Appendix E-2: Aggregated Aquatic Systems

6. Please rank the following threats to ALL wildlife in all Aquatic Systems Habitats in Indiana.

	Critical threat	Serious threat	Somewhat of a threat	Slight threat	No threat	Unknown	Response Total
Invasive/non-native species	7% (5)	10% (7)	25% (17)	25% (17)	16% (11)	16% (11)	**68**
High sensitivity to pollution	10% (7)	35% (24)	33% (23)	13% (9)	1% (1)	7% (5)	**69**
Bioaccumulation of contaminants	1% (1)	6% (4)	32% (22)	29% (20)	6% (4)	26% (18)	**69**
Predators (native or domesticated)	3% (2)	6% (4)	26% (18)	31% (21)	25% (17)	9% (6)	**68**
Dependence on other species (mutualism, pollinators)	3% (2)	5% (3)	14% (9)	8% (5)	48% (32)	23% (15)	**66**
Diseases/parasites (of the species itself)	0% (0)	0% (0)	8% (5)	33% (22)	11% (7)	48% (32)	**66**
Regulated hunting/fishing pressure (too much)	3% (2)	1% (1)	15% (10)	19% (13)	53% (36)	9% (6)	**68**
Species over population	1% (1)	1% (1)	6% (4)	3% (2)	81% (55)	7% (5)	**68**
Unintentional take/ direct mortality (e.g., vehicle collisions, power line collisions, by-catch, harvesting equipment, land preparation machinery)	6% (4)	9% (6)	6% (4)	22% (15)	51% (35)	7% (5)	**69**
Unregulated collection pressure	0% (0)	0% (0)	1% (1)	21% (14)	68% (46)	10% (7)	**68**
Dependence on irregular resources (cyclical annual variations) (e.g., food, water, habitat limited due to annual variations in availability)	14% (10)	7% (5)	22% (15)	16% (11)	17% (12)	23% (16)	**69**
						Total Respondents	**748**

Appendix E-2: Aggregated Aquatic Systems

7. Please also rank these threats to ALL wildlife in all Aquatic Systems Habitats in Indiana.

	Critical threat	Serious threat	Somewhat of a threat	Slight threat	No threat	Unknown	Response Total
Habitat loss (breeding range)	24% (16)	29% (20)	24% (16)	9% (6)	7% (5)	7% (5)	**68**
Habitat loss (feeding/foraging areas)	21% (14)	34% (23)	24% (16)	10% (7)	6% (4)	6% (4)	**68**
Small native range (high endemism)	1% (1)	7% (5)	10% (7)	13% (9)	63% (42)	4% (3)	**67**
Near limits of natural geographic range	7% (5)	14% (3)	6% (4)	7% (5)	76% (53)	0% (0)	**70**
Large home range requirements	0% (0)	0% (0)	3% (2)	9% (6)	71% (46)	17% (11)	**65**
Viable reproductive population size or availability	13% (9)	15% (10)	12% (8)	21% (14)	32% (22)	7% (5)	**68**
Specialized reproductive behavior or low reproductive rates	13% (9)	16% (11)	18% (12)	10% (7)	34% (23)	9% (6)	**68**
Degradation of movement/migration routes (overwintering habitats, nesting and staging sites)	10% (7)	21% (14)	21% (14)	7% (5)	21% (14)	21% (14)	**68**
Genetic pollution (hybridization)	0% (0)	0% (0)	4% (3)	18% (12)	58% (39)	19% (13)	**67**
Unknown	0% (0)	0% (0)	10% (3)	0% (0)	7% (2)	83% (24)	**29**
Other (please specify below)	0% (0)	15% (3)	0% (0)	5%(1)	5% (1)	75% (15)	**20**
					Total Respondents		**659**

8. Other threats to ALL wildlife in all Aquatic Systems Habitats in Indiana.

- None that I can think of. As adjacent states initiate harvest seasons for otters, there might be added pressure to take otters accidentally trapped in Indiana across state lines to market fur. However, I wouldn't expect this to have a significant impact at a statewide or even regional scale.
- Disturbance by recreational boating.
- Commercial over exploitation resulting in low spawner stock abundance.
- Egg predators predation, nutritional requirements, early mortality syndrome
- Stream channelizing.
- My area of expertise is effects of contamination on biological organisms, especially aquatic. This makes filling out he survey difficult. My knowleldge is applicable to aquatic habitatis rather than specific species in this survey.
- Threats to the Orangethroat Darter are related to threats to the habitat. It prefers high-functioning, high quality riffle habitat in headwater streams. Headwater streams, are not always given as much protection or value as larger rivers downstream. Threats to the species colonization, such as aquatic passage problems through culverts are one threat. Threats to the species watersheds, such as pollution, clearing of the riparian vegetation, creek gravel mining, and channelization are also threats to the habitat of this species.; Threats to the Orangethroat Darter are related to threats to the habitat. It prefers high-functioning, high quality riffle habitat in headwater streams. Headwater streams, are not always given as much protection or value as larger rivers downstream. Threats to the species colonization, such as aquatic passage problems through culverts are one threat. Threats to the species watersheds, such as pollution, clearing of the riparian vegetation, creek gravel mining, and channelization are also threats to the habitat of this species.; Threats to the Orangethroat Darter are related to threats to the habitat. It prefers high-functioning, high quality riffle habitat in headwater streams. Headwater streams, are not always given as much protection or value as larger rivers downstream. Threats to the species colonization, such as aquatic passage problems through culverts are one threat. Threats to the species watersheds, such as pollution, clearing of the riparian vegetation, creek gravel mining, and channelization are also threats to the habitat of this species.
- High stream flows for a few months following spawning can seriously reduce year class strength.
- High stream flows following spawning can seriouslyh reduce year class strength. This threat can be reduced by reducing ditching in headwaters, installing grass waterways and WASCOBS, maintaining riparian corridors. All of these measures will slow stream flows and reduce siltation.

Total Respondents **9**

9.	Please briefly describe the top two threats to ALL wildlife in all Aquatic Systems Habitats in Indiana identified above.

- Wetland loss and degradation
- Habitat loss mostly related to urban sprawl. Degradation of migration routes, also often related to urban sprawl and other development.
- Urbanization.
- Pollution/degradation of aquatic systems: reproductive performance of otters can be compromised by high levels of
- PCBs, heavy metals, etc. that bio-accumulate in the aquatic food chain. Direct loss of aquatic habitats such as wetlands, marshes, etc. also impact otters... but not to the extent pollutants could.
- Human disturbance.
- Modification/degradation of habitats.
- Over-population.
- Habitat loss (feeding areas) - many reservoirs are getting very old and the once abundant standing timber is now diminishing which is reducing cover for white crappie.
- Dependence on irregular sources - in many reservoirs, shad is the dominant forage base for crappie. If shad are growing extremely fast, crappie can only utilize shad for a short period of time before the shad outgrow the size crapie can consume.
- Competition with invasives, namely gizzard shad.
- Water level control regimes at impoundments.
- Loss or degradation of nesting habitat. Loss or degradation of brood-rearing and foraging areas.
- Habitat loss-urbanization and habitat loss-breeding, feeding, and foraging.
- Habitat loss.
- Degradation of movement/migration routes.
- Year class failure related to low spawner stock abundance. Competition with non native species for limited available food resources.
- Lack of successful spawning, possibly related to bioenergetics. Too much egg predation.
- Long-term declines in water quality associated with lake eutrophication.
- Annual and seasonal variations in habitat availability.
- Cold, clear water is critical for cisco survival; increased runoff and nutrient loading have degraded the habitat for this species in many of the 50+ lakes it once occurred in. Few lakes still have the species, and there is apparently little to no reproduction.
- The deliberate stocking of predator fish in cisco lakes has been a threat to this species for years; if this hasn't been stopped, it needs to.
- Loss of habitat (reproductive/feeding) that is essential for northern pike survival.
- Over harvest and illegal harvest (This doesn't seem to be a major threat as of now)

- Loss of undisturbed natural lake habitat.
- Habitat loss & habitat degradation.
- Sediment deposition.
- Habitat loss (loss of large nesting trees).
- Loss of brood rearing habitat.
- Loss of high quality nesting habitat.
- Habitat loss.
- Degradation of movement/migration routes.
- Although not habitat specific, the inability to responsibly and proactively manage mink according to the wildlife conservation model, as opposed to reactive measures through nuisance practices, is a concern regarding the conservation of mink. This concern applies across the landscape, not just in urban and suburban environments.
- Past pollution problems and dams on rivers block migration.
- Exotic species competition, specifically the round goby.
- Habitat degradation, non-point sources runoff resulting from loss of riparian buffers due to development.
- High sediment loads during spring rains.
- The acute effects of toxicants are recognized as a threat to organisms, but there is little knowledge on ecosystems or regional effects on chronic insults. Toxicants are more destructive to the embrolarva stages, but these are poorly documented. Pollution controls do not have definite focus on chronic effects.
- Habitat loss and pollution.
- Siltation- hornyhead chub are sight-feeders and mound builders for spawning; thus, muddy water will hamper their chances of survival and if the silt covers gravel and their nest, chances for successful reproduction will be limited.
  Competition from other species better adapted to muddy and silty stream conditions.
- Runoff, mostly agricultural.
- In-stream modifications.
- Pike have suffered a major loss of spawning habitat due to the prevalence of dredging within the watershed. This practice along with levee construction has resulted in the near elimination of in-stream and emergent wetland vegetation throughout the majority of the watershed.
- Habitat loss - requires shallow clear water with little current in weedy areas over gravel, sand, and silt to feed on insects and lay reproduce
- Dredging (removal of aquatic vegetation and increasing depth of ditch).
- Habitat loss/unintentional take-'cleaning' and dredging of streams of the Kankakee drainage can result in a large amount of creek heelsplitters being lost.
- Dependence on other species-require fish host to reproduce; if fish populations decrease for any of a variety of reasons, then creek heelsplitter reproduction could decrease substantially.
- Habitat loss - requires shallow clear water with little current in weedy areas over gravel, sand, and silt to feed on insects and lay reproduce.

- Dredging of headwater streams.
- Alterations of hydrology from land-use changes.
- Runoff.
  Habitat modification.

- The top two threats for the species are threats to migration (aquatic passage problems through stream crossing structures) and threats to the breeding habitat (high quality riffles). Threats to riffle habitat result from water quality degradation and loss of stream channel stability due to land management activities such as dredging, channelization, roads, and clearing of riparian vegetation.; The top two threats for the species are threats to migration (aquatic passage problems through stream crossing structures) and threats to the breeding habitat (high quality riffles). Threats to riffle habitat result from water quality degradation and loss of stream channel stability due to land management activities such as dredging, channelization, roads, and clearing of riparian vegetation.; The top two threats for the species are threats to migration (aquatic passage problems through stream crossing structures) and threats to the breeding habitat (high quality riffles). Threats to riffle habitat result from water quality degradation and loss of stream channel stability due to land management activities such as dredging, channelization, roads, and clearing of riparian vegetation.
- Habitat loss (breeding and foraging/feeding areas): Siltation of small headwater streams is limiting the population of southern redbelly dace because the species spawn over gravel substrates. Also, the removal of vegetation could decrease food availablity to the herbivorous species. They occupy streams that have a permanent flow of clear water; thus siltation or alterations in flow regimes could also affect the species.
- Hellbenders have a small geographic range and population sizes in Indiana. In many locations there is concern about low reproductive rates, but this is unknown in Indiana populations.
- Runoff.
- Habitat modification.
- Runoff introducing sediments, even if only temporary.
- In-stream modifications.
- Pollution within the Tippecanoe River system in Indiana.

  Any factor which reduces the reproductive population size.
- Pollution.
- Habitat loss - siltation of spawning areas and pools, loss of in-stream cover, riparian destruction, channelization.
- Point source pollution, which triggers fish kills or repels rock bass from the area.
- Habitat loss and degradation are serious threats to rock bass. They prefer silt free streams to reproduce and thrive. They also relate closely to structure/cover therefore any habitat loss is a threat.
- Habitat Loss - The Eastern Sand darter requires sandy bottoms in fast flowing streams to bury eggs, hide from predators, ambush prey, conserve energy, and maintain position in unstable/shifting sandbars. Low reproductive rates/small populations - reach maturity at age 1, but only lives a few years.
- Breeding and feeding/foraging habitat loss due to sedimentation from farm fields and stream banks as well as the removal of natural riparian vegetation; breeding and feeding/foraging habitat loss due to sedimentation from farm fields and stream banks as well as the removal of natural riparian vegetation.

- Habitat loss - siltation which reduces spawning areas and fills pools, loss of in-stream cover (snagging and log removal), riparian destruction which allows water to warm and will reduce opportunity for logs and woody debris to enter stream, channelization.
- Pollution which triggers fish kills or repels smallmouth from the area.
- Zebra mussels.
- Instream dredging.
- Zebra mussels.
- In-stream modifications.
- Pollution.
- Possible lack of reproductive success as indicated by poor length frequency distribution.
- Possible sensitivity to pollution as indicated by its rarity in the Ohio River reach in Indiana.
- Habitat loss and pollution.
- Degradation of nesting and staging sites- pools or riffles with slow current beneath flat rocks.
- Low reproductive rates-Males reach sexual maturity at 2 while females can reproduce at 1 and they only have a life span of about 3 years.
- Commercial type fishing devices - trot lines, branch lines, big nets, other passive fishing
- Extreme depredation by overabundant raccoons (on eggs) - maybe by coyotes, too.
- Extant population (if any) far below level for unassisted recovery.
- Nest depredation mainly by raccoons = very low recruitment.
- Nest/embryo/hatchling loss associated with attraction to row crop land for nesting.
- Potential loss of adults to road kill and to rogue raccoons (kill adults for their eggs)
- Insuring that populations maintain critical larva-host connections.
- Habitat loss for both breeding and feeding/foraging areas. The slough darter prefers a mud or silt bottom with little current velocity and vegetation to deposit eggs on. They also spawn few eggs so reproduction is lower in places where vegetation is lacking. They also compete with other darters for insects and have a high mortality due to stagnation and freezing in the pools they desire to live in.

