anurans. Herpetological Review 41:168–170.
Heemeyer, J.L. and M.J. Lannoo. 2011. *Lithobates areolatus circulosus* (northern crawfish frog). Winterkill. Herpetological Review 42:261–262.
Heemeyer, J.L. and M.J. Lannoo. 2012. Breeding migrations in crawfish frogs *(Lithobates areolatus):* Long-distance movements, burrow philopatry and mortality in a near-threatened species. Copeia 2012:440–450.
Heemeyer, J.L., P.J. Williams and M.J. Lannoo. 2012. Obligate crayfish burrow use and core habitat requirements of crawfish frogs. Journal of Wildlife Management 76:1081–1091.
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.
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.
Kinney, V.C., J.L. Heemeyer, A.P. Pessier and M.L. Lannoo. 2011. Seasonal pattern of *Batrachochytrium dendrobatidis* infection and mortality in *Lithobates areolatus:* Affirmation of Vredenburg's "10,000 Zoospore Rule" PloS One e16708.doi:10.1371/journal.pone.0016708.
Kinney, V.C. and M.J. Lannoo. 2010. *Lithobates areolatus circulosus* (northern crawfish frog). Breeding. Herpetological Review 41:197–198.
Klemish, J.L., N.J. Engbrecht and M.J. Lannoo. Positioning minnow traps to avoid accidental deaths of breeding frogs. Herpetological Review 44:241–242.
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.
Nunziata, S.O., M.J. Lannoo, J.R. Robb, D.R Karns, S.L. Lance and S.C. Richter. 2013. Population and conservation genetics of crawfish frogs, *Lithobates areolatus,* at their northeastern range limit. Journal of Herpetology 47:361–368.
Terrell, V.C.K., N.J. Engbrecht, A.P. Pessier and M.J. Lannoo. 2014. Drought reduces chytrid fungus *(Batrachochytridium dendrobatidis)* infection intensity and mortality but not prevalence in adult crawfish frogs *(Lithobates areolatus)*. Journal of Wildlife Diseases 50:56–62.
Terrell, V.C.K., J.L. Klemish, N.J. Engbrecht, J.A. May, P.J. Lannoo, R.M. Stiles and M.J. Lannoo. 2014. Amphibian and reptile recolonization of reclaimed coal spoil grasslands. Journal of North American Herpetology 2014:59–68.
Williams, P.J., N. J. Engbrecht, J. R. Robb, V. C. K. Terrell and M.J. Lannoo. Surveying a threatened species through a narrow detection window. Copeia 2013:553–562.
Williams, P.J., J.R. Robb, R.H. Kappler, T.E. Piening and D.R. Karns. 2012. Intraspecific density dependence in larval development of the crawfish frog *Lithobates areolatus*. Herpetological Review 43:36–38.
Williams, P.J., J.R. Robb and D.R. Karns. 2012. Habitat selection by crawfish frogs *(Lithobates areolatus)* in a large mixed grassland/forest habitat. Journal of Herpetology 46:682–688.
Williams, P.J., J.R. Robb and D.R. Karns. 2012. Occupancy modeling of breeding crawfish frogs in southeastern Indiana. Wildlife Society Bulletin 36:350-357.

THESES

Engbrecht, N.J. 2010. The status of crawfish frogs *(Lithobates areolatus)* in Indiana and a tool to assess populations. M.S. Thesis, Indiana State University, Terre Haute, IN.
Heemeyer, J.L. 2011. Breeding migrations, survivorship and obligate crayfish burrow use by adult crawfish frogs *(Lithobates areolatus)*. M.S. Thesis, Indiana State University, Terre Haute, IN.
Kinney, V.C. 2011. Adult survivorship and juvenile recruitment in populations of crawfish frogs *(Lithobates areolatus),* with additional consideration of the population sizes of associated pond breeding species. M.S. Thesis, Indiana State University, Terre Haute, IN.

