

ALL AMPHIBIANS IN ALL HABITATS NARRATIVE

Problems affecting species and habitats

Species threats

Respondents ranked the top threats to all amphibians in all habitats in Indiana:

Rank	Threats to all amphibians in all habitats
1	Habitat loss (breeding range)
2	Habitat loss (feeding/foraging areas)
3 (tie)	Near limits of natural geographic range
3 (tie)	Dependence on irregular resources (cyclical annual variations) (e.g., food, water, habitat limited due to annual variations in availability)
4	Degradation of movement/migration routes (overwintering habitats, nesting and staging sites)
5	Small native range (high endemism)
6	High sensitivity to pollution
7	Invasive/non-native species
8	Predators (native or domesticated)
9	Bioaccumulation of contaminants
10	Dependence on other species (mutualism, pollinators)

A respondent listed additional threats to all amphibians in all habitats in Indiana (not ranked):

- Changes in burrowing crawfish or rodent populations that would impact the availability of burrows
- Introduction of fish into formally fishless breeding waters
- Development of barriers between the Crawfish frog's burrow and breeding waters

Respondents listed top threats to all amphibians in all habitats in Indiana (not ranked):

- Habitat loss and degradation
 - Ephemeral wetland. Most ephemeral wetlands have been destroyed in Indiana to provide deep-water habitats for ducks under the misguided notion that deeper was better for wildlife. These fish-infested deep waters have no habitat for plains leopard frog
 - Upland forested habitat
 - Land use changes or other factors impact the availability and persistence of suitable burrows. Development of barriers between the Crawfish frog's burrow and breeding waters
 - Increase of migration distance to breeding sites as a result of habitat loss.
- Invasive species

Appendix F-73: Amphibians

- *Oxidus gracilis* is a non-native millipede that invades caves and impacts cave salamanders by preying on native food base; potential impact is unknown but could be significant
- Reed canary grass, purple loosestrife and other invasive species decrease plant diversity, cover and overall wetlands health
- Extreme rarity and habitat specialization
 - Only two sites are known to have green salamanders in Indiana and this is a habitat specialist needing rocky outcrops in forested areas.
 - Hellbenders have a small geographic range and population size in Indiana. In other states, there is concern about low reproductive rates, but this is unknown in Indiana populations
- Introduction of fish into formerly fishless waters
 - Impacts Crawfish frogs

Technical experts and conservation organizations reviewed the above results and were asked if these were a reasonable representation of the threats to all amphibians in all habitats. There were no responses.

Habitat threats

Respondents ranked the top threats to all amphibian habitats in Indiana:

Rank	Threats to all amphibian habitats
1	Habitat degradation
2	Habitat fragmentation
3	Agricultural/forestry practices
4	Commercial or residential development (sprawl)
5	Drainage practices (stormwater runoff)
6	Impoundment of water/flow regulation
7	Stream channelization
8	Mining acidification
9	Point source pollution (continuing)
10	Residual contamination (persistent toxins)
11 (tie)	Invasive/non-native species
11 (tie)	Nonpoint source pollution (sediments and nutrients)
12	Counterproductive financial incentives or regulations
13	Successional change

Respondents did not list additional threats to amphibian habitats in Indiana

Respondents listed top threats to all amphibian habitats in Indiana (not ranked):

- Habitat loss, degradation and fragmentation
 - Due to deforestation
 - Of streams

Appendix F-73: Amphibians

- Of ephemeral wetlands
- Forestry practices that open the forest canopy around cave entrances can greatly impact habitat for cave salamanders, drying out the entrance to the point that it is not usable by salamanders
- Cattle grazing, farming and development activities that affect the persistence of burrows for Crawfish frog in formally flooded or moist grasslands
- Draining of breeding ponds and ditches and introduction of fish into breeding waters
- Invasive species in wetlands
 - Invasion by species like reed canary grass, cattails, purple loosestrife and other invasives create monocultures

Technical experts and conservation organizations reviewed the above results and were asked if these were a reasonable representation of the threats to all amphibian habitats. There were no responses

Additional research and survey efforts

Current body of research

Species research

Eighty-seven percent of respondents consider the current body of science for all amphibians in all habitats in Indiana to be inadequate or non-existent. Twelve percent of respondents consider current body of science to be adequate.