Total Respondents **60**

10. Please rank the following threats to the HABITAT of ALL wildlife in all Aquatic Systems Habitats in Indiana.

	Critical threat	Serious threat	Somewhat of a threat	Slight threat	No threat	Unknown	Response Total
Commercial or residential development (sprawl)	13% (8)	36% (23)	30% (19)	13% (8)	9% (6)	0% (0)	**64**
Counterproductive financial incentives or regulations	2% (1)	9% (6)	13% (8)	3% (2)	20% (13)	53% (34)	**64**
Invasive/non-native species	9% (6)	6% (4)	20% (13)	28% (18)	15% (10)	22% (14)	**65**
Nonpoint source pollution (sedimentation and nutrients)	21% (14)	29% (20)	31% (21)	12% (8)	1% (1)	6% (4)	**68**
Habitat fragmentation	8% (5)	31% (20)	28% (18)	11% (7)	11% (7)	11% (7)	**64**
Successional change	2% (1)	11% (7)	11% (7)	16% (10)	36% (23)	25% (16)	**64**
Diseases (of plants that create habitat)	0% (0)	0% (0)	3% (2)	14% (9)	37% (23)	46% (29)	**63**
Habitat degradation	31% (21)	40% (27)	21% (14)	4% (3)	1% (1)	1% (1)	**67**
Climate change	2% (1)	0% (0)	11% (7)	15% (10)	40% (26)	32% (21)	**65**
Stream channelization	38% (25)	30% (20)	18% (12)	6% (4)	3% (2)	5% (3)	**66**
Impoundment of water/flow regulation	13% (8)	22% (14)	29% (18)	17% (11)	29% (8)	6% (4)	**63**
Agricultural/forestry practices	13% (8)	36% (23)	28% (18)	14% (9)	6% (4)	3% (2)	**64**
Residual contamination (persistent toxins)	3% (2)	14% (9)	29% (19)	24% (16)	3% (2)	27% (18)	**66**
Point source pollution (continuing)	12% (8)	24% (16)	26% (17)	21% (14)	2% (1)	15% (10)	**66**
Mining/acidification	2% (1)	17% (11)	19% (12)	20% (13)	22% (14)	20% (13)	**64**
Drainage practices (stormwater runoff)	8% (5)	32% (21)	30% (20)	15% (10)	8% (5)	8% (5)	**66**
Unknown	0% (0)	0% (0)	0% (0)	4% (1)	0% (0)	96% (23)	**24**
Other (please specify below)	0% (0)	0% (0)	0% (0)	4% (1)	0% (0)	94% (17)	**18**
						Total Respondents	**1,081**

11. Other HABITAT threats to ALL wildlife in all Aquatic Systems Habitats in Indiana.

- Competition with round goby for near-shore habitat.
- Riparian corridor destruction. Loss of shading and sedimentation.
- Sand and gravel operations could destroy preferred habitat.

Total Respondents **3**

12. Please briefly describe the top two HABITAT threats to ALL wildlife in all Aquatic Systems Habitats in Indiana identified above.

- Habitat degradation & fragmentation.
- Urban sprawl and regulations that allow loss of habitat. The human/beaver interface usually results with either the habitat being eliminated or the beaver being eradicated.
- Urbanization.
- Water pollution not only impacts otter reproduction (see previous section), but may also impact the quantity/quality of aquatic prey for otters. Loss of wetland habitats reduces amount of suitable habitat for otters.
- Factors that affect food availability.
- Modification of stream shoreline habitats.
- Regulation of impounded water - extreme water fluctuations in mainly the Army Corps reservoirs can negatively effect crappie populations especially if the water fluctuations occur during spawning.
- Habitat degradation - the natural decomposition of flooded timber and woody debris is lessening the available cover for crappie. Also, siltation covers root wads left in the bottom of an impoundment, which eliminates useable crappie cover.
- Habitat loss/degradation due to a variety of circumstances.
- Residential development around lake shorelines. Degradation of aquatic plants and wetlands around lake shorelines.
- Commerical and or residential development.
- Habitat fragmentation.
- Agricultural practices.
- Urban development.
- Competition with non-native species for habitat. Need a quality place to live that is not in competition with round goby.
- Identification of habitat along Indiana's near-shore area.
- Habitat degradation.
- Successional change.
- Water quality degradation that leads to cloudy water is the key threat.
- Emergent bulrush and wetland habitat loss. It has been well documented in northern states that northern pike prefer flooded vegetation for spawning during the spring. Loss of this habitat from boating and wildlife (waterfowl and muskrat feeding) may reduce reproductive habitat for northern pike in some natural lakes.
- Bulkhead seawall development reduces emergent vegetation used by northern pike for reproduction and for cover during feeding.
- Shoreline and labeled alterations.

Appendix E-2: Aggregated Aquatic Systems

- Habitat loss & degradation.
- Stream channelization removing nesting sites and destroying brood habitat. Soil runoff caused by poor agricultural practices and urban development.
- Channelization removes and/or changes the vegetative and invertabrate communities. Channelization also alters the natural water flow which results in a much degraded habitat.
- The loss of bottomland hardwoods continues to be a threat. These area provide a high quality food source and nesting sites for woodies.
- Drainage Practices.
- Stream channelization.
- The participant is forced to speculate about the meaning of successional and climate change. Agriculture/Forestry practices have different effects. Grouping these practices as a single category does not appropriately represent the individual practice. Point and non-point pollution may have a positive or negative impact.
- Sedimentation and dams fragmenting habitat.
- Invasive species competition, specifically round goby interactions. Stream channelization resulting in loss of habitat.
- Invasive species, non-point source pollution
- Sedimentation and loss of habitat due to development in headwater areas
- Habitat degradation and non-point source pollution
- Non-point source pollution- sedimentation and agricultural practices- again sedimentation.
- Loss of riparian corridor and runoff.
- The channelization of many streams in the upper Kankakee watershed and the associated fragmentation of wetland habitat has severely altered the state of the aquatic habitat in general.
- Non-point source pollution (sedimentation resulting in smothering of substrates and turbidity).
- Habitat degradation (removal of vegetation and shallow water).
- Stream channelization (straightening the channels to move water faster) and Habitat degradation (removal of debris in the stream to speed up the transfer of water off of the land and into the receiving stream).
- Habitat degradation, stream channelization-cause temporary loss of habitat and impact the mussels directly by killing them or taking them out of the habitat
- Non-point source pollution (sedimentation resulting in smothering of substrates and turbidity).
- Habitat degradation (removal of vegetation and shallow water).
- Stream channelization (straightening the channels to move water faster) and Habitat degradation (removal of debris in the stream to speed up the transfer of water off of the land and into the receiving stream).
- Runoff, mostly agricultural.
- Channelization.

Appendix E-2: Aggregated Aquatic Systems

- Top two threats from the list up above are habitat degradation and stream channelization
- Non-point source pollution in the form of sedimentation.
- Destruction of clear shaded waters by forestry/agricultural practices or stream channelization.
- Habitat degradation of streams.
- Instream modifications, runoff, both agricultural and residential, agricultural runoff.
- Impoundment.
- Any significant sedimentation into the stream can become a major threat.
  Any toxins or pollutants are a critical threat.
- Any channelization which reduces the shallow (less than 1.5 feet) sand/gravel substrate can critically reduce or fragment habitat.
- Habitat degradation - sedimentation, channelization, cover removal, riparian removal.
- Point source pollution - waste water treatment plants and confined feeding operations.
- Any practices that create more erosion/sediment depostion and eliminates instream cover is a serious threat. Therefore, I'd have to say nonpoint source pollution and habitat degredation are the most serious threats.
- Habitat degradation and stream channelization because this will directly affect the sediment transfer within the stream and microhabitat of the Eastern Sand Darter.
- Breeding and feeding/foraging habitat loss due to sedimentation from farm fields and stream banks as well as the removal of natural riparian vegetation especially thru drainage maintenance activities.
- Habitat degradation by sedimentation, channelization, cover removal, riparian removal.
- Point source pollution - these eco-regions have major threats from large cities causing fish kills from waste water treatment plans. Also, confined feeding operations in the rural areas are a major threat to the stream fish communities.
- Impoundment, in-stream modifications.
- Dredging (mining, COE).
- Impoundment.
- Stream channelization.
- Non-point source pollution.
- Loss of high quality riffles and outside bend deep fast runs, loss of riparian zone and siltation.
- Habitat degradation in terms of removal of substrate for spawning and sedimentation for covering the substrate needed to spawn.
- Channelization.
- Drain/cut off oxbow ponds.
- Trample sandbars or remove other nesting areas along banks.
- Habitat loss through channelization and draining of oxbow ponds and elimination
  of flows that create point bars on rivers.

- Rowcrop practices: crushing nests during ground insect/weed control; crushing overwinter hatchlings during harvest & early spring plowing
- Pollutants and toxins are major threats.

  Habitat degradation may be a factor, since there are large expanses in the Wabash and East Fork White River where relic valves are common, but the living species is absent.
- Habitat degradation and stream channelization as development continues in the Ohio River Drainage Habitat.

Total Respondents **56**

Appendix E-2: Aggregated Aquatic Systems

13.	What current monitoring efforts by state agencies are you aware of for ALL wildlife in all Aquatic Systems Habitats in Indiana?		
	Yes, these efforts occur	**Not aware of these efforts occuring**	**Response Total**
Statewide year-round monitoring conducted by state agencies	11% (7)	89% (57)	**64**
Statewide once a year monitoring conducted by state agencies	8% (5)	92% (57)	**62**
Periodic statewide (less than once a year but still regularly scheduled) monitoring conducted by state agencies	13% (8)	87% (53)	**61**
Occasional statewide (less than once a year and not regularly scheduled) monitoring conducted by state agencies	28% (17)	72% (43)	**60**
Regional or local year-round monitoring conducted by state agencies	8% (5)	92% (58)	**63**
Regional or local once a year monitoring conducted by state agencies	23% (13)	79% (48)	**61**
Periodic regional or local (less than once a year but still regularly scheduled) monitoring conducted by state agencies	45% (28)	55% (34)	**62**
Occasional regional or local (less than once a year and not regularly scheduled) monitoring conducted by state agencies	70% (43)	30% (18)	**61**
		Total Respondents	**494**

14. What current monitoring efforts by other organizations are you aware of for ALL wildlife in all Aquatic Systems Habitats in Indiana?

	Yes, these efforts occur	Not aware of these efforts occuring	Response Total
Statewide year-round monitoring conducted by other organizations	2% (1)	98% (62)	**63**
Statewide once a year monitoring conducted by other organizations	8% (5)	92% (59)	**64**
Periodic statewide (less than once a year but still regularly scheduled) monitoring conducted by other organizations	0% (0)	100% (62)	**62**
Occasional statewide (less than once a year and not regularly scheduled) monitoring conducted by other organizations	2% (1)	98% (61)	**62**
Regional or local year-round monitoring conducted by other organizations	8% (5)	94% (58)	**63**
Regional or local once a year monitoring conducted by other organizations	23% (14)	79% (49)	**63**
Periodic regional or local (less than once a year but still regularly scheduled) monitoring conducted by other organizations	18% (11)	84% (52)	**63**
Occasional regional or local (less than once a year and not regularly scheduled) monitoring conducted by other organizations	32% (20)	68% (42)	**62**
		Total Respondents	**502**

15. How crucial are these monitoring efforts by state agencies for the conservation of ALL wildlife in all Aquatic Systems Habitats in Indiana?

	Very crucial	Somewhat crucial	Slightly crucial	Not crucial	Unknown	Response Total
Statewide year-round monitoring conducted by state agencies	11% (7)	3% (2)	11% (7)	53% (34)	22% (14)	**64**
Statewide once a year monitoring conducted by state agencies	10% (6)	3% (2)	11% (7)	51% (31)	25% (15)	**61**
Periodic statewide (less than once a year but still regularly scheduled) monitoring conducted by state agencies	7% (4)	13% (8)	18% (11)	36% (22)	26% (16)	**61**
Occasional statewide (less than once a year and not regularly scheduled) monitoring conducted by state agencies	3% (2)	16% (10)	10% (6)	44% (27)	26% (16)	**61**
Regional or local year-round monitoring conducted by state agencies	3% (2)	13% (8)	13% (8)	45% (28)	26% (16)	**62**
Regional or local once a year monitoring conducted by state agencies	1% (6)	22% (13)	22% (13)	23% (14)	23% (14)	**60**
Periodic regional or local (less than once a year but still regularly scheduled) monitoring conducted by state agencies	18% (11)	34% (21)	19% (12)	15% (9)	15% (9)	**62**
Occasional regional or local (less than once a year and not regularly scheduled)	26% (16)	24% (15)	13% (8)	15% (9)	23% (14)	**62**

monitoring conducted by state agencies		
	Total Respondents	**493**

16. How crucial are these monitoring efforts by other organizations for the conservation of ALL wildlife in all Aquatic Systems Habitats in Indiana?