PRESENTATIONS

Lannoo, M.J. Habitats lost and habitats found. Association of Zoos and Aquariums Workshop (Keynote), Toledo Zoo, April '09.
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, September '10.
Lannoo, M.J. Update on the biology of crawfish frogs. Association of Zoos and Aquariums Workshop (Keynote), April '11.
Lannoo, M.J. The conservation biology of crawfish frogs. SE PARC, February '11.
Lannoo, M.J. Update on the conservation biology of crawfish frogs. Iowa Lakeside Lab, June '11.
Lannoo, M.J. The biology of crawfish frogs. Canadian Association of Herpetologists' Annual Meeting (Keynote), October '11.
Lannoo, M.J. Update on the conservation biology of crawfish frogs. Iowa Lakeside Lab, June '12.
Lannoo, M.J. Ethics and values across changed and changing landscapes. World Congress of Herpetology (Invited), August '12.
Lannoo, M.J. The conservation biology of crawfish frogs. University of Iowa, September '12.
Lannoo, M.J. Can we re-introduce crawfish frogs into Iowa? Iowa State University, September '12.
Lannoo, M.J. Recent progress on the conservation of crawfish frogs. Association of Zoos and Aquariums Workshop (Keynote), April '13.
Lannoo, M.J. The conservation biology of crawfish frogs. University of Iowa, September '13
Lannoo, M.J. The conservation biology of crawfish frogs. Iowa

State University, September '13

Lannoo, M.J. The conservation biology of crawfish frogs. Iowa Lakeside Laboratory, September '14

Lannoo, M.J. The conservation biology of crawfish frogs. Oregon State University, October '14

Lannoo, M.J. The conservation biology of crawfish frogs, University of Alaska, October '14

Lannoo, M.J. and R.M. Stiles. How can we prevent crawfish frogs from being federally listed? Fish and Wildlife Service Conservation Science Webinar Series, November '14.

Lannoo, M.J. Do amphibians have the emotional and economic clout to save amphibians? Kansas Herp. Soc. Keynote. November '14.

Lannoo, M.J., J.L. Klemish, R.M. Stiles and J.W. Swan. Amphibian habitat creation on post-industrial landscapes (Invited). Canadian Society of Zoologists' Annual Meeting, May '15.

Engbrecht, N.J. Status and distribution of crawfish frogs *(Lithobates areolatus)* in Indiana. Indiana Academy of Science, October '09.

Engbrecht, N.J., V.C. Kinney and M.J. Lannoo. Using call counts to estimate anuran population sizes: an example using crawfish frogs *(Lithobates areolatus).* SE PARC, February '11.

Engbrecht, N.J. and M.J. Lannoo. Status and conservation of crawfish frogs in Indiana. SE PARC, February '11.

Engbrecht, N.J. Cracking the crawfish frog code: understanding and conserving one of North America's most secretive frogs. Bethel College, November '11.

Engbrecht, N.J. The secret world of crawfish frogs: understanding and conserving one of North America's most secretive frogs. Friends of Potato Creek State Park Meeting, August '13.

Engbrecht, N.J., R.M. Stiles and M.J. Lannoo. Crawfish frog behavioral differences in post-burned and vegetated grasslands. Midwest Fire Conference, February '15.

Heemeyer, J.L. Post-breeding migration and habitat selection of the crawfish frog *(Lithobates areolatus).* Indiana Academy of Science, October '09.

Heemeyer, J.L. and M.J. Lannoo. Crawfish frog migratory behavior and survival. SE PARC, February '11.

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.

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" SE PARC February '11.

Stiles, R.M. Captive-rearing state endangered crawfish frogs. Indiana Amphibian and Reptile Technical Advisory Committee Meeting, October '15.

Stiles, R.M. Wildlife cameras reveal resilience to climate variables in a threatened frog species. Kansas Herpetological Society Annual Meeting, November '15.

Stiles, R.M. and M.J. Lannoo. Can captive-reared tadpoles re-establish crawfish frog populations? Indiana State University Exposium, March '13.

Stiles, R.M., V.C.K. Terrell and M.J. Lannoo. Survivorship estimates across life stages suggest a 1000-m upland buffer is key to keeping crawfish frogs from being federally petitioned. Joint Meeting of Ichthyologists and Herpetologists, July '15.

Stiles, R.M., J.R. Robb, M. Sieggreen and M.J. Lannoo. Recovering crawfish frog populations in Indiana: a state wildlife grant success story (Invited). The Wildlife Society Conference, October '14.