Title = Amphibians and reptiles from 23 counties of Indiana.;
Author = Robert Brodman;
Date = 2003;
Publisher = Proceedings of the Indiana Academy of Science, 112: 43-54.

Title = The Status of Amphibians in Rural Northwest Indiana;
Author = Brodman, R., and M. Kilmurry;
Date = 1998;
Publisher = Iowa University Press, Iowa City, Iowa

Title = Discovery of green salamanders in Indiana and a distributional survey. In Status & Conservation of Midwestern Amphibians;
Author = Robert Madej;
Date = 1998;
Publisher = University of Iowa Press, Iowa City

Title = Amphibians and Reptiles of Indiana;
Author = Sherman A. Minton, Jr.;
Date = 2001;
Publisher = Indiana Academy of Sciences

Title = Multivariate analyses of the influences of water chemistry and habitat parameters on the abundances of pond-breeding amphibians.;
Author = Robert Brodman et al;
Date = 2003;
Publisher = Journal of Freshwater Ecology 18: 425-436.

Title = Ten- to eleven-year population trends of two pond-breeding amphibian species, red-spotted newts and green frogs. In Status & Conservation of Midwestern;
Author = Spencer Cortwright;
Date = 1998;

Appendix F-73: Amphibians

Publisher = University of Iowa Press, Iowa City

Title = Green salamander: Family plethodontidae, Aneides aeneus Cope and Packard, 1881.;

Author = Pauley, T. K. and M.B. Watson;

Date = 2005;

Publisher = In: Amphibian Declines: The Conservation Status of United States Species. M. Lannoo, (ed.), University of

Author = www.natureserve.org/explorer

Technical experts and conservation organizations reviewed the above results and were asked if these were a reasonable representation of the current body of science for all amphibians in all habitats. There were no responses.

Habitat research

All respondents consider the current body of science for all amphibian habitats in Indiana to be inadequate or nonexistent.

Title = Amphibians and reptiles from 23 counties of Indiana.;

Author = Robert Brodman;

Date = 2003;

Publisher = Proceedings of the Indiana Academy of Science, 112: 43-54.

Technical experts and conservation organizations reviewed the above results and were asked if these were a reasonable representation of the current body of science for all amphibian habitats. There were no responses.

Research needs

Species research

Respondents indicated research needs for all amphibians in all habitats in Indiana, ranked in order of importance:

Rank	Research needs for all amphibians in all habitats
1 (tie)	Threats (predators/competition, contamination)
1 (tie)	Limiting factors (food, shelter, water, breeding sites)
2	Relationship/dependence on specific habitats
3	Distribution and abundance
4	Population health (genetic and physical)
5	Life cycle

Appendix F-73: Amphibians

Respondents cited additional research needs for all amphibians in all habitats in Indiana as follows (not ranked):

- Quite little is known about much of the basic natural history of some amphibians
- Very little is known about the basic natural history, population ecology and abundance in Indiana of the lesser siren
- Some amphibians are in great need of study on all aspects of its ecology
- Metapopulation dynamics and migration distances to and from ephemeral wetlands for Spotted salamander
- How many ephemeral wetlands habitats within the landscape are needed to maintain healthy populations of some amphibians
- Buffer size and vegetation composition around ephemeral wetlands

Technical experts and conservation organizations reviewed the above results and were asked if these were a reasonable representation of the research needs for all amphibians in all habitats. There were no responses.