	Very crucial	**Somewhat crucial**	**Slightly crucial**	**Not crucial**	**Unknown**	**Response Total**
Statewide year-round monitoring conducted by other organizations	3% (2)	5% (3)	11% (7)	47% (29)	34% (21)	**62**
Statewide once a year monitoring conducted by other organizations	6% (4)	2% (1)	15% (9)	44% (27)	34% (21)	**62**
Periodic statewide (less than once a year but still regularly scheduled) monitoring conducted by other organizations	3% (2)	5% (3)	13% (8)	44% (27)	34% (21)	**61**
Occasional statewide (less than once a year and not regularly scheduled) monitoring conducted by other organizations	3% (2)	3% (2)	13% (8)	47% (28)	33% (20)	**60**
Regional or local year-round monitoring conducted by other organizations	2% (1)	7% (4)	13% (8)	44% (27)	34% (21)	**61**
Regional or local once a year monitoring conducted by other organizations	8% (5)	8% (5)	19% (12)	37% (23)	27% (17)	**62**
Periodic regional or local (less than once a year but still regularly scheduled) monitoring conducted by other organizations	5% (3)	11% (7)	15% (9)	36% (22)	33% (20)	**61**
Occasional regional or local (less than once a year and not regularly scheduled) monitoring conducted by other organizations	7% (4)	11% (7)	20% (12)	31% (19)	31% (19)	**61**
				Total Respondents		**490**

17. Regional or local state agency monitoring for ALL wildlife in all Aquatic Systems Habitats in Indiana.

- State and county highway dept. monitor beaver activity only as flooding of roadways occur. IDNR property monitor and attempt to eliminate problems associated with flooding of adjacent private property. State Furbearer Biologist tracks and monitors trapping harvest data.
- IDNR personnel monitor otter mortality (road-kills, trap-related, etc.) at a statewide level. Also, IDNR personnel conduct winter bridge/stream surveys for otter sign. These are conducted on a county basis at a statewide level.
- Breeding Bird Atlas statewide every 20 years.
- Patoka Lake
  Hovey Lake
  Dogwood Lake
  Lake Sullivan
  Many other lakes
- IDNR - Division of Fish and Wildlife
- Many impoundments throughout the state have general fisheries survey conducted on them and crappie are caught during these.
- Fish and Wildlife properties in northern Indiana
- Tri-County Fish and Wildlife Area, Division of Fish and Wildlife.
- Lake Michigan proper out of Michigan City.
- Spring assessment out of Michigan City. Fall spawning assessment, Indiana waters of Lake Michigan. 9 month creel survey for harvest information. These efforts are conducted by the IDNR-Fish and Wildlife division.
- Division of Fish and Wildlife at cisco lakes.
- Department of Environmental Management water quality monitoring.
- NE Indiana by DFW (Jed Pearson).
- Northern Pike are monitored via general fish surveys conducted to update lake status. There is now monitoring of northern pike on a general schedule.
- There was a tracking study conducted in two Indaia natural lakes in the late 1990's by the IDNR to better understand reproductive habitat of northern pike.
- Division of Fish and Wildlife standardized largemouth bass sampling protocol.
- Tournament fishing monitoring by the Division of Fish and Wildlife.
- None.
- Patoka River watershed.
- State monitoring- banding and nest box surveys.
- Several Fish & Wildlife Areas acroos the state perform annual wood duck banding. These properties include Hovey Lake FWA, Glendale FWA, Minnihaha FWA, Willow Slough FWA, Jasper=Pulaski FWA, LaSalle FWA, Pigeon River FWA, Tri-County FWA, and there may be others.
  Many of these properties also conduct nest box monitoring activities on an annual basis.

Additionally, Indiana participates in the Harvest Information Program which can provide information about migration,population index and/or trends, as well as information about the amount of hunting pressure.

- Hovey Lake
  Tri-county
  Jasper Pulaski
  Pigeon River
  Winimac
  Willow Slough
  LaSalle

- IDEM annual eco-region sampling.

- IDNR-Fish and Wildlife, Lake Michigan Fisheries office.

- Headwater streams surveys were conducted in 2001 through 2004 by IDNR-Fish and Wildife, Lake Michigan Fisheries Office.

- IDEM eco-region sampling.

- IDNR periodically conducts fish stream surveys. IDEM conducts stream health surveys using fish and invertebrates.

- IDEM monitors the Great Lakes Drainage once every five years; thus, they may have data available for hornyhead chub captured in the basin as part of the fish community assessments. IDNR may also sample fish communities in this area and have data on the hornyhead chub.

- Maumee system.

- DNR fishery surveys are occasionally conducted on the Iroquois River, the Yellow River, and the Kankakee River. IDEM occasionally samples fish for contaminants analysis for the annual Fish Consumption Advisory.

- IDEM and IDNR collect fish community samples in this area; thus, they may have data on the distribution of Least darters.

- IDEM monitors the Kankakee River basin once every five years to determine if the stream are supporting a well-balanced warmwater aquatic community. Tadpole madtoms may have been captured while sampling headwater streams.

- Random locations within the Kankakee drainage.

- IDEM and IDNR collect fish community samples in this area; thus, they may have data on the distribution of Least darters.

- IDNR non-game biologist does mussel surveys. But, he is only one person and there are thousands of miles of streams in state.

- Wabash system.

- IDEM and the DNR Nongame program also conduct monitoring during the field season, once a year for fish. These above fish surveys are not specific to the Orangethroat Darter, but would include the Orangethroat Darter.; IDEM and the DNR Nongame program also conduct fish monitoring during the field season. These above fish surveys are not specific to the Orangethroat Darter, but would include the Orangethroat Darter.

- IDEM monitors the health of major river basins every 5 years by looking at chemical, physical, and biological data collected at random locations within the watershed. Southern redbelly dace have been captured in the Ohio River Drainage Habitat; however, specific monitoring for the species has not occured to my knowledge by anyone state or other organization.

Appendix E-2: Aggregated Aquatic Systems

- IDNR Fish & Wildlife Division.
- Wabash system.
- Tippecanoe River, Maumee system.
- Periodic (usually annual) monitoring in the Tippecanoe River by IDNR.
- Blue River (Harrison County)
  Sugar Creek (Shelby County)
  Indian Creek (Greene County)
- IN early to mid 1990's, Division of Fish and Wildlife conducted fish community inventories on the major streams throughout the state.
- Game fish population estimates (including rock bass) have been conducted on 5 streams every other year from 1998 through 2004.
- Various streams throughout the region, some are sampled more regularly than others IDEM probabilistic sampling.
- Indiana DNR Special Studies on T&E species- IDNR, Brant Fisher, did a study on the population of Eastern Sand Darters in Indiana over the past five years. IDNR- regional fish collection surveys may have collected some specimens of the Eastern Sand Darter. Indiana Department of Environmental Management (IDEM) occasionally collected Eastern Sand Darters as part of their Surface Water Quality Monitoring Strategy evaluating fish community structure in certain watersheds every 5 years.
- See IDEM OWQ's Surface Water Qaulity Monitoring Strategy and project work plans and IDNR Fisheries Section Work Plans.
- Blue River (Harrison County).
- In early to mid 1990's the Division of Fish and Wildlife conducted a smallmouth bass inventory.
- 5 streams have been sampled every other year from 1998 to 2004 to estimate smallmouth bass populations to determine the effect of smallmouth bass population changes due to the imposition of a 12-inch black bass size limit in 1998.
- Ohio River, Wabash system.
- Ohio River, Wabash.
- Wabash River
  West Fork White River
  East Fork White River
  Ohio River
- Ohio, White and Wabash rivers.
- Occasional stream surveys.
- INDFW, 1999 Wabash River, 2003 East Fork White River, 2004 West Fork White River, 2004 Main Stem White River, 1993 Patoka River, 2004 Ohio River Cannelton Pool, annual commercial fish harvest monitoring.
- Ohio River, Newburgh and McApline Tailwater fall/winter annual monitoring, occasional stream surveys
- IDNR I believe has conducted special studies on some wildlife species IDEM has record of some wildlife species being caught in that area.
- I'm unaware of any. Perhaps some occur coincident with large fish survey.

- Ask Zack Walker, I believe there was an accidental capture near Shoals.
- IDNR non-game biologist continually monitors fishes and mussels throughout the state, including Yellow Sandshell habitat. Two surveys have been done- ten years apart, completed last year - by IDNR biologists in the Wabash, Tippecanoe, and East Fork White Rivers; results are pending. This is in prime Yellow Sandshell habitat.
- Blue River (Harrison County)
  East Fork White River
  West Fork White River

Total Respondents **60**

18. Regional or local monitoring by other organizations for ALL wildlife in all Aquatic Systems Habitats in Indiana.

- Brodman, Saint Joseph's College.
- Cortwright, IUN.
- None that I am aware of.
- Federal Breeding Bird Survey, state May Day counts, Summer Bird Counts.
- None.
- None known.
- Not aware of any.
- F&W properties in northern Indiana, natural lakes, nature preserves.
- Unknown.
- Out of Michgian City and near Gary by Ball State University.
- USFWS and Illinois natural history survey egg and fry assessments at the Port of Indiana. This is part of a Fish and Wildlife Restoration Grant.
- Newton, Jasper, Pulaski, Starke, Lake & Porter Counties.
- Muskatatuck NWR also perform wood duck banding operations.
- Muscatatuck NWR.
- City of Elkhart-Elkhart & St. Joseph counties.
- In some cities stream health is also assessed by fish and invertebrate surveys.
- Elkhart Public Works and Utilities has a fisheries biologist on staff that actively collects fish community samples from the Great Lakes Basin (1-2 times in the summer). He may have data on the hornyhead chub as well.
- Maumee system.
- None.
- Commmonwealth Biomonitoring frequently does habitat evaluations in small streams as part of watershed studies. If I happen to see a shell, I make a note of it in field notes. These are NOT official mussel surveys.
- Wabash system.
- The Hoosier National Forest conducts yearly fish surveys within two or more 5th level HUCs that encompass the Hoosier National Forest, which includes the Ohio River Drainage, Eastern Corn Belt/Interior Plateau Ecoregions. These above fish surveys are not specific to the Orangethroat Darter, but would include the Orangethroat Darter; The Hoosier National Forest conducts yearly fish surveys within two or more 5th level HUCs that encompass the Hoosier National Forest, which includes the Ohio River Drainage, Eastern Corn Belt/Interior Plateau Ecoregions. These above fish surveys are not specific to the Orangethroat Darter, but would include the Orangethroat Darter.
- Wabash system.
- Tippecanoe River, Maumee system.

- Uncertain.
- None known to occur that specifically target rock bass.
- West Fork White River & tributaries(Muncie area).
- Ball State University fish sampling.
- While collecting fish community samples to evaluate the community structure and ability of the stream to support a healthy fish community, these organizations may have collected Eastern Sand Darters: Soil and Water Conservation Districts within those Ecoregions, Purdue University, Wildcat Creek Watershed Alliance? I would check with the Scientific Collectors Permit office for a list of organizations collecting in those ecoregions and also check with the IDEM Section 319 webpage for project summaries where fish or habitat in those ecoregions were studied.
- US Environmental Protection Agency; USGS Water Resources Division; Ohio River Valley Water Sanitation Commission; Midwest Biodiversity Institute, US Army Corps of Engineers; Muncie Bureau of Water Quality; City of Elkhart Water Quality; various universities; various consulting firms.
- None known to occur that specifically target smallmouth bass.
- Ohio River.
- Ohio River, Wabash.
- Ohio, White and Wabash rivers.
- I'm unaware of any.
- None.

Total Respondents **35**

19. Please list organizations that are monitoring ALL wildlife in all Aquatic Systems Habitats in Indiana.

- Brodman, Saint Joseph's College.
- Cortwright, IUN.
- IDNR.
- USGS (Breeding Bird Survey) and volunteers with Indiana Audubon Society.
- DNR/DFW.
- None known.
- Not known.
- Audubon Society, Ducks Unlimited, Indiana Division of Fish and Wildlife.
- Unknown.
- BBS.
- IDNR-Fish and Wildlife, Ball State University, University of Michigan through a coastal program grant. USFWS
- Indiana DNR, Division of Fish and Wildlife. Illinois Natural History Survey, USFWS.
- Bass fishing clubs who hold tournaments on Lake Wawasee and Syracuse Lake.
- Robert Brodman, Saint Joseph's College.
- DNR/DFW.
- IDNR.
- USFW.
- USFWS.
- Indiana Division of Fish and Wildlife. Population monitoring efforts at the state, regional and local scales are to monitor annual trends. Monitoring programs are not limited to river and stream habitats for mink.
- City of Elkhart - Elkhart and St. Joseph counties.
- IDNR-Fish and Wildlife.
- IDNR, IDEM, City of Elkhart and South Bend.
- TNC.
- DNR and IDEM.
- None.
- None than I know of. Most mussel surveys are on bigger rivers. I was contacted by a college prof. interested in taking a class out to a small stream to learn about mussels. I discouraged him from doing so unless he followed DNR regulations concerning collectors' permits. I haven't heard any more from him.
- Consultants, perhaps TNC.

- USDA Forest Service, Hoosier National Forest; USDI Fish and Wildlife Service; IDEM; IDNR; USDA Forest Service, Hoosier National Forest; USDI Fish and Wildlife Service; IDEM; IDNR.
- Consultant.
- TNC.
- TNC, USFWS.
- Uncertain.
- DNR/DFW.
- None known that specifically target rock bass.
- Muncie Bureau of Water Quality.
- DNR/DFW.
- None known that are specifically targeting smallmouth bass.
- USFWS.
- USFWS.
- Consultants.
- DNR/DFW.
- Electric utilities, Ball State University, Purdue University.
- None.
- IDEM monitors fish communities not particular species; however, the Slough darter has been captured by electrofishing in the Ohio River Drainage Habitat.
- DNR/DFW.

