

## Appendix E-76: Mammals

### 6. Please rank the following threats to ALL Mammals in ALL habitats in Indiana.

	<b>Critical threat</b>	<b>Serious threat</b>	<b>Somewhat of a threat</b>	<b>Slight threat</b>	<b>No threat</b>	<b>Unknown</b>	<b>Response Total</b>
Invasive/non-native species	3% (1)	5% (2)	13% (5)	16% (6)	63% (24)	0% (0)	<b>38</b>
High sensitivity to pollution	0% (0)	8% (3)	5% (2)	24% (9)	34% (13)	29% (11)	<b>38</b>
Bioaccumulation of contaminants	0% (0)	11% (4)	13% (5)	16% (6)	32% (12)	29% (11)	<b>38</b>
Predators (native or domesticated)	0% (0)	3% (1)	13% (5)	39% (15)	45% (17)	0% (0)	<b>38</b>
Dependence on other species (mutualism, pollinators)	0% (0)	0% (0)	3% (1)	3% (1)	89% (33)	5% (2)	<b>37</b>
Diseases/parasites (of the species itself)	3% (1)	8% (3)	13% (5)	24% (9)	39% (15)	13% (5)	<b>38</b>
Regulated hunting/fishing pressure (too much)	0% (0)	0% (0)	3% (1)	13% (5)	84% (32)	0% (0)	<b>38</b>
Species over population	0% (0)	5% (2)	8% (3)	8% (3)	76% (29)	3% (1)	<b>38</b>
Unintentional take/ direct mortality (e.g., vehicle collisions, power line collisions, by-catch, harvesting equipment, land preparation machinery)	0% (0)	11% (4)	13% (5)	24% (9)	50% (19)	3% (1)	<b>38</b>
Unregulated collection pressure	0% (0)	0% (0)	0% (0)	21% (8)	76% (29)	3% (1)	<b>38</b>
Dependence on irregular resources (cyclical annual variations) (e.g., food, water, habitat limited due to annual variations in availability)	0% (0)	3% (1)	18% (7)	26% (10)	47% (18)	5% (2)	<b>38</b>
							<b>Total Respondents</b>
							<b>417</b>

### 7. Please also rank these threats to ALL Mammals in ALL habitats in Indiana.

	<b>Critical threat</b>	<b>Serious threat</b>	<b>Somewhat of a threat</b>	<b>Slight threat</b>	<b>No threat</b>	<b>Unknown</b>	<b>Response Total</b>
Habitat loss (breeding range)	13% (5)	18% (7)	26% (10)	24% (9)	18% (7)	0% (0)	<b>38</b>
Habitat loss (feeding/foraging areas)	11% (4)	24% (9)	29% (11)	18% (7)	18% (7)	0% (0)	<b>38</b>
Small native range (high endemism)	3% (1)	8% (3)	8% (3)	16% (6)	65% (24)	0% (0)	<b>37</b>
Near limits of natural geographic	0% (0)	5% (2)	8% (3)	11% (4)	74% (28)	3% (1)	<b>38</b>

## Appendix E-76: Mammals

range								
Large home range requirements	0% (0)	0% (0)	11% (4)	16% (6)	74% (28)	0% (0)	<b>38</b>	
Viable reproductive population size or availability	0% (0)	5% (2)	3% (1)	24% (9)	66% (25)	3% (1)	<b>38</b>	
Specialized reproductive behavior or low reproductive rates	0% (0)	5% (2)	16% (6)	8% (3)	71% (27)	0% (0)	<b>38</b>	
Degradation of movement/migration routes (overwintering habitats, nesting and staging sites)	5% (2)	13% (5)	8% (3)	24% (9)	50% (19)	0% (0)	<b>38</b>	
Genetic pollution (hybridization)	0% (0)	3% (1)	0% (0)	13% (5)	74% (28)	11% (4)	<b>38</b>	
Unknown	0% (0)	5% (1)	0% (0)	0% (0)	18% (4)	77% (17)	<b>22</b>	
Other (please specify below)	5% (1)	11% (2)	16% (3)	5% (1)	5% (1)	58% (11)	<b>19</b>	
							<b>Total Respondents</b>	<b>382</b>

### 8. Other threats to ALL Mammals in ALL habitats in Indiana.

1. Captive cervids
  2. Urban sprawl, the attendant loss of habitat and added roads, traffic and human interference.
  3. Genetic contamination from farmed white-tails
  4. Loss of small farms, urban sprawl
  5. Cold wet weather when first litters appear (Late March and early April)
  6. Fragmentation of forest habitat and loss of farmland habitat to housing.
  7. The spread of BushHoneySuckles, construction, tree diseases, tree insects, and the removal of fence rows.
  8. Loss of forest habitat surrounding winter hibernacula/caves.
- Cottontail numbers are proportional to available habitats. To increase or decrease in number, depends on available habitats. Agricultural policy i.e. production without supply side considerations influence the availability of the habitats. Cottontails are a game species and utilized heavily as a recreational resource and is therefore a luxury. The tradeoff concerning the cottontail is that we the American public, want beef, corn and related foodstuffs at a low cost. The cottontail will not prevail here as being necessary under those societal needs!
- 9.
  10. With reference to "unregulated collection pressure," I included disturbance related to research/monitoring.
  11. Habitat loss to natural succession is a critical threat to cottontail populations in Indiana.