Habitat research

Respondents indicated research needs for all amphibian habitats in Indiana, ranked in order of importance:

Rank	Research needs for all amphibian habitats
1	Threats (land use change/competition, contamination/global warming)
2	Distribution and abundance (fragmentation)
3	Relationship/dependence on specific site conditions
4	Growth and development of individual components of habitat
5	Successional changes

Respondents were specific about research needs for all amphibian habitats in Indiana:

- Factors that limit the distribution of sirens in Indiana
- Crawfish frog habitat needs to be adequately described
- Metapopulation dynamics and migration distances to and from ephemeral wetlands
- How many ephemeral wetlands habitats within the landscape are needed to maintain healthy populations of some amphibians
- Buffer size and vegetation composition around ephemeral wetlands

Technical experts and conservation organizations reviewed the above results and were asked if these were a reasonable representation of the research needs for all amphibian habitats. There were no responses.

Conservation actions necessary

Species actions

Appendix F-73: Amphibians

Of a variety of potential actions, respondents ranked the following conservation efforts in order of ability to address threats to all amphibians in all habitats in Indiana:

Rank	Conservation efforts for all amphibians in all habitats
1	Habitat protection
2	Regulation of collecting
3	Threats reduction
4 (tie)	Exotic/invasive species control
4 (tie)	Public education to reduce human disturbance
5	Translocation to new geographic range

Respondents listed other current conservation practices for all amphibians in all habitats in Indiana (not ranked):

- Bullfrog tadpoles could be introduced into an area as by-product to fish stocking or from released pet tadpoles
- Study burrow-making crawfish and their burrows
- Wetland restoration

Respondents recommended these practices for more effective conservation of all amphibians in all habitats in Indiana (not ranked):

- Habitat protection and restoration. See list of habitats needing protection:
 - Ephemeral wetlands and wetland complexes
 - Forested upland habitat protection
 - Fishless breeding habitat
 - Historic ranges of species in question
 - Crawfish frog
 - Main threat to green salamander populations is deforestation resulting in loss, degradation or fragmentation of habitat. Logging activities should keep at least 100 meters of buffered forest habitat around rock outcrops and cliffs
 - Cave entrances from inappropriate management activities
- More species information
 - Green salamander: Little is known about the population biology, lifespan, mortality rates, dispersal, colonization of habitats, metapopulation dynamics and extent of arboreal activity
 - Sirens: We need to better understand factors that limit siren abundance and distribution

Technical experts and conservation organizations reviewed the above results and were asked if these were a reasonable representation of the effective conservation of all amphibians in all habitats. There were no responses.

Appendix F-73: Amphibians

Habitat actions

Of a list of possible actions, respondents ranked the ability of the following conservation efforts to address threats to all amphibian habitats in Indiana:

Rank	Conservation efforts for all amphibian habitats
1	Habitat protection on public lands
2	Habitat protection through regulation
3	Habitat restoration on public lands
4 (tie)	Habitat protection through incentives (financial)
4 (tie)	Protection of adjacent buffer zone
5	Habitat restoration through regulation
6 (tie)	Habitat restoration incentives (financial)
6 (tie)	Artificial habitat creation (artificial reefs, nesting platforms)
6 (tie)	Managing water regimes
6 (tie)	Land use planning
6 (tie)	Cooperative land management agreements (conservation easements)
7 (tie)	Corridor development/protection
7 (tie)	Pollution reduction
7 (tie)	Technical assistance
7 (tie)	Restrict public access and disturbance

Respondents listed other conservation practices for all amphibian habitats in Indiana (not ranked):

- Many current conservation practices and incentives programs promoted by biologists seem to be aimed at ducks and actually manage against some amphibians
- Development and retention of stormwater retention ponds

Respondents listed these practices for more effective conservation of all amphibian habitats in Indiana (not ranked):

- Habitat protection and restoration. Habitats to be protected include:
 - Ephemeral wetlands
 - Forest protection
 - Those on public and private lands
 - Protect cave entrances from disturbance
 - Protection of buffers needed for amphibians migrating to ephemeral wetlands for breeding