Total Respondents **40**

20. What are the current monitoring techniques for ALL wildlife in all Aquatic Systems Habitats in Indiana?

	Frequently used	Occasionally used	Not used but possible with existing technology and data	Not used and not possible with existing technology and data	Not economically feasible	Unknown	Response Total
Radio telemetry and tracking	0% (0)	7% (4)	52% (29)	5% (3)	20% (11)	16% (9)	**56**
Modeling	5% (3)	17% (10)	26% (15)	22% (13)	5% (3)	24% (14)	**58**
Coverboard routes	0% (0)	5% (2)	5% (2)	11% (4)	3% (1)	76% (28)	**37**
Spot mapping	5% (2)	20% (8)	25% (10)	0% (0)	3% (1)	48% (19)	**40**
Driving a survey route	13% (5)	5% (2)	8% (3)	23% (9)	10% (4)	41% (16)	**39**
Reporting from harvest, depredation, or unintentional take (road kill, bycatch)	27% (14)	15% (8)	6% (3)	29% (15)	8% (4)	15% (8)	**52**
Mark and recapture	17% (10)	34% (20)	27% (16)	2% (1)	5% (3)	15% (9)	**59**
Professional survey/census	51% (31)	38% (23)	5% (3)	0% (0)	0% (0)	7% (4)	**61**
Volunteer survey/census	2% (1)	37% (17)	24% (11)	2% (1)	2% (1)	33% (15)	**46**
Trapping (by any technique)	32% (15)	13% (6)	15% (7)	4% (2)	4% (2)	32% (15)	**47**
Representative sites	31% (16)	40% (21)	12% (6)	0% (0)	0% (0)	17% (9)	**52**
Probabilistic sites	19% (9)	17% (8)	32% (15)	0% (0)	0% (0)	32% (15)	**47**
Other (please specify below)	19% (4)	0% (0)	0% (0)	0% (0)	0% (0)	81% (17)	**21**
						Total Respondents	**615**

21. Other monitoring techniques for ALL wildlife in all Aquatic Systems Habitats in Indiana.

- Techniques currently in use in Indiana appear to be covered by the selections above.
- Unknown.
- Aerial surveys.
- Long term monitoring through gillnets, trawling has been conducted at 3 sites along the lake michigan lakefront since the mid 70's by Ball State University during the summer season. Creel census has been conducted by IDNR-Fish and Wildlife division for approximately 20 years. Commercial monitoring was conducted until the halt of the commercial fishing industry in 1996.
- Nest box survey.
- Nest box surveys.
- Electro-fishing and seining are appropriate methods for monitoring the Orangethroat darter.; Electro-fishing and seining are appropriate methods for monitoring the Orangethroat darter.; Electro-fishing and seining are appropriate monitoring techniques for the Orangethroat Darter.
- Unintentional take could be monitored from fish kill cadaver counts if the officers could be trained to identify norther hog suckers instead of not counting them or just lumping them into the generic class of "round bodied suckers"
- Larval sampling to check for reproduction.

Total Respondents **9**

22.	What one or two monitoring techniques would you recommend for effective conservation of ALL wildlife in all Aquatic Systems Habitats in Indiana?

- Aquatic surveys and minnow traps.
- Regulated trapping.
- Stream surveys for otter sign.
- Reporting (number, location, etc.) of unintentional take and biological data obtained from recovered specimens (reproductive parameters).

  REFERENCE: Melquist, W.E., P.J. Polechla, Jr., and D. Toweill. 2003. River Otter. Pages 708-734 in Wild Mammals of North America: biology, management, and conservation. 2nd edition. G.A. Feldhamer, B.C. Thompson, and J.A. Chapman (eds.), John Hopkins University Press, Baltimore, MD, 1216 pages.
- Directed surveys (canoe surveys, migration counts) most intensive.
- General breeding bird surveys less intensive.
- Electrofishing survey.
- Trap netting survey.
- Gill netting surveys.
  Angler creel surveys.
- Population estimates.
- Reporting from harvest(angler creel surveys) - This survey will show angler exploitation.
- Professional survey (fish management surveys) - This survey will show size structure, relative abundance, and provide age and growth information.
- Professional surveys or counts on F&W areas during migration periods (tracts annual migration trends and is index to population levels). Harvest surveys on F&W areas (tracts annual numbers taken) "Wildlife Investigational Techniques" by The Wildlife Society.
- Mark/Recapture-Banding (intensive), Ducks,Geese&Swans of North America, Frank C. Bellrose.
- Harvest data collection (less intensive) Wildlife Management Vol 2, Reuben Edwin Trippensee.
- Banding.
- Brood surveys.
- Fall trawl sampling for young of the year production. Possible incorporation of hydracoustic models for the near shore area.
- I would like to see all the lake trout stocked in Lake Michigan to be coded wire tagged. That will allow for better understanding of survival after stocking and movement of the fish. It will also allow for better understanding of spawning site fidelity.
- Occasional gill-netting to verify presence followed by intensive netting to confirm low levels or absence.
- Large fyke-nets are used in Lake Webster (Kosicusko Co.) to collected brood stock for muskellunge. These nets would be useful in capturing northern pike as well. This would allow biologist to capture enough fish to get a representative sample of adult fish. There is still no effective method of sampling young esocids without mortality.
- Springtime dc electrofishing according to DFW standard protocol.

- Standard DFW creel survey procedures.
- Tournament monitoring by the DFW and bass clubs.
- Minnow trapping and either mark recapture or telemetry.
- Electrofishing.
- Trap nets.
- Brood surveys.
- Continued participation in HIP is perhaps the most cost effective method for monitoring the flyway population.
- Banding operations help in determining the status of populations on a local or statewide level.
- Brood counts.
- Increased banding efforts.
- Radio telemetry or mark & recapture.
- Stream sampling using electrofishing techniques and seining. This should be done every 5 years to get a clear picture of changes that occur to habitat, water quality and invasive species introductions and distribution.
- Rotational sampling at reference sites along the headwaters. Historical comparisons from the early 80's will be compared with the sampling that was completed 2001-2004.
- Professional Fish Surveys and Creel Surveys.
- IDEM, IDNR, and Elkhart use electrofishing equipment to sample fish communities; however, a seine could probably be used as well as tagging and radio telemetry to track the species movement.
- Intensive quantitative sampling of known populations. Need to understand demography of the clubshell. See Strayer & Smith, 2003. AFS Monogr. 8.
- Less intensive qualitative sampling of new or not recently surveyed areas. Need to determine distribution and status of some the clubshell. See same for protocols.
- Periodic electrofishing surveys and mark recapture techniques probably provide the best information about the pike populations.
- Representative sites or look for sites where the habitat is suitable for the least darter and seine in the vegetation over rocky substrate.
- Seining or kick net.
- Electrofishing.
- Professional surveys using timed searches, systematic sampling (Strayer and Smith 2003)-A guide to sampling freshwater mussel populations. American Fisheries Society Monograph 8. American Fisheries Society. Bethesda, Maryland. 103 pp.
- Representative sites or look for sites where the habitat is suitable for the least darter and seine in the vegetation over rocky substrate.
- Seining or kick net.
- Electrofishing.

- Intensive quantitative sampling of known populations. Need to understand demography of the clubshell. See Strayer & Smith, 2003. AFS Monogr. 8.
- Less intensive qualitative sampling of new or not recently surveyed areas. Need to determine distribution and status of some wildlife species. See same for protocols.
- Electro-fishing streams. Take a random sampling of streams within a watershed (5th or 6th level HUC)and standardize the stream reach length for the survey...usually 15 times the stream width. Seining is also an appropriate method for sampling, especially in the riffle habitats.; Electro-fishing streams..take a random sampling of streams within a watershed (5th or 6th level HUC)and standardize the stream reach length for the survey...usually 15 times the stream width. Seining is also an appropriate method for sampling, especially in the riffle habitats.; Electro-fishing can be used to sample stream habitats. I suggest designing a random sample of all streams within a watershed (5th or 6th level HUC). The size of the stream reach sampled would be 15 times the stream width. Seining would also be an appropriate method for sampling.
- Target the habitat with seining equipment or electrofishing.
- Professional Survey.
- Intensive quantitative sampling of known populations. Need to understand demography of the clubshell. See Strayer & Smith, 2003. AFS Monogr. 8.
- Less intensive qualitative sampling of new or not recently surveyed areas. Need to determine distribution and status of some wildlife species. See same for protocols.
- Intensive quantitative sampling of known populations. Need to understand demography of the clubshell. See Strayer & Smith, 2003. AFS Monogr. 8.
- Less intensive qualitative sampling of new or not recently surveyed areas. Need to determine distribution and status of some wildlife species. See same for protocols.
- State DNR or professional census at representative or probabilistic sites.

  Development of trained, select volunteer core to undertake surveys at probabilistic sites, particularly where the species should, or could occur and has not been documented in recent years.
- Stream fish community surveys.
- Rock bass population estimates.
- Electrofishing surveys.
- See where populations of the darter have been captured in the past and then with sienes or electrofishing equipment mark and recapture the darter to document habitat characteristics, water quality information, and land use characterization where the darters occur. You will need to target the habitat and not the exact location since the sandbars will probably shift over time. Look on the web for mark and recapture surveys as well as other eastern sand darter publications. I found many by just searching the web for Eastern Sand Darter.
- Electrofishing results from probabilistic and representative sites.
- Electrofishing catch rate data.
- Population estimates.
- Angler creel surveys.
- Stream fish community surveys - To determine smallmouth bass distribution and abundance. There may be a correlation of smallmouth abundance to the species richness to the overall fish community.

- Smallmouth bass population estimates.
- Intensive quantitative sampling of known populations. Need to understand demography of the clubshell. See Strayer & Smith, 2003. AFS Monogr. 8.
- Less intensive qualitative sampling of new or not recently surveyed areas. Need to determine distribution and status of the clubshell. See same for protocols.
- Intensive quantitative sampling of known populations. Need to understand demography of the clubshell. See Strayer & Smith, 2003. AFS Monogr. 8.
- Less intensive qualitative sampling of new or not recently surveyed areas. Need to determine distribution and status of the clubshell. See same for protocols.
- Electrofishing swift water habitat.
- Hoop nets.
- Electrofishing river wide.
- Hoop-netting by scientists and commercial fishermen.
- Periodic stream surveys.
- Fall/winter Ohio River tailwater sampling and ocassional stream surveys.
- Seining at representative sites.
- Occasional censusing with very large, heavily bated hoop nets left out overnight.
  Do not set during rising waters.
  Check within 12 hours.
- Search for nests in June (after determining any adults present at all) methods used inFL and LA for nests, in AR and LA for capturing adults.
- Looking for basking individuals with a spotting scope.
- Perhaps use of fyke nets with big leads, or basking traps to estimate numbers after visual spotting determines presence.
- Systematic monitoring of probabilistic sites (professional).

  Use of volunteer census/monitoring.
- Seining or electrofishing representative sites using professionals.
- ELECTROFISHING CATCH RATES.
- POPULATION ESTIMATES.

Total Respondents **57**

23. What current HABITAT inventory and assessment efforts or activities by state agencies are you aware of for ALL wildlife in all Aquatic Systems Habitats in Indiana?

	Yes, these efforts occur	No effort that I'm aware of	Response Total
Statewide annual inventory and assessment conducted by state agencies	3% (2)	97% (61)	**63**
Statewide once a year inventory and assessment conducted by state agencies	2% (1)	98% (62)	**63**
Periodic statewide (less than once a year but still regularly scheduled) inventory and assessment conducted by state agencies	3% (2)	97% (61)	**63**
Occasional statewide (less than once a year and not regularly scheduled) inventory and assessment conducted by state agencies	13% (8)	87% (54)	**62**
Regional or local year-round inventory and assessment conducted by state agencies	3% (2)	97% (61)	**63**
Regional or local once a year inventory and assessment conducted by state agencies	10% (6)	90% (57)	**63**
Periodic regional or local (less than once a year but still regularly scheduled) inventory and assessment conducted by state agencies	29% (18)	71% (45)	**63**
Occasional regional or local (less than once a year and not regularly scheduled) inventory and assessment conducted by state agencies	43% (27)	57% (36)	**63**
	Total Respondents		**503**

24. What current HABITAT inventory and assessment efforts or activities by other organizations are you aware of for ALL wildlife in all Aquatic Systems Habitats in Indiana?

	Yes, these efforts occur	No effort that I'm aware of	Response Total
Statewide year-round inventory and assessment conducted by other organizations	2% (1)	98% (61)	**62**
Statewide once a year inventory and assessment conducted by other organizations	2% (1)	98% (61)	**62**
Periodic statewide (less than once a year but still regularly scheduled) inventory and assessment conducted by other organizations	3% (2)	97% (61)	**63**
Occasional statewide (less than once a year and not regularly scheduled) inventory and assessment conducted by other organizations	3% (2)	97% (61)	**63**
Regional or local year-round inventory and assessment conducted by other organizations	8% (5)	92% (58)	**63**
Regional or local once a year inventory and assessment conducted by other organizations	15% (9)	85% (53)	**62**
Periodic regional or local (less than once a year but still regularly scheduled) inventory and assessment conducted by other organizations	17% (11)	83% (52)	**63**
Occasional regional or local (less than once a year and not regularly scheduled) inventory and assessment conducted by other organizations	31% (20)	69% (45)	**65**
	Total Respondents		**503**

25. How crucial are these HABITAT efforts by state agencies for the conservation of ALL wildlife in all Aquatic Systems Habitats in Indiana?

	These efforts are very crucial for this HABITAT	These efforts are somewhat crucial for this HABITAT	These efforts are slightly crucial for this HABITAT	These efforts are not crucial for this HABITAT	Unknown	Response Total
Statewide annual inventory and assessment conducted by state agencies	3% (2)	5% (3)	11% (7)	43% (26)	38% (23)	**61**
Statewide once a year inventory and assessment conducted by state agencies	10% (6)	5% (3)	10% (6)	39% (24)	37% (23)	**62**
Periodic statewide (less than once a year but still regularly scheduled) inventory and assessment conducted by state agencies	10% (6)	10% (6)	10% (6)	32% (19)	37% (22)	**59**
Occasional statewide (less than once a year and not regularly scheduled) inventory and assessment conducted by state agencies	7% (4)	14% (8)	11% (6)	30% (17)	38% (21)	**56**
Regional or local year-round inventory and assessment conducted by state agencies	0% (0)	7% (4)	21% (12)	35% (20)	37% (21)	**57**
Regional or local once a year inventory and assessment conducted by state agencies	3% (2)	7% (4)	31% (18)	24% (14)	34% (20)	**58**
Periodic regional or local (less than once a year but still regularly scheduled) inventory and assessment conducted by state agencies	14% (8)	29% (17)	17% (10)	14% (8)	27% (16)	**59**
Occasional regional or local (less than once a year and not regularly scheduled) inventory and assessment conducted by state agencies	14% (8)	22% (13)	15% (9)	19% (11)	31% (18)	**59**
					Total Respondents	**471**

26. How crucial are these HABITAT efforts by other organizations for the conservation of ALL wildlife in all Aquatic Systems Habitats in Indiana?