## Appendix E-76: Mammals

12. It might be possible to overharvest fox squirrels in small forest fragments in the northern part of the state but I believe that this too is unlikely.
13. Although not habitat specific, the inability to responsibly and proactively manage coyotes according to the wildlife conservation model, as opposed to reactive measures through nuisance practices, is a concern regarding the conservation of coyotes. This concern applies across the landscape, not just in urban and suburban environments.
14. Although not habitat specific, the inability to responsibly and proactively manage raccoons according to the wildlife conservation model, as opposed to reactive measures through nuisance practices, is a major concern regarding the conservation of raccoons. This concern applies across the landscape, not just in urban and suburban environments.
15. Although not habitat specific, the inability to responsibly and proactively manage opossums according to the wildlife conservation model, as opposed to reactive measures through nuisance practices, is a concern regarding the conservation of opossums. This concern applies across the landscape, not just in urban and suburban environments.
16. There are competition and disease concerns about red fox populations but they are not limited to grasslands. Although not habitat specific, the inability to responsibly and proactively manage red fox according to the wildlife conservation model, as opposed to reactive measures through nuisance practices, is a concern regarding the conservation of red fox. This concern applies across the landscape, not just in urban and suburban environments.
17. Although not habitat specific, the inability to responsibly and proactively manage muskrats according to the wildlife conservation model, as opposed to reactive measures through nuisance practices, is a concern regarding the conservation of muskrats. This concern applies across the landscape, not just in urban and suburban environments.
18. sporadic occurrence of early and mid successional fields is the greatest deterrent to higher abundance
19. Unregulated Human Activity in Hibernacula
20. 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.
21. Loss of wetlands (muckland) would be the threat to some mammals
22. needs caves or mines for hibernation within probably 60 miles of its summering ground

**Total Respondents**                      **22**

(skipped this question)                      17

**9.** Please briefly describe the top two threats to ALL Mammals in ALL habitats in Indiana identified above.

1. Overpopulation will lead to an unmanageable resource and severe habitat degradation.
- Captive cervids contaminate genetic integrity and increase chance of infection for wild deer

## Appendix E-76: Mammals

2. Coyotes are highly adaptable and are seemingly expanding their numbers across the state. People are generally "anti-coyote" fearing predation on pets, livestock and wildlife.
3. CWD will come to IN  
Trophy mgt & associated leasing will lead to overpopulation & fewer active hunters
4. The mammals in Generalist habitats faces few if any threats.
5. Habitat loss  
Mammal competition
6. Habitat loss mostly related to urban sprawl. Degradation of migration routes, also often related to urban sprawl and other development.
7. Invasive/non-native vegetative species such as fescue do not provide cover, nutrition and are thought to be toxic.  
Habitat loss to uncontrolled vegetative succession is a serious threat.
8. CWD, EHD & tuberculosis could be devastating to a deer herd of our density.  
Loss of habitat to rural development.
9. Loss of Grassland Habitat  
Competition with Coyotes
10. Habitat fragmentation & habitat destruction.
11. Habitat loss- Land development  
Invasive species and its relation to habitat loss
12. Human disturbance of hibernating bats (e.g., Ray's Cave in Greene Co.)  
Alterations to microclimate within hibernacula
13. 1)Agricultural policy  
2)Domestic predators  
  
-Some traditional hibernacula have been rendered unsuitable or degraded due to cave development/commercialization (including disturbance of hibernating bats by human visitation), modification of the cave environment, or alternation of surface features.  
-Threats also occur on summer habitat (not addressed here because it is not captured within the "cave habitat" category).
14. Habitat loss to agriculture and natural succession
15. The 2 greatest threats to the fox squirrel are overall loss of habitat and fragmentation of the remaining forest tracts.
16. As above
17. As 8 above
18. As 8 above
19. As 8 above

## Appendix E-76: Mammals

20. As above

21. Although not habitat specific, the inability to responsibly and proactively manage beaver according to the wildlife conservation model, as opposed to reactive measures through nuisance practices, is a concern regarding the conservation of beaver. This concern applies across the landscape, not just in urban and suburban environments.

22. 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.

23. lack and distance apart of available patches of habitat  
these habitats are ephemeral

24. Human disturbance of active hibernacula

Loss of typical maternal roosting structures (large snags with sloughing bark)

Exclusion of maternity colonies from buildings

25. Build-up of dense urban development around roost location without adequate greenspace for foraging.

26. Pollution/degradation of aquatic systems: reproductive performance of otters can be compromised by high levels of PCBs, heavy metals, etc. that bioaccumulate 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.