Appendix F-73: Amphibians

Technical experts and conservation organizations reviewed the above results and were asked if these were a reasonable representation of the effective conservation of all amphibian habitats. There were no responses

Proposed plans for monitoring

Current monitoring

Species monitoring

Respondents indicated knowledge about monitoring efforts conducted by state agencies for all amphibians in all habitats in Indiana (not ranked):

- Statewide once-a-year monitoring
- Statewide year-round monitoring
- Occasional regional or local (less than once a year but regularly scheduled) monitoring
- Occasional statewide (less than once a year and not regularly scheduled) monitoring
- Regional or local year-round monitoring
- Periodic statewide (less than once a year but still regularly scheduled) monitoring
- Regional or local once-a-year monitoring
- Periodic regional or local (less than once a year but still regularly scheduled) monitoring

Respondents indicated knowledge of monitoring efforts conducted by other organizations for all amphibians in all habitats in Indiana (not ranked):

- Occasional regional or local (less than once a year and not regularly scheduled) monitoring
- Regional or local once-a-year monitoring
- Periodic regional or local (less than once a year but still regularly scheduled) monitoring
- Regional or local year-round monitoring

Respondents considered ranked the importance of monitoring efforts by state agencies for conservation of all amphibians in all habitats in Indiana:

Rank	Monitoring by state agencies for all amphibians in all habitats
1	Statewide once-a-year monitoring
2 (tie)	Periodic statewide (less than once a year but still regularly scheduled) monitoring
2 (tie)	Regional or local year-round monitoring
3 (tie)	Occasional statewide (less than once a year and not regularly scheduled) monitoring
3 (tie)	Periodic regional or local (less than once a year but still regularly scheduled) monitoring
4 (tie)	Occasional regional or local (less than once a year and not regularly scheduled) monitoring
4 (tie)	Statewide year-round monitoring

Appendix F-73: Amphibians

5	Regional or local once-a-year monitoring
---	--

Appendix F-73: Amphibians

Respondents ranked the importance of monitoring efforts by other organizations for conservation of all amphibians in all habitats in Indiana:

Rank	Monitoring by other organizations for all amphibians in all habitats
1	Regional or local year-round monitoring
2	Occasional regional or local (less than once a year and not regularly scheduled) monitoring
3	Periodic regional or local (less than once a year but still regularly scheduled) monitoring
4 (tie)	Periodic statewide (less than once a year but still regularly scheduled) monitoring
4 (tie)	Regional or local year-round monitoring
5 (tie)	Statewide once a year monitoring
5 (tie)	Occasional statewide (less than once a year and not regularly scheduled) monitoring
6	Statewide year-round monitoring

Respondents listed the following regional or local monitoring efforts by state agencies for all amphibians in all habitats in Indiana (not ranked):

- IDNR Division of Fish and Wildlife's NAAMP and Frog Watch programs collectively are the statewide effort to monitor frog and toad populations in Indiana, including bullfrogs. The data can be analyzed regionally
- IDNR Division of Nature Preserves
- IDNR non-game herpetologist incorporates monitoring as part of annual field season

Respondents listed the following regional or local monitoring efforts by other organizations for all amphibians in all habitats in Indiana (not ranked):

- NW Indiana (Newton, Jasper, Pulaski, Lake, Porter counties)
- Chicago Wilderness
- Spencer Cortwright, IUN
- Robert Brodman, St. Joseph's College
- University professors and members of the Herpetology TAC for Indiana as part of their annual field season

Respondents listed the following organizations that monitor all amphibians in all habitats in Indiana (not ranked):

- Robert Brodman, St. Joseph's College
- Spencer Cortwright, IUN
- Chicago Wilderness

Appendix F-73: Amphibians

The following table reflects the opinions of multiple respondents, thus multiple check marks are possible. Additionally, some of these differences may reflect different taxonomic group bias.