	These efforts are very crucial for this HABITAT	These efforts are somewhat crucial for this HABITAT	These efforts are slightly crucial for this HABITAT	These efforts are not crucial for this HABITAT	Unknown	Response Total
Statewide year-round inventory and assessment conducted by other organizations	2% (1)	3% (3)	13% (8)	29% (18)	52% (32)	**62**
Statewide once a year inventory and assessment conducted by other organizations	3% (2)	3% (2)	11% (7)	29% (18)	53% (33)	**62**
Periodic statewide (less than once a year but still regularly scheduled) inventory and assessment conducted by other organizations	5% (3)	5% (3)	15% (9)	24% (15)	52% (32)	**62**
Occasional statewide (less than once a year and not regularly scheduled) inventory and assessment conducted by other organizations	3% (2)	3% (2)	16% (10)	25% (16)	52% (33)	**63**
Regional or local year-round inventory and assessment conducted by other organizations	3% (2)	8% (5)	15% (9)	24% (15)	50% (31)	**62**
Regional or local once a year inventory and assessment conducted by other organizations	3% (2)	8% (5)	16% (10)	21% (13)	52% (32)	**62**
Periodic regional or local (less than once a year but still regularly scheduled) inventory and assessment conducted by other organizations	10% (6)	10% (6)	19% (12)	15% (9)	47% (29)	**62**
Occasional regional or local (less than once a year and not regularly scheduled) inventory and assessment conducted by other organizations	8% (5)	8% (5)	14% (9)	21% (13)	49% (31)	**63**
				Total Respondents		**498**

27.	Regional or local state agency HABITAT inventory and assessment for ALL wildlife in all Aquatic Systems Habitats in Indiana.

- I suspect some state agencies monitor and assess aquatic habitats at a statewide level ... maybe not on an annual basis, but perhaps every few years. No agency comes to mind though that does it. Nonetheless, this is an important component of inventorying otter habitat in Indiana.
- Unknown.
- None.
- None known to occur.
- Not familiar with habitat assessments that occur on impoundments.
- Natural lakes in northern Indiana.
- Unknown.
- Lake Michigan proper along the shoreline in nearshore area less than 30 feet in depth.
- Habitat mapping and shoreline aerial imagery.
- NE IN, DFW, Jed Pearson.
- Recently the IDNR has begun sampling/mapping emergent plant species in some Indiana natural lakes. These plants may be used as reproductive habitat for northern pike.
- Not aware of any.
- None.
- Nearly all of the river and stream habitats in Indiana fall under state and/or federal jurisdiction, so obtaining and maintaining accurate and current information on these habitats is always occurring on a statewide basis.
- Trail Creek, East Branch of Little Calumet river, Reynolds Creek, Salt Creek, West Branch of Little Calumet River, Deep River.
- IDEM ecoregion surveys.
- In all major tributaries of Lake Michigan.
- Like I mentioned in my survey for the Eastern Sand Darter, IDEM, IDNR, and Elkhart use the QHEI (Qualitative Habitat Evaluation Index) to assess habitat in streams.
- Maumee system.
- Habitat evaluations are conducted as part of general stream surveys by DNR biologists. Such surveys have been conducted on the Iroquois River, the Yellow River, and the Kankakee River.
- As I stated in previous surveys, the QHEI would provide a habitat assessment for sites where least darters were collected.
- IDEM conducts a habitat assessment while sampling stream for fish community assessments using the QHEI (Qualitative Habitat Evaluation Index).
- None.
- As I stated in previous surveys, the QHEI would provide a habitat assessment for sites where least darters were collected.

- IDEM conducts a habitat assessment while sampling stream for fish community assessments using the QHEI (Qualitative Habitat Evaluation Index).
- Wabash system.
- Wabash system.
- Tippecanoe River and Maumee system.
- (Usually species inventories are made, with relevant habitat information)
- Blue River (Harrison County)
  Sugar Creek (Shelby County)
  Indian Creek (Greene County)
- Indiana Department of Natural Resources - Divison of Fish and Widlife.
- Indiana Department of Environmental Management
- IDEM - statewide QHEI.
- I don't know of any Habitat Inventory or Assessment done specifically for the Eastern Sand Darter in the habitat you list; however, I do know that IDEM as well as IDNR and other organizations use the Qualitative Habitat Evaluation Index to document the habitat quality of the streams sampled for aquatic communities.
- IDEM/OWQ/BSS; IDNR/FWD/FS; ORSANCO.
- Blue River (Harrison County).
- Indiana Dept of Natural Resources - Division of Fish and Wildlife.
- Indiana Department of Environmental Management.
- Ohio River, Wabash system.
- Ohio River, Wabash.
- West Fork White River.
- East Fork White River
  Wabash River
- Unknown.
- If any inventory is occurring, it's for water quality or fish contamination.
- I am assuming that the governmental division responsible for water pollution control conducts some sampling regarding organic and heavy metal toxins in the water.
- I'm unclear as to whether there is any survey on silting in or natural changes in river channels
- IDNR primarily monitors mussel species, making habitat notations. No real habit monitors made. However, Indiana Department of Environmental Management, IDNR Division of Water do monitor water quality (as a component of habitat).
- BLUE RIVER (HARRISON COUNTY)

Total Respondents **44**

28.	Regional or local HABITAT inventory and assessment by other organizations for ALL wildlife in all Aquatic Systems Habitats in Indiana.

- Brodman, Saint Joseph's College in NW Indiana.
- Cortwright, IUN in Brown County
- Unknown.
- None.
- None known.
- Unknown.
- Lake Michigan proper along the shoreline in nearshore area less than 30 feet in depth.
- Not aware of any.
- Newton, Jasper, Starke, Pulaski, Lake & Porter counties.
- Many local zoning boards, planning commissions and drainage boards also keep and maintain their own records in regard to land use patterns within these habitats.
- City of Elkhart
- St. Joseph River
- Maumee system.
- None.
- We (Commonewealth Biomonitoring) do habitat evaluations on small streams as part of watershed studies. These evaluations are not specific to mussels, but are Ohio EPA QHEI methods.
- Wabash system.
- Two or more 5th level HUC watersheds a year that encompass the Hoosier National Forest are sampled; a random sampling of streams found within these 5th level HUCs occurs.
- Wabash system.
- Tippecanoe River and Maumee system.
- None known.
- Muncie BWQ - WFWR and tributaries in the Muncie area.
- None.
- None known.
- Ohio River.
- Ohio River, Wabash.
- West Fork White River
  East Fork White River
  Wabash River

- Unknown.
- USACOE Ohio River.
- USACOE Ohio River.
- If any inventory is occurring, it's for water quality or fish contamination.
- Occasional grants to universities?
- NONE

Total Respondents **31**

29. Please list organizations that are monitoring this HABITAT for ALL wildlife in all Aquatic Systems Habitats in Indiana.

- Unknown.
- None.
- None known.
- Indiana Division of Fish and Wildlife.
- Unknown.
- IDNR, USFSW, Ball State, University of Michigan.
- Indiana DNR- Fish and Wildlife division. USFWS/GLFC.
- Not aware of any.
- Robert Brodman, Saint Joseph's College.
- None that I am aware of.
- IDNR
  USFWS
  USDA
  IDEM
  USACE
  EPA
  Local government entities (area plan commissions, zoning boards etc…)
- IDNR-Fish and Wildlife, USFWS
- IDNR-Fish and Wildlife, Lake Michigan Fisheries Office.
- IDNR, IDEM, City of Elkhart and South Bend.
- TNC.
- DNR division of Fish and Wildlife.
- None.
- Consultants, perhaps TNC.

- IDEM, IDNR, USDA Forest Service, USDI Fish and Wildlife Service.
- IDEM- Qualitative Habitat Evaluations completed at sites where southern redbelly dace may have been captured as part of the fish community sampling program.
- Consultants.
- TNC.
- TNC, USFWS.
- DNR/DFW.
- None known.
- Muncie; Elkhart; USGS/WRD.
- DNR/DFW.
- None known.
- USFWS
- USFWS
- Consultants.
- DNR/DFW.
- Unknown.
- USACOE Ohio River
- USACOE Ohio River
- IDEM performs habitat assessments in this area whoever samples for state water pollution control.
- Fish quality? State board of health??
- IDEM makes assessments of the habitat while doing fish community surveys in the Ohio River Drainage Habitat.
- DNR/DFW

Total Respondents **38**

30. What are the current HABITAT inventory and/or assessment techniques for ALL wildlife in all Aquatic Systems Habitats in Indiana?

	Frequently used	Occasionally used	Not used but possible with existing technology and data	Not used and not possible with existing technology and data	Not economically feasible	Unknown	Response Total
GIS mapping	7% (4)	32% (19)	27% (16)	8% (5)	2% (1)	25% (15)	**60**
Aerial photography and analysis	3% (2)	24% (14)	17% (10)	10% (6)	2% (1)	43% (25)	**58**
Systematic sampling	20% (11)	33% (18)	11% (6)	2% (1)	0% (0)	35% (19)	**55**
Property tax estimates	2% (1)	0% (0)	0% (0)	19% (9)	10% (5)	69% (33)	**48**
State revenue data	0% (0)	0% (0)	0% (0)	19% (9)	11% (5)	70% (33)	**47**
Regulatory information	2% (1)	10% (5)	2% (1)	12% (6)	6% (3)	67% (33)	**49**
Participation in landuse programs	2% (1)	20% (10)	16% (8)	6% (3)	6% (3)	50% (25)	**50**
Modeling	2% (1)	30% (16)	22% (12)	0% (0)	4% (2)	43% (23)	**54**
Voluntary landowner reporting	0% (0)	19% (9)	6% (3)	6% (3)	11% (5)	57% (27)	**47**
Other (please specify below)	7% (2)	7% (2)	0% (0)	0% (0)	0% (0)	85% (23)	**27**
						Total Respondents	**495**

31. Other HABITAT inventory and assessment techniques for ALL wildlife in all Aquatic Systems Habitats in Indiana.

- None
- Unknown
- Bottom mapping of habitat
- IBI, and QHEI for representative sites.
- Qualitative Habitat Evaluation Index(QHEI); REMAP protocols for Northern Forested Streams; stream channel cross-sections and longitudinal profiles; substrate analysis; descriptions of riparian vegetation; water quality parameters are measured using probes and Hydro-labs
- Water quality monitoring
- QHEI
- QHEI
- QHEI.

Total Respondents **9**

32. What one or two HABITAT inventory and assessment techniques would you recommend for effective conservation of ALL wildlife in all Aquatic Systems Habitats in Indiana?

- Systematic sampling & GIS.
- GIS technology appears to be the most feasible means for inventory and assessment of otter habitat at a statewide scale. I suspect analysis of aerial photos could be useful also, perhaps at a local scale. Unfortunately, I do not have any references.
- Aerial imagery to identify and quantify habitat.
- Systematic sampling would probably be best to determine the abundance of cover that is available, but could be very difficult as most of the habitat is hidden under the surface of the water.
- GIS mapping(electronic data base of current habitat) Aerial photography and analysis (examine changes in habitat)
- "Wildlife Investigational Techniques" by The Wildlife Society.
- G.I.S. (intensive) Wildlife Management Techniques Manual, Fourth Edition, Sanford D. Schemnitz
- Aerial (less intensive) same.
- Spring counts- aerial.
- Lidar mapping would help identify spawning areas within the nearshore zone along Indiana's coastline.
- Digital satellite imagery to conduct bottom contour mapping in nearshore spawning areas.
- Emergent bulrush and wetland monitoring and protection via ecozones.
- Evaluate land and water use practices to reduce in lake and upstream degradation of vegetation and shoreline.

- Unknown.
- Suvery (intensive) and GIS (less intensive).
- GIS mapping.aerial photo. and analysis.
- Developing and maintaining accurate GIS data sets on the habitat is very important.
- Spring, summer, fall and winter surveys.
- GIS mapping and aerial photography.
- Sampling.
- Sampling using electrofishing and seining in headwater areas. Completing IBI and QHEI and water quality analysis for these sites.
- Assessment using the Qualitative Habitat Evaluation Index.
- Assess riparian corridor and water quality.
- Systematic sampling of the habitat along the length of the stream to provide baseline data for comparison across time.
- GIS mapping of restored, fully connected wetland to provide an inventory of available spawning habitat.
- Don't really think that a habitat inventory of any kind is necessary for creek heelsplitter habitat in the Kankakee drainage.
- Assess riparian corridor presence.
- Water quality.
- Two protocols that I recommend for reference include the following:
  Harrelson, C.C., C.L. Rawlins, and J.P. Potyondy. 1994. Stream Channel Reference Sites: An Illustrated Guide to Field Technique. USDA Forest Service. General Technical Report RM-245.
  The above reference offers useful guidance on measuring stream channel cross-sections and substrate within the stream. This information can be used to determine if a stream channel is stable and if the substrate is available within riffle habitats, which are the preferred habitat of the Orangethroat Darter.
  Simon, T. P. and P.M. Stewart. 1998. Standard Operating Procedures For Development of Watershed Indicators In REMAP: Northern Lakes and Forest Streams.
  The above reference is very useful for developing a watershed level sampling design and includes useful methods for measuring stream channel and stream habitat parameters.

  The Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA is a useful qualitative field method that can be used to prioritize sites within a watershed for stream habitat or water quality improvement.
- Systematic survey & GIS.
- Assess riparian corridor.
- Water quality monitoring.
- CREP, farmer incentives for no-till, riparian corridors, etc.
- Strictly control instream modifications: mining, snagging, etc.
- More extensive use of GIS- modeled habitat probabilities.
- QHEI.