Stiles, R.M., J.R. Robb, M. Sieggreen and M.J. Lannoo. Recovering crawfish frog populations in Indiana: a state wildlife grant success story (Invited). Terre Haute Center for Medical Education Research Meeting, November '14.

Stiles, R.M., J.R. Robb, M. Sieggreen and M.J. Lannoo. Recovering crawfish frog populations in Indiana: a state wildlife grant success story. Midwest Fish and Wildlife Conference, January '15.

Terrell, V.C.K., J.C. Maerz, N.J. Engbrecht, R.M. Stiles and M.J. Lannoo. Population dynamics of threatened crawfish frog informs management decisions. Joint Meeting of Ichthyologists and Herpetologists, July '14.

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.

PROGRESS TO DATE

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 and current distribution, not only in Indiana but also throughout other states east of the Mississippi River. We understand when they breed and have now identified a large percentage, perhaps all, of known breeding sites in Indiana. We understand survivorship in egg, larval and juvenile life-history stages, as well as in post-breeding adults. We sent water samples of breeding wetlands for analyses and have shown that neither pesticides nor metals are factors influencing survivorship.

We have successfully raised large numbers of tadpoles to metamorphosis. In 2013-2015, we partnered with the Detroit Zoological Society to hatch crawfish frog eggs and raise tadpoles to pre-metamorphic stages. Our results suggest that crawfish frogs can be captive-reared, but they exhibit partial cannibalism and are susceptible to disease in late larval stages at high densities. In 2015, we also partnered with the Indianapolis Zoo to hatch and raise crawfish frog tadpoles.

Workers at Big Oaks National Wildlife Refuge continued to trap and mark crawfish frogs in five ponds; created new wetlands in suitable habitats, and relocated eggs and juveniles in an effort to

300-gallon tanks are used to headstart crawfish frog tadpoles at Indiana State University, March 2015. (photo by Rochelle Stiles)

populate these new areas; continued to investigate characteristics of crawfish frog breeding ponds, including the effects of raising tadpoles in ponds with cattail *(Typha spp.)* dominated substrate; and released marked tadpoles (raised at the Detroit Zoo; see above) at two sites.

We have now tracked crawfish frogs for nearly 9,000 "telemetered frog days." From these data, we understand where adult burrows are located and have made a distinction between primary and secondary burrows. We understand activity patterns and habitat use.

We understand the pattern of infection by the chytrid fungus, which exhibits seasonal waxing and waning, and kills less than 7 percent of adults during or immediately after breeding. We now also understand how drought affects this process.

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.

We have documented the first case of ranavirus in crawfish frogs, which are found only in North America.

We better understand the role that management techniques such as prescribed burning, cultivation, mowing and establishing food plots have on populations. Genetic analyses have been done and are published. These data show that individual breeding sites at Hillenbrand Fish & Wildlife Area are genetically distinct from those at Big Oaks National Wildlife Refuge.

We used data collected from drift fences at Nate's Pond and Cattail Pond from 2009 to 2015 on adult and juvenile survivorship to calculate population trajectories. Stage-based matrix models show that Cattail Pond is a population sink, and during five of the six years of our study (2009, 2012, 2013, 2014, 2015), Nate's Pond also was acting as a sink. In short, adult longevity does not appear to be keeping pace with larval mortality.

Our data suggest that a combination of 1 km no-plow buffer zones surrounding crawfish frog breeding wetlands in combination with captive-rearing/head-starting programs for tadpoles is sufficient to restore or establish crawfish frog populations where upland crayfish populations are robust and healthy.

Drs. Lannoo and Robb have assembled a crawfish frog recovery plan for Indiana, and submitted it to the DNR in 2012. Workers within the state communicate frequently. In addition, we have set up a listserve (sevosa@listserve.eku.edu) to communicate with people working on this species group (three species: crawfish frogs, gopher frogs *[L. capito],* which have been listed for federal protection, and dusky gopher frogs [*L. sevosa,* which are federally endangered]).

COST: $903,216 FOR THE INITIAL FIVE-YEAR PROJECT; $400,317 FOR THE ADDITIONAL TWO-YEAR PROJECT