Respondents ranked existing monitoring techniques for all amphibians in all habitats in Indiana:

Monitoring techniques for all amphibians in all habitats	Used	Not used but possible with existing technology or data	Not economically feasible
Professional survey/census	X		
Probabilistic sites	X		
Trapping (by any technique)	X	X	
Representative sites	X		
Volunteer survey/census	X	X	
Driving a survey route	X		
Coverboard routes	X	X	
Reporting from harvest, depredation, or unintentional take (road kill, by-catch)	X		
Modeling	X	X	
Spot mapping		X	
Radio tracking and telemetry		X	
Mark and recapture		X	

Respondents listed these additional monitoring techniques for all amphibians in all habitats in Indiana (not ranked):

- Bullfrog tadpoles and adults are often recorded during amphibian surveys of particular sites, such as a military base or superfund site. Bullfrogs also are encountered and recorded during fish survey
- Sampling for eggs or larva

Technical experts and conservation organizations reviewed the above results and were asked if these were a reasonable representation of the monitoring techniques for all amphibians in all habitats. There were no responses

Habitat inventory and assessment

Respondents noted their awareness of current inventory and assessment efforts by state agencies for all amphibian habitats in Indiana (not ranked):

Appendix F-73: Amphibians

- Occasional regional or local (less than once a year but regularly scheduled) monitoring
- Occasional statewide (less than once a year and not regularly scheduled) monitoring
- Statewide annual inventory and assessment
- Statewide once-a-year inventory and assessment
- Regional or local year-round inventory and assessment
- Regional or local once-a-year inventory and assessment
- Periodic statewide (less than once a year but still regularly scheduled) inventory and assessment
- Periodic regional or local (less than once a year but still regularly scheduled) inventory and assessment

Respondents noted their awareness of current inventory and assessment efforts by other organizations for all amphibian habitats in Indiana (not ranked):

- Occasional regional or local (less than once a year but regularly scheduled) inventory and assessment
- Occasional statewide (less than once a year and not regularly scheduled) inventory and assessment
- Periodic regional or local (less than once a year but still regularly scheduled) inventory and assessment
- Regional or local once-a-year inventory and assessment
- Regional or local year-round inventory and assessment

Respondents ranked the importance of the following inventory and assessment efforts by state agencies for conservation of all amphibian habitats in Indiana:

Rank	Inventory and assessment by state agencies for all amphibian habitats
1	Statewide annual inventory and assessment
2	Occasional regional and local (less than once a year and not regularly scheduled) inventory and assessment
3	Statewide once a year inventory and assessment
4 (tie)	Periodic statewide (less than once a year but still regularly scheduled) inventory and assessment
4 (tie)	Periodic regional or local (less than once a year but still regularly scheduled) inventory and assessment
4 (tie)	Occasional statewide (less than once a year and not regularly scheduled) inventory and assessment
4 (tie)	Regional or local once-a-year inventory and assessment
5	Regional or local year-round inventory and

Appendix F-73: Amphibians

	assessment
--	------------

Appendix F-73: Amphibians

Respondents ranked the importance of inventory and assessment efforts by other organizations for conservation of all amphibian habitats in Indiana:

Rank	Inventory and assessment by other organizations for all amphibian habitats
1	Regional or local once-a-year inventory and assessment
2	Occasional regional and local (less than once a year and not regularly scheduled) inventory and assessment
3	Regional or local year-round inventory and assessment
4	Periodic regional or local (less than once a year but still regularly scheduled) inventory and assessment
5	Statewide once-a-year inventory and assessment
6 (tie)	Periodic statewide (less than once a year but still regularly scheduled) inventory and assessment
6 (tie)	Occasional statewide (less than once a year and not regularly scheduled) inventory and assessment
7	Statewide year-round inventory and assessment