- QHEI.
- More habitat inventories and assessments.
- QHEI.
- GIS.
- Qualitative Habitat Evaluation Index (QHEI) in conjunction with a stream community survey or sampling specifically for smallmouth bass. This can show which habitat components most strongly correlate with smallmouth bass abundance and or size structure.
- Assess zebra mussel infestations. Contact P. Morrison, USFWS, Parkersburg, WV.
- Zebra mussel assessment. Contact P. Morrison, USFWS, Parkersburg, WV.
- QHEI.
- Recording GIS information.
- Record habitat when the species is collected during a survey.
- GIS mapping and aerial photography and analysis.
- GIS mapping and aerial photography and analysis.
- High resolution aerial photography DURING LOW WATER - digitized for GIS. locate:
  1) Deep river holes with woody debris (favored by adults)
  2) health/permanence of oxbow ponds
  3) nesting habitat
- High resolution aerial photography during low water periods – digitize and use in GIS - re. how lasting are oxbow ponds during droughts.
- Occasional site visits to assess vegetation quality for this herbivorous turtle.
- To look at saturation of potential habitat: with GIS construction of existing potential habitat(based upon known factors)and overlaying the current distribution of the Yellow Sandshell.
- QHEI.

Total Respondents **43**

33. What is the current body of science for ALL wildlife in all Aquatic Systems Habitats in Indiana?

		Response Total	Response Percent
Complete, up to date and extensive		1	2%
Adequate		23	36%
Inadequate		32	50%
Nonexistent		5	8%
Other (please explain below)	Unknown in the larger scale	3	5%
	Total Respondents		**64**

34.	Please provide a citation (title, author, date, publisher) that would give the best overview of ALL wildlife in all Aquatic Systems Habitats in Indiana, if available. This resource may be used if further detail is needed.

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 = Ten- to eleven-year population trends of two pond-breedong amphibian species, red-spotted newts and green frogs. In Status & Conservation of Midwester;
Author = Spencer Cortwright;
Date = 1998;
Publisher = University of Iowa Press, Iowa City

Title = Mammals of Indiana;
Author = Russell E. Mumford/ John Whitaker, Jr.;
Date = 1982;
Publisher = Bloomington Indiana University Press

Title = Indiana River Otter Reintroduction Program, 2000-2001;
Author = Scott A. Johnson;
Date = November 2001;
Publisher = Internal report, Indiana Department of Natural Resources, Bloomington, IN

Title = Restoring river otters in Indiana;
Author = Scott A. Johnson and Kim A. Berkley;
Date = 1999;
Publisher = Wildlife Society Bulletin 27:419-427.

Title = Atlas of Breeding Birds in Indiana
Author = Castrale, J.S., E. Hopkins, C.E. Keller
Date = 1998
Publisher = IDNR

Title = Many in AFS journal of fish management and transactions of AFS
Impoundments Strategic Plan
Author = IDNR - Fish and Wildlife
Date = 1997
Publisher = IDNR - Fish and Wildlife

Title = Ducks, Geese & Swans of North America
Author = Frank C. Bellrose
Date = 1976
Publisher = Stackpole Books

Title = Preliminary Results of 2004 Ball State University Yellow Perch Research in Indiana Waters of Lake Michigan;
Author = Paul Allen and Thomas Lauer;
Date = Cctober 2004;
Publisher = Ball State University

Title = Yellow Perch Research and Management in Lake Michgian, Evaluating Progress in a Cooperative Effort, 1997-2001;
Author = David Clapp and John Dettmers;
Date = November 2004;
Publisher = American Fisheries Society, Fisheries

Title = Lake Trout Restoration Plan;
Date = In progress

Appendix E-2: Aggregated Aquatic Systems

Title = Lake Trout Impediments Docuement;
Author = Numerous,;
Date = 2003;
Publisher = Lake Trout Task group/LMTC

Title = Cisco population status and management in Indiana
Author = Jed Pearson
Date = 2001
Publisher = Division of Fish and Wildlife

Title = Northern Pike Spawning Habitat Investigations At Two Narural Lake In Indiana
Author = Cwalinski, Tim A.
Date = September 2001
Publisher = Indiana Department of Natural Resources

Title = DFW largemouth bass database
Author = Jed Pearson
Date = unpublished
Publisher = unpublished

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 = Ecology and Management of the Wood Duck
Author = Bellrose and Holm
Date = 1994
Publisher = Stackpole Books

Title = Fisheries Survey of the East Branch of the Little Calumet River Watershed
Author = Neil Ledet
Date = 1978
Publisher = IDNR Fisheries Section

Title = Naiades of Pennsylvania
Author = Ortmann
Date = 1919
Publisher = Carnegie Museum

Title = Fishery, Habitat, and Recreational Use Surveys for the Kankakee River
Author = Price and Robertson
Date = 2005
Publisher = DNR - Division of Fish and Wildlife (in review)

Title = Occurrence and distribution of freshwater mussels in the small streams of Tippecanoe County, Indiana
Author = Myers-Kinzie, M., S. Wente, & A. Spacie
Date = 2001
Publisher = Proc. Ind. Acad. Sci.

Title = Naiades of Pennsylvania
Author = Ortmann
Date = 1919
Publisher = Carnegie Museum

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.

Appendix E-2: Aggregated Aquatic Systems

Title = Naiades of Pennsylvania
Author = Ortmann
Date = 1919
Publisher = Carnegie Museum

Title = Federal Recovery Plan
Author = USFWS
Date = 1993
Publisher = USFWS

Title = 'Clubshell'
Author = USFW, Division of Endangered Species
Date = 12/1997
Publisher = Online

Title = A survey of fish communities and aquatic habitats at Indiana's major steams with emphasis on smallmouth bass distribution and abundance
Author = Stuart T. Shipman
Date = December 1997
Publisher = DNR fisheries section

Title = A survey of fish communities and aquatic habitats at Indiana's major streams with emphasis on smallmouth bass distribution and abundance.
Author = Stuart T. Shipman
Date = December 1997
Publisher = DNR fisheries section

Title = The Fishes of Missouri
Author = William L. Plieger
Date = 1997
Publisher = Missouri Conservation Commission

Title = Handbook of freshwater fishery biology
Author = Kenneth D. Carlander
Date = 1997
Publisher = Iowa University Press

Title = Fishes of Ohio
Author = Milt Troutman
Date = 12/1997
Publisher = OSU Press

Title = A survey of fish communities and aquatic habitats at Indiana's major streams with emphasis on smallmouth bass distribution and abundance
Author = Stuart Shipman
Date = December 1997
Publisher = DNR/Fisheries section

Title = A survey of fish communities and aquatic habitats at Indiana's major streams with emphasis on smallmouth bass distribution and abundance
Author = Stuart Shipman
Date = December 1997
Publisher = IDNR

Title = Federal Recovery Plan
Author = USFWS
Date = 1991
Publisher = USFWS

Title = Freshwater mussels of Tennessee

Appendix E-2: Aggregated Aquatic Systems

Author = Parmalee & Bogan
Date = 1998
Publisher = U of Tennessee Press

Title = Wabash River Catfish Reports
Author = Rob Columbo
Date = 2002,2003,2004,2005
Publisher = SIU/INDFW
Title = GIS mapping and aerial photography and analysis
Author = ORFMT
Date = annually since 1999
Publisher = ORFMT

Title =
Author = Minton
Date = 2001
Publisher =

Title = (Numerous internet sites, including USF&W)
Author =
Date =
Publisher =

Title = A survey of fish communities and aquatic habitats at Indiana's major streams with emphasis on smallmouth bass distribution and abundance
Author = Stuart Shipman
Date = 12/1997
Publisher = DNR/Fisheries section

35.	If possible, please provide a second citation (title, author, date, publisher) that would give another good overview of ALL wildlife in all Aquatic Systems Habitats in Indiana. This resource may also be used if further detail is needed.

Title = Waterfowl & Wetlands an Intergarted review
Author = Theodore A. Bookout
Date = 1979
Publisher = LaCrosse Printing

Title = Yellow Perch Research and Management in Lake Michgian, Evaluating Progress in a Cooperative Effort, 1997-2001
Author = David Clapp and John Dettmers
Date = November 2004
Publisher = American Fisheries Society, Fisheries

Title = Lake Trout Impediments Documents
Author = Numerous,
Date = 2003
Publisher = Lake Trout Task group/LMTC

Title = Largemouth bass size limits at Indiana natural lakes - a 30-year history
Author = Jed Pearson
Date = 2003
Publisher = unpublished

Title = Ducks, Geese and Swans of North America
Author = Bellrose
Date = 1976
Publisher = Stackpole Books

Title = Stream Survey of the East Arm of the Little Calumet River
Author = Edward Braun
Date = 1974
Publisher = IDNR Division of Fish and Wildlife

Title = Freshwater mussels of the Midwest
Author = Cummings & Mayer
Date = 1992
Publisher = INHS

Title = A fishery survey of the Kankakee River in Indiana
Author = Robertson and Ledet
Date = 1981
Publisher = DNR - Division of Fish and Wildlife

Title = Freshwater Mollusca of WI
Author = Baker
Date = 1919
Publisher = WI Geol. Nat. Hist. Surv.

Title = Freshwater mussels of the Midwets
Author = Cummings & Mayer
Date = 1992
Publisher = INHS

Title = Field guide to freshwater mussels of Midwest
Author = Cummings & Mayer
Date = 1992
Publisher = INHS

Title = Surveys of the fish communties and aquatic habitats in 16 small streams in Indiana from 1996 through 1997.
Author = Douglas C. Keller
Date = 1999
Publisher = IDNR

Title = fishes of Tennessee
Author = Etnire and Starnes
Date =
Publisher =

Title = FW fishes of Canada
Author = Scott & Crossman
Date =
Publisher =

Title = Surveys of the fish communties and aquatic habitats in 16 small streams in Indiana from 1996 through 1997.
Author = Douglas C. Keller
Date = 1999
Publisher = IDNR

Title = Life history and propagation...
Author = Jones & Neves
Date = 2002
Publisher = JNABS

Title = Freshwater mussels of the Midwest
Author = Cummings & Mayer
Date = 1992
Publisher = INHS

Title = numerous INDFW FMR's
Author = Numerous
Date = numerous
Publisher = INDFW

Title = various INDFW FMR's
Author = various
Date = various
Publisher = INDFW

Title = Freshwater Mussels of the Midwest
Author = Cummings & Mayer
Date =1992
Publisher = Illinois Natural History Survey

36. What is the current HABITAT body of science for ALL wildlife in all Aquatic Systems Habitats in Indiana?

	Response Total	Response Percent
Complete, up to date and extensive		
Adequate	12	20%
Inadequate	34	56%

Nonexistent		10	16%
	The body of science is better than adequate, it is quite extensive and up to date, but by no means is it complete.		
Other (please explain below)	Unknown on the larger scale	5	8%
	not my expertise - look for historical geography/hydrology		
		Total Respondents	**61**

37. Please provide a citation (title, author, date, publisher) that would give the best HABITAT overview of ALL wildlife in all Aquatic Systems Habitats in Indiana, if available. This resource may be used if further detail is needed.

Title = Mammals of Indiana;
Author = Russell E. Mumford;
Date = 1982;
Publisher = Bloomington Indiana University Press

Title = Soil Survey's of Indiana Counties
Author = U.S. Dept. of Agriculture, SCS
Date = 1990
Publisher = U.S. Dept. of Agriculture

Title = Cisco population status and management in Indiana
Author = Jed Pearson
Date = 2001
Publisher = Division of Fish and Wildlife

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 = Wetlands
Author = Mitsch & Gosselink
Date =1993
Publisher = Van Nostrand Rheinhold

Title = Fisheries Survey of the East Branch of the Little Calumet River Watershed
Author = Neil Ledet
Date = 1978
Publisher = IDNR Fisheries Section

Title = Naiades of Pennsylvania
Author = Ortmann
Date = 1919
Publisher = Carnegie Museum

Title = Fishery, Habitat, and Recreational Use Surveys for the Kankakee River
Author = Price and Robertson
Date = 2005
Publisher = DNR - Division of Fish and Wildlife (in review)

Title = Naiades of Pennsylvania
Author = Ortmann
Date = 1919

Publisher = Carnegie Museum

Title = Naiades of Pennsylvania
Author = Ortmann
Date =1919
Publisher = Carnegie Museum

Title = Federal Recovery Plan
Author = USFWS
Date =1993
Publisher = USFWS

Title = A survey of fish communities and aquatic habitatts at Indiana's major streams with emphasis on smallmouth bass distribution and abundance.
Author = Stuart T. Shipman
Date = December 1997
Publisher = IDNR

Title = A survey of fish communities and aquatic habitats at Indiana's major streams with emphasis on smallmouth bass distribution and abundance
Author = Stuart T. Shipman
Date =12/1997
Publisher = DNR/Fisheries section

Title = A survey of fish communities and aquatic habitats at Indiana's major streams with emphasis on smallmouth bass distribution and abundance
Author = Stuart T. Shipman
Date = December 1997
Publisher = IDNR

Title = Federal Recovery Plan
Author = USFWS
Date =1991
Publisher = USFWS

Title = Freshwater Mollusca of WI
Author = Baker
Date =1928
Publisher = WI Geol. Nat. Hist. Surv.

Title = Ohio River Mainstem Study
Author = USACOE
Date =2000?
Publisher = USACOE

Title = Ohio River Mainstem Study
Author = USACOE
Date =2000?
Publisher = USACOE

Title = ??? Sugar Creek???
Author =?
Date = late 1970s/early 1980s
Publisher = PhD thesis IU Bloomington

38.	If possible, please provide a second citation (title, author, date, publisher) that would give another good HABITAT overview of ALL wildlife in all Aquatic Systems Habitats in Indiana. This resource may also be used if further detail is needed.

Title = Management of Seasonally Flooded Impoundments
Author = Leigh H. Fredrickson, T. Scott Taylor
Date = 1982
Publisher = U.S. Fish and Wildlife Service

Title = Southern Forested Wetlands
Author = Messina & Conner
Date = 1998
Publisher = CRC Press LLC

Title = Stream Survey of the East Arm of the Little Calumet River
Author = Edward Braun
Date = 1974
Publisher = IDNR Division of Fish and Wildlife

Title = Freshwater Mollusca of WI
Author = Baker
Date = 1928
Publisher = WI Geol. Nat. Hist. Survey

Title = A fishery survey of the Kankakee River in Indiana
Author = Robertson and Ledet
Date = 1981
Publisher = DNR - Division of Fish and Wildlife

Title = Freshwater Mollusca of WI
Author = Baker
Date = 1919
Publisher = WI Geol. Nat. Hist. Surv.

Title = Freshwater Mollusca of WI
Author = Baker
Date = 1929
Publisher = WI Geol. Nat. Sci. Surv.

Title = Naiades of Pennsylvania
Author = Ortmann
Date = 1919
Publisher = Carnegie Museum

Title = Surveys of the fish communities and aquatic habitats in 16 small streams in Indiana from 1996 through 1997.
Author = Douglas C. Keller
Date = 1999
Publisher = IDNR

Title = Surveys of the fish communties and aquatic habitats in 16 small streams in Indiana from 1996 through 1997.
Author = Douglas C. Keller
Date = 1999
Publisher = IDNR

Title = Naiades of Pennsylvania
Author = Ortmann
Date = 1919
Publisher = Carnegie Museum

39. What are the research needs for ALL wildlife in all Aquatic Systems Habitats in Indiana?

	Urgently needed	Greatly needed	Needed	Slightly needed	Not needed	Unknown	Response Total
Life cycle	11% (7)	3% (2)	40% (26)	18% (12)	26% (17)	2% (1)	**65**
Distribution and abundance	11% (7)	22% (14)	41% (26)	13% (8)	13% (8)	2% (1)	**64**
Limiting factors (food, shelter, water, breeding sites)	15% (10)	32% (21)	32% (21)	11% (7)	8% (5)	2% (1)	**65**
Threats (predators/competition, contamination)	18% (12)	28% (18)	26% (17)	15% (10)	11% (7)	2% (1)	**65**
Relationship/dependence on specific habitats	15% (10)	20% (13)	38% (25)	12% (8)	12% (8)	2% (1)	**65**
Population health (genetic and physical)	6% (4)	12% (8)	29% (19)	32% (21)	17% (11)	3% (2)	**65**
Other (please specify below)	5% (1)	0% (0)	5% (1)	5% (1)	11% (2)	74% (14)	**19**
					Total Respondents		**408**

40. Other research needs for ALL wildlife in all Aquatic Systems Habitats in Indiana.

- Relationship(s) between population levels and population indices.
- How to produce more, larger crappie.
- Unknown.
- Harvest.
- Survival/nest success.
- Limiting factors and impacts of competition and predation.
- Very little is known about the basic natural history, population ecology and abundance in Indiana of the lesser siren.
- Research needs are not limited to river and stream habitats.
- Habitat needs are not completely understood. I have seen fresh dead cylindrical papershell in channelized ag ditches. Other small streams with good habitat have only weathered dead fragments.
- To find out why the Clubshell has depopulated most of its former distribution in Indiana. Developing some sort of timeline (late Pleistocene, Holocene (usually archaeological), or historic) for relic valve distribution might narrow the possibilities of critical limiting factors (post-settlement siltation,etc.).
- Determine population-limiting factors in the Ohio River.
- Cost effectiveness and periodic effective duration of local raccoon elimination.
- Socio-economic impacts of terminating commercial fishing use of commercial equipment in the lower West Fork and Middle East Fork White River.

- Whether genetic stock from northern Arkansas will suffice for re-introduction - or will farmed stock from AR or LA will suffice.

Total Respondents **11**

41. What are the HABITAT research needs for ALL wildlife in all Aquatic Systems Habitats in Indiana?

	Urgently needed	Greatly needed	Needed	Slightly needed	Not needed	Unknown	Response Total
Successional changes	0% (0)	6% (4)	24% (15)	17% (11)	37% (23)	16% (10)	**63**
Distribution and abundance (fragmentation)	14% (9)	16% (10)	33% (21)	16% (10)	14% (9)	6% (4)	**63**
Threats (land use change/competition, contamination/global warming)	22% (14)	31% (20)	23% (15)	14% (9)	6% (4)	3% (2)	**64**
Relationship/dependence on specific site conditions	15% (9)	23% (14)	27% (17)	18% (11)	11% (7)	6% (4)	**62**
Growth and development of individual components of the habitat	11% (7)	10% (6)	38% (23)	16% (10)	15% (9)	10% (6)	**61**
Other (please specify below)	0% (0)	8% (2)	4% (1)	4% (1)	8% (2)	76% (19)	**25**
						Total Respondents	**338**

42. Other HABITAT research needs for ALL wildlife in all Aquatic Systems Habitats in Indiana.

Unknown

Water quality variations and impacts of land us and shoreline alterations

Factors that limit the distribution of sirens in Indiana

Affects of channelization on streambank communities and the affects on adjacent oxbows, bottomland hardwoods and other riparian areas

Effects of roads and stream crossings on the some wildlife species; Is aquatic passage through culverts and other stream crossing structures adequate or are these crossings causing aquatic habitat fragmentation?

Water quality requirements

Same as on previous panel

Total Respondents **7**

43. How well do the following conservation efforts address the threats to ALL wildlife in all Aquatic Systems Habitats in Indiana?

	Very well	Somewhat	Not at all	Not used	Unknown	Response Total
Habitat protection (use below for details)	27% (16)	53% (31)	5% (3)	7% (4)	8% (5)	**59**
Population management (hunting, trapping)	20% (12)	31% (18)	2% (1)	39% (23)	8% (5)	**59**
Population enhancement (captive breeding and release)	2% (1)	8% (5)	2% (1)	83% (49)	5% (3)	**59**
Reintroduction (restoration)	10% (6)	14% (8)	3% (2)	68% (40)	5% (3)	**59**
Food plots	2% (1)	7% (4)	3% (2)	72% (42)	16% (9)	**58**
Threats reduction	7% (4)	25% (15)	5% (3)	46% (27)	17% (10)	**59**
Native predator control	2% (1)	7% (4)	5% (3)	80% (47)	7% (4)	**59**
Exotic/invasive species control	0% (0)	15% (9)	22% (13)	35% (21)	28% (17)	**60**
Regulation of collecting	7% (4)	37% (22)	20% (12)	24% (14)	12% (7)	**59**
Disease/parasite management	0% (0)	10% (6)	2% (1)	55% (32)	33% (19)	**58**
Translocation to new geographic range	5% (3)	8% (5)	2% (1)	75% (44)	10% (6)	**59**
Protection of migration routes	7% (4)	12% (7)	2% (1)	49% (29)	31% (18)	**59**
Limiting contact with pollutants/contaminants	9% (4)	49% (23)	6% (3)	30% (14)	6% (3)	**47**
Public education to reduce human disturbance	8% (5)	47% (28)	8% (5)	22% (13)	14% (8)	**59**
Culling/selective removal	3% (2)	10% (6)	3% (2)	69% (41)	14% (8)	**59**
Stocking	5% (3)	12% (7)	3% (2)	75% (44)	5% (3)	**59**
Other (please specify below)	0% (0)	0% (0)	4% (1)	9% (2)	87% (20)	**23**
					Total Respondents	**954**

44. Other current conservation practices for ALL wildlife in all Aquatic Systems Habitats in Indiana.

- Unknown
- Regulation of sport harvest. Closure of commercial fishery to allow spawning stock biomass to increase, thus allowing for the production of offspring that can eventually add to the spawning stock biomass.
- Habitat protection if it greatly reduced the turbidity in streams for hornyhead chub feeding and breeding behaviors. Also, exotic/invasive species control would help the hornyhead population. The hornyhead chub is sensitive to pollution so limiting contact with pollutants/contaminants would benefit the species. The hornyhead chub is also a popular bait fish, so regulation of collecting would be beneficial to the species.
- Habitat protection occurs in the form of the Clean Water Act, National Forest Management Act and other state and federal regulations that protect aquatic habitat and aquatic species. These regulations may or may not be enough for the sake of Orangethroat Darter conservation.
- Wildife species listed as endangered are illegal to take/"collect." People need to be reminded of this.

Total Respondents **5**

45.	What one or two specific practices would you recommend for more effective conservation of ALL wildlife in all Aquatic Systems Habitats in Indiana?

- Habitat protection.
- Regulated trapping and nuisance animal control policies.
- Protection of aquatic and riverine habitats is essential. More programs or efforts to restore lost or degraded systems would be beneficial. Educational programs aimed to reduce incidental take would also benefit otters especially where population densities are lower.
- Prevention of stream channelization and other (pollution) habitat factors.
- Limit disturbance in nesting/migration habitat.
- Does not need conserving.
- Habitat protection - Actually, I mean habitat enhancement by adding more woody cover to the old impoundments where the former woody cover has decomposed.
- Habitat protection (without habitat the Mallard won't do well) Population management (makes use of surplus numbers and regulates take) "The Mallard" by John Madson Olin Mathieson Chemical Corporation.
- Habitat Protection (intensive) Reproduction and Protection, Ducks,Geese & Swans of North America, Bellrose Protection of Migrating Routes (intensive) Same
- Hen houses.
- Habitat conservation.
- Buffer zones.
- Completely eliminate commercial fishing. This appears to have reduced the spawning stock to a level that could not maintain a fishery.
- Habitat protection and education to reduce habitat disturbance.
- Assure there is no stocking of predator fish in cisco lakes.
- Greatly limit/mitigate any new development on cisco lakes, particularly addressing runoff from lawns and other water quality issues.
- Work to get any farmlands adjacent to cisco lakes into no-till.
- Implementation of ecozones in undeveloped areas to conserve that vegetation present.
- Implement a catch and release only regulation in lakes with low densities.
- Habitat management and harvest management.
- Habitat protection is the key, but we need to better understand factors that limit siren abundance & distribution.
- To best benfit the Wood Duck, one must first improve the habitat. This particular question seems redundant with #48.
- Therefore refer to my answer in box number 48.
- Habitat protection.

- Nest boxes.
- See #43. In addition, although not habitat specific, outreach programs are needed to effectively and accurately educate citizens about wildlife (game and non-game), the wildlife conservation model (for game and non-game), and the need for effective mink management programs.
- Protection of migration routes.
- Land use planning and education.
- Habitat protection through land use regulation. Agricultural runoff protection through education and land use planning.
- Habitat protection and Public Education.
- Habitat protection - erosion controls.
- Exotic species - possession of exotic species illegal (must dispose of fish properly and not release back to stream).
- Intensive quantitative sampling of known populations. Need to understand demography of the clubshell. See Strayer & Smith, 2003. AFS Monogr. 8.
- Less intensive qualitative sampling of new or not recently surveyed areas. Need to determine distribution and status of some wildlife species. See same for protocols.
- Restoring the connection between the streams and the wetlands that were formerly associated with them to allow pike access to spawning areas. Current water management regimes often rely on pumping to fill restored wetlands, thus, fish passage is still restricted.
- Habitat protection and the possible reintroduction of the least darter into suitable habitats that have been restored.
- Habitat protection.
- Protect habitat by limiting the amount of dredging that occurs in the Kankakee watershed.
- Habitat protection and the possible reintroduction of the least darter into suitable habitats that have been restored.
- Habitat protection.
- The following applies to all mussel species. Educate anglers that it is ILLEGAL to use mussels as fishing bait.
- CREP, other incentives for BMP's.
- Limit instream modifications.
- See Watters, 2000. Proc. 1st FMCS Symposium.
- Restoration of stream channels, restoring or protecting stream channel function so that riffle habitats are enhanced or protected.
- Restoration or enhancement of riparian vegetation to enhance or protect stream channels from runoff or impacts to the channel.
- Maintenance of roads and stream crossings so that stream channel function and aquatic passage are maintained.
- Habitat protection.

- Habitat protection.
- Eliminate instream modifications, including impoundment.
- Restore riparian corridor.
- See Watters, 2000. Proc. 1st FMCS Symposium.
- Strict enforcement of laws regulating instream modification; incentives to farmers.
- Propagation.
- Protect the shallow sand/gravel habitat from siltation and channelization, and keep the waters free of pollutants and toxins.
- Pollution control.
- Habitat protection or enhancement.
- Rock bass appear to be doing very well with little to no intensive management in streams where there is ample instream cover and good water quality. Therefore, habitat protection and contaminant reduction would be my recommendations.
- I am not sure what you are asking in this question. The best way to conserve the eastern sand darter would be to reduce sedimentation covering the sand substrate which the darter needs to survive and reproduce. Current efforts to reduce sedimentation in streams is somewhat effective, but I'm not sure if it is enough to keep the eastern sand darter from disappearing.
- Declare moratorium on channel/drainage "improvement" projects that do not mitigate losses.
- Pollution control - from waste water treatment plants and confined feeding operations.
- Habitat protection and enhancement.
- Strictly limit instream modifications.
- Remove existing dams wherever possible.
- See Watters, 2000. Proc. 1st FMCS Symposium.
- Limit instream modification.
- Restore free-flowing systems.
- See Watters, 2000. Proc. 1st FMCS Symposium.
- Public education.
- Regulation of collecting.
- Habitat protection/restoration and pollution control.
- Habitat protection and threats reduction.
- Re-stock, as too few if any turtles remain.
- End use of commercial fishing equipment.
- Do periodic local removal of raccoons.

- Protection of the habitat against pollutants and toxins.
- Expand and liberalize the taking of raccoons so as to greatly reduce numbers associated with river cooter habitat.
- Raccoon reduction used re. sea turtles in FL and endangered Illinois mud turtle in IA, proposed for alligators. in LA
- Cease any future channelization plans and restore existing oxbow ponds - provide landowner financial incentive.
- Local restocking where raccoons reduced should hasten delisting criteria.
- Habitat protection.
- Threats reduction.