Respondents cited additional methods for regional or local inventory and assessment by state agencies for all amphibian habitats in Indiana (not ranked):

- Division of Fish and Wildlife nongame
- Frog call surveys include rural and agricultural areas throughout the state

Respondents listed all regional or local inventory and assessment by other organizations for all amphibian habitats in Indiana (not ranked):

- Indiana Karst Conservancy and local grottos
- Kankakee Sands and other Conservancy preserves. Staff evaluate the restored/cleared habitat to judge its ability to support plains leopard frog and other species of concern
- NW Indiana (Newton, Jasper, Pulaski, Starke, Lake and Porter counties), Robert Brodman
- Chicago Wilderness
- Robert Brodman, St. Joseph's College
- Cortwright monitors populations in Brown and Porter counties.
- Robert Brodman monitors populations in Owens County

Respondents listed organizations that conduct inventory and assessments for all amphibian habitats in Indiana (not ranked):

- Indiana Karst Conservancy and local grottos
- The Nature Conservancy
- Robert Brodman, St. Joseph's College

Appendix F-73: Amphibians

- IDNR nongame herpetologist
- University professors
- Members of the Herpetology TAC for Indiana

The following table reflects the opinions of multiple respondents, thus multiple check marks are possible. Additionally, some of these differences may reflect different taxonomic group bias.

Respondents ranked current inventory and assessment techniques for all amphibian habitats in Indiana:

Inventory and assessment techniques for all amphibian habitats	Used	Not used but possible with existing technology or data	Not economically feasible
Systematic sampling	X	X	
GIS mapping	X	X	
Aerial photography and analysis	X	X	
Modeling	X	X	
Voluntary landowner reporting		X	

Respondents summarized other inventory and assessment techniques for all amphibian habitats in Indiana as follows (not ranked)

- Visual estimation – has the entrance been changed in anyway from its historical configuration (forest canopy opened up, entrance enlarged or blocked, etc.)
- Visual estimate of amount of appropriate habitat being provided in restored areas
- If there was a significant decline in bullfrog habitat on state-owned properties, the state would hear about it from frog hunters
- Pit-fall trapping and coverboard objects adjacent to ephemeral wetlands; mark and recapture

Technical experts and conservation organizations reviewed the above results and were asked if these were a reasonable representation of the inventory and assessment techniques for all amphibian habitats. There were no responses.

Recommended monitoring

Species monitoring

Respondents recommended the following monitoring techniques for all amphibians in all habitats in Indiana (not ranked):

- Trapping
 - Minnow trapping (mark recapture or telemetry)
 - Trapping during breeding migration

Appendix F-73: Amphibians

- Pit-fall traps and coverboard objects near ephemeral wetland breeding sites
- Surveys and systematic sampling
 - Frog call
 - Tadpole
 - Eggs and larva
 - Near rocky outcrops
 - To determine how far adults are traveling to deposit eggs
 - During the fall at breeding sites

Technical experts and conservation organizations reviewed the above results and were asked if these were a reasonable representation of the monitoring techniques for all amphibians in all habitats. There were no responses.

Habitat inventory and assessment

Respondents recommended the following inventory and assessment techniques for all amphibian habitats in Indiana (not ranked):

- Systematic sampling and GIS
- Systematic sampling (intensive) and GIS (less intensive)
- Urban residents could be encouraged to participate in the Frog Watch program
- Crawfish frog habitat can be described by a combination of hydrology, soil type, proximity to breeding waters and vegetation. These factors should be investigated to develop a model for crawfish frog habitat
- Pit-fall traps and coverboards can be used to assess population size and use of ephemeral wetlands for breeding. Mark and recapture can be used to determine migration patterns and use of specific ephemeral wetlands for breeding

Technical experts and conservation organizations reviewed the above results and were asked if these were a reasonable representation of the inventory and assessment techniques for all amphibian habitats. There were no responses.