Total Respondents **51**

Appendix E-2: Aggregated Aquatic Systems

46. How well do the following conservation efforts address the HABITAT threats to ALL wildlife in all Aquatic Systems Habitats in Indiana?

	Very well	Somewhat	Not at all	Not used	Unknown	Response Total
Habitat protection through regulation	14% (8)	58% (34)	12% (7)	3% (2)	14% (8)	**59**
Habitat protection on public lands	20% (12)	53% (31)	5% (3)	12% (7)	10% (6)	**59**
Habitat protection incentives (financial)	17% (10)	46% (27)	8% (5)	14% (8)	15% (9)	**59**
Habitat restoration through regulation	16% (9)	40% (23)	5% (3)	17% (10)	22% (13)	**58**
Habitat restoration on public lands	22% (13)	40% (27)	7% (4)	14% (8)	12% (7)	**59**
Habitat restoration incentives (financial)	24% (13)	36% (20)	5% (3)	16% (9)	18% (10)	**55**
Artificial habitat creation (artificial reefs, nesting platforms)	3% (2)	29% (17)	7% (4)	46% (27)	15% (9)	**59**
Selective use of functionally equivalent exotic species in place of extirpated natives	0% (0)	5% (3)	3% (2)	68% (41)	23% (14)	**60**
Succession control (fire, mowing)	2% (1)	9% (5)	7% (4)	71% (41)	12% (7)	**58**
Corridor development/protection	12% (7)	37% (22)	3% (2)	32% (19)	15% (9)	**59**
Managing water regimes	14% (8)	41% (24)	2% (1)	17% (10)	27% (16)	**59**
Pollution reduction	20% (12)	60% (36)	2% (1)	7% (4)	12% (7)	**60**
Protection of adjacent buffer zone	28% (17)	48% (29)	2% (1)	10% (6)	12% (7)	**60**
Restrict public access and disturbance	7% (4)	20% (12)	17% (10)	41% (24)	15% (9)	**59**
Land use planning	14% (8)	59% (35)	3% (2)	8% (5)	15% (9)	**59**
Technical assistance	0% (0)	53% (31)	2% (1)	22% (13)	24% (14)	**59**
Cooperative land management agreements (conservation easements)	19% (11)	46% (26)	4% (2)	12% (7)	19% (11)	**57**
Other (please specify below)	0% (0)	0% (0)	0% (0)	0% (0)	100% (20)	**20**
				Total Respondents		**1,018**

47.	Other current HABITAT conservation practices for ALL wildlife in all Aquatic Systems Habitats in Indiana.

- Unknown
- Limiting disturbance through the construction (DOW) permit process.
- Habitat protection and restoration on all lands by any means necessary would benefit all species (except those that are exotic and more tolerant than others) not just the hornyhead chub. Pollution reduction, protection of adjacent buffer zone, land use planning, and conservation easements would all be beneficial practices to the Hornyhead chub.
- I am not aware of any of the above for which I marked "not used."
- Again, I don't know if these practices are working well in Indiana, but the best way to conserve the critical habitat for the eastern sand darter would be habitat protection on all lands through whatever means necessary, habitat restoration of the floodplain would also be critical to the amount of sedimentation reaching the stream bed, managing water regimes may also impact the settling of sediments in stream (thus dam removal may be appropriate), protection of adjacent buffer zone is key to stopping deleterious effects of erosion and sedimentation in the stream, land use planning and conservation easements would also keep the runoff to a minimum.

Total Respondents **5**

48.	What one or two specific HABITAT practices would you recommend for more effective conservation of ALL wildlife in all Aquatic Systems Habitats in Indiana?

- Habitat protection.
- Proper land use planning, at a watershed scale, would not only benefit otters but other aquatic and riparian species. Strict enforcement of existing pollution regulations, and if needed, development of stricter laws would be beneficial.
- Water regime management for migration habitat.
- Protection of nesting habitat along streams.
- Improve land use practices in watershed will reduce sedimentation in impoundments and reduce nutrient inputs.
- Reducing nutrient inputs will allow a deeper thermocline which is important for crappie growth. Crappie growth suffers when water temperatures become too high.
- Habitat restoration in the form of woody debris.
- In Army Corps of Engineers impoundments alterations in water level control would likely benefit crappie.
- Habitat protection through regulation (only sure way to protect habitat without public ownership) Purchase more public land.
- Habitat protection through regulation, (less intensive)cover a large geographic area. Ducks,Geese & Swans of North America, Bellrose.
- Habitat Protection through incentives, (intensive), best landowner cooperation, same.
- Landowner programs.
- Buffers.
- Habitat conservation regulations.
- Habitat creation, ie. artificial structures during lake construction projects.
- Pollution reduction and land-use zoning.
- Implementation of ecozones in undeveloped areas to conserve that vegetation present.
- Reduce inlet and upstream degradation. Increase awareness and cooperation of landowners to create better shoreline and tributary habitat.
- Habitat protection and restoration through regulation.
- Habitat protection. However more research is needed to address the effectiveness of habitat restoration on siren conservation.
- Corridor protection.
- Elimination of, or at the very least, reducing, the amount of stream channelization that occurs.

  Restoration of bottomland hardwoods through the farmbill and other incentive type programs is also very good.
- Elimination of ditches and stream channelization.
- Protection of habitat through land use planning. Currently most of the headwaters areas run through agricultural

areas and need to maintain riparian buffer strips.

- Protection and restoration of buffer zones.
- Protection of adjacent buffer zone.
- Non-point Source Pollution reduction.
- Assess riparian corridor and water quality monitoring (see Watters, 2000. Proc. 1st FMCS Symposium).
- Wetland restoration projects with connectivity to the stream or "corridor" development that allows passage to wetlands already restored. We need to move toward natural regulation of water levels instead of artificial means.
- Habitat protection through regulation.
- Protection of adjacent buffer zone.
- Habitat protection.
- Restrict disturbance to habitat (dredging, removal of debris).
- Any type of habitat protection/restoration-eliminate dredging.
- Habitat protection through regulation.
- Protection of adjacent buffer zone.
- Habitat protection.
- Restrict disturbance to habitat (dredging, removal of debris).
- Treat small streams as biological resources and not just drainage ditches. At the very least, require that a mussel survey be done before dredging.
- Promote riparian corridor.
- Limit habitat modifications.
- Streambank stabilization or stream restoration (reconstructing the channel to reconnect it to its natural floodplain elevation).
- Culvert or stream crossing structure improvement (replace non-functioning culverts or other crossing structures and replace with ones that function and are at the right elevation/location within the stream's longitudinal profile).
- Restoration of riparian vegetative communities through tree planting, etc.
- Habitat protection and Protection of adjacent buffer zone.
- Habitat protection.
- CREP and other incentives for BMP's.
- Restrict instream modifications.
- See Watters, 2000. Proc. 1st FMCS Symposium.
- No instream modifications.
- Limit runoff through incentives or other means.

- See Watters, 2000. Proc. 1st FMCS Symposium.
- Manage pollutants and toxins, maintain available habitat through regulation and buffer zones, increase habitat through incentives, technical assistance and restoration.
- Protection of adjacent buffer zones (riparian corridor).
- Buffer/riparian zone protection - leads to improved water quality and more instream cover.
- Pollution reduction - improved water quality and fewer fish kills.
- Habitat protection.
- Land use planning.
- Protection of adjacent buffer zones (riparian corridor). More participation would likely occur with financial incentives.
- Restrict instream modifications.
- Restore free-flowing systems.
- Eliminate habitat modifications (in-stream dredging, channelization, etc.).
- See Watters, 2000. Proc. 1st FMCS Symposium.
- Buffer strips.
- Bank stabilization.
- Non-point source pollution reduction.
- Riparian conservation easements.
- Restoration of riparian zones, riffle protection/restoration.
- Habitat restoration and protection.
- Encourage return to natural meander channel (within flood control).
- Let dead trees in river stay; perhaps add some.
- Rehabilitate drained oxbow ponds through conservation easement.
- Oxbow pond conservation easements and restoration - prime feeding habitat.
- Enhance natural river channel evolution including point bar development and snags (downed trees in the water) - provides basking sites and nesting.
- Habitat away from row crop agriculture.
- Manage water quality and pollutants.

  Protection of adjacent buffer zones.
- Habitat protection.

Total Respondents **52**

49.	Do you have any additional comments or information on ALL wildlife in ALL Aquatic Systems Habitat that you feel would be useful in the development of the Indiana Comprehensive Wildlife Strategy?

- Newts have a spotty distribution in Indiana. We need to better understand the factors that lead to this.
- The IDNR reintroduction program appears to have successfully restored otters in select watersheds throughout the state. Populations are established near release sites, have expanded to adjacent habitats, and colonized areas not originally targeted for restoration. Public interest in this species remains high and the otter can serve as a profile species for wetland and riverine protection.
- No.
- No.
- Kettle Lakes are limited in number, although habitat surrounding them can be manipulated. No new Kettle Lakes can be created so it is critical to provide protection through, regulations, incentives and management.
- Provide information on habitat creation and farming techniques.
- Provide incentives to create/maintain such habitat.
- Much research work has been done on the yellow perch by Ball State University since the mid 1970's. This works serves as the framework for the management of the population in Indiana's waters of Lake Michigan. It is critical that funding for this project continue to maintain the dataset. It is the largest and longest dataset for yellow perch on all of Lake Michigan and has served as the foundation for many management decisions on sport and commerical harvest decisions.
- We need to learn a lot more about lesser sirens in order to develop a good conservation design.
- It has been over 20 years since the surveys were conducted, prior to the 2001-2004 surveys. It is important that surveys be conducted every 5 years or so to document changes to water quality, habitat and riparian zone protection.
- The overall smallmouth bass population in this area is somewhat poor aside from the St. Joseph River. I believe this is mostly due to the lack of habitat and loss of buffer zones. Buffer zones are vital to the health of smallmouth bass populations. They supply and protect habitat that is vital to the survival of the smallmouth bass.
- IDEM has collected hornyhead chubs from the Elkhart River (Elkhart & Noble counties), St. Joseph River (Dekalb County), Cedar Creek (Allen Co.), Yellow Creek (Elkhart Co.), and Pigeon River (Lagrange Co.). If you would like the data, we can provide water chemistry, biological, and habitat data assessments.
- N/A
- IDEM has captured least darters at the following locations: Ringeisen Ditch, Trib of Carpenter Cr, Keefe Ditch, Claude May Ditch, and Howe Ditch in Jasper County, Singleton Ditch in Lake Co., Weiss Ditch in Newton Co., and Minier Lateral in Benton Co.
- IDEM has collected tadpole madtoms on the following streams: West Creek and Singleton Ditch in Lake County, Dausman Ditch in Kosciusko Co., Bogus Run in Starke Co., and Slough Creek in Jasper Co.
- IDEM has captured least darters at the following locations: Ringeisen Ditch, Trib of Carpenter Cr, Keefe Ditch, Claude May Ditch, and Howe Ditch in Jasper County, Singleton Ditch in Lake Co., Weiss Ditch in Newton Co., and Minier Lateral in Benton Co.
- IDEM has collected tadpole madtoms on the following streams: West Creek and Singleton Ditch in Lake County, Dausman Ditch in Kosciusko Co., Bogus Run in Starke Co., and Slough Creek in Jasper Co.
- N/A
- IDEM has captured many southern redbelly dace in their random fish sampling program. Most of these

specimens came from the Whitewater Basin in headwater streams <20 sq. miles with high gradient and high biological integrity.

- Too little in known about some wildlife species, especially Indiana populations.
- N/A
- N/A
- To find out just why the Clubshell depopulated so much of its former range, which once included much of the interior of Indiana. Knowing this "why" should disclose a critical limiting factor, and could lead to its future preservation.
- There is a great potential source for select avocational technical assistance (= volunteers) to undertake monitoring and survey where funding falls short.
- I would definitely search the internet for more information on specific studies done on the Eastern Sand Darter; however, I could not find much on the habitat itself in the Eastern Corn Belt/Interior Plateau Ecoregions of the Ohio River Drainage. IDEM has a list of sites of where Eastern Sand Darters have been collected with water chemistry and habitat (QHEI) assessments if interested.
- The length of this survey possibly destroys its usefulness as many/most experts will not have the time and or patience to do this for very many species; some may not even do it al all.
- No.
- N/A
- N/A
- No.
- The blue sucker population is doing well in the Wabash River and parts of the White River. Reintroduction into additional waterbodies is a possible option, but research is needed to determine why the population is healthy in the Wabash/White and not other Great Rivers.
- IDEM has collected spottail darters in Posey Co. on a tribe of Black River and Hawthorne Creek.
- Convince DNR that some restocking will be necessary (only known capture in Indiana in last 50 years died on DNR watch).
- Convince DNR that raccoon population reduction will be critical during early rehab (and important later on - increase recreational harvest).
- Put lower West Fork and Middle East Forks White River off limits to commercial fishing. Forget about Ohio R & lower Wabash (State cannot control).
- As with alligator snapping turtle, persuade DNR to take measures for significant raccoon reduction in/near river cooter habitat. Assuming cooter populations then increase, raccoon control remains desirable but less important. This species is herbivorous and thus not attracted to fish bait. Use of giant nets in oxbow ponds would trap cooters, which might then drown.
- This appears to be a resilient species that is relatively tolerant of some silt; it has ezpanded beyond rivers and streams and has taken up residence in reservoirs. If we afford it the broad protection (i.e., against pollutants and habitat destruction)that we attempt to give to mussels in general and to other components of our wildlife and environment, it should do well.
- IDEM has captured slough darters on the following streams: Turkey Cr (Clay Co.), Patoka R and N Fk Little Pigeon Cr (Dubois Co.), Patoka R and Yellow Cr as well as Smith Fk Pigeon Cr (Gibson Co.), Bruster Br and Flat Cr (Pike Co.), E Fk Crooked Cr (Spencer Co.), Busseron Cr (Sullivan Co.), and Lost Cr, Otter Cr, N Br Otter Cr in

Vigo Co.

- No.

Total Respondents	**35**