27. 1. Loss of grasslands, and grassland ground squirrel populations.  
2. Fragmentation of habitat

28. The major two threats are loss of summer and winter (caves) habitat. In addition, education of cavers and continued improvements to cave gates are important to the Indiana bat survival.

29. Habitat Loss in this relatively specialized habitat is the primary threat to the short-tailed shrew. Early successional grassland habitats provides marginal habitat requirements for this specialized species. The short-tailed shrew is an insectivore/vermivore. Early successional grassland habitat occurs in abandoned land associated with either agricultural, industrial or urban land uses. Only in isolated situations do grasslands develop as a dominant habitat type in Indiana. Most grasslands will eventually be dominated by shrub or tree cover. By definition early successional grassland habitat is a temporary habitat type.

30. probably draining of wetlands for farming or development

I seek to qualify my answer about loss of migration habitat. The large-scale mortality being reported from wind turbines and other sources is the most threatening issue for this species.

31. We also need information about how this species migrates to begin thinking about where not to place such structures.

Loss of winter range is a slight concern since we really don't know where they are going.

32. Threats to bobcat populations in Indiana are human-related factors such as direct mortality (incidental take, road kills, persecution) and habitat loss. Conversion of native communities and

## Appendix E-76: Mammals

(incidental take, road-kills, persecution) and habitat loss. Conversion of native communities and habitats for human use cause direct loss of habitats for bobcats and their prey items.

- Indiana is at the easternmost periphery of the historic range FGS in North America. Their range in NW Indiana coincides with some of the most productive agricultural lands in the state (i.e., Benton County) or some of the most densely populated areas (i.e., Lake, Porter counties). Principal threats are primarily habitat related .... either direct loss of grassy/herbaceous cover, conversion of smaller farms (that used to maintain fencerows, etc.) to agri-business entities, and to lesser extent, invasion of extensive woody components into existing grassland communities. Being at the edge of their range, we probably didn't have a lot of animals to start with either ... In summary: small, nomadic populations in restricted portion of state (maybe only 3-6 counties) that is subjected to developmental and agricultural pressures.
- 33.

- The Allegheny woodrat occupies cliffs, caves, and other rocky habitats in deciduous forests. When forests become fragmented, for whatever reasons, several negative impacts to woodrat populations can result. First, loss of mature mast-producing trees can occur; changes in forest composition can also result. Woodrats may have to cross non-forested areas to reach preferred feeding areas (i.e., hard mast crops or soft mass .... berries, etc.). While doing so, they may become exposed to ubiquitous predators (great-horned owls, raccoons). Raccoon densities may be higher in non-forested settings (such as farmed areas on top of cliffs), which could expose woodrats to higher levels of raccoon roundworm.
- 34.

This is probably the least-threatened bat in the US.

35. Major threats are closure of roosts (both hibernacula and maternal) and incidental take from collisions
36. loss of habitat is probably the only threat to some mammals, plus people trying to remove them from their lawns and gardens.

**Total Respondents 36**

(skipped this question) 3

### 10. Please rank the following threats to the HABITAT of ALL Mammals in ALL habitats in Indiana.

	<b>Critical threat</b>	<b>Serious threat</b>	<b>Somewhat of a threat</b>	<b>Slight threat</b>	<b>No threat</b>	<b>Unknown</b>	<b>Response Total</b>
Commercial or residential development (sprawl)	13% (5)	42% (16)	21% (8)	11% (4)	13% (5)	0% (0)	<b>38</b>
Counterproductive financial incentives or regulations	0% (0)	5% (2)	14% (5)	16% (6)	27% (10)	38% (14)	<b>37</b>
Invasive/non-native species	3% (1)	11% (4)	11% (4)	18% (7)	47% (18)	11% (4)	<b>38</b>
Nonpoint source pollution (sedimentation and nutrients)	0% (0)	0% (0)	11% (4)	29% (10)	37% (13)	23% (8)	<b>35</b>
Habitat fragmentation	13% (5)	24% (9)	18% (7)	18% (7)	26% (10)	0% (0)	<b>38</b>
Successional change	3% (1)	12% (4)	6% (2)	30% (10)	48% (16)	0% (0)	<b>33</b>



## Appendix E-76: Mammals

7. The participant has to speculate about the meaning of climate change. Is a "change" an increase or decrease in temperature? Agriculture/Forestry practices may have different effects. Grouping these as a single practice does not appropriately represent each individual practice. Point and non-point pollution may be positive or negative to the habitat as related to beaver.
8. Mowing or burning for aresthetic purposes such that badger prey population or badger cover are diminished.
9. needs cavaes or mines as indicated above; Pesticides could be a major threat, for this onther bats, but unknown for sure,

<b>Total Respondents</b>	<b>9</b>
(skipped this question)	30

### 12. Please briefly describe the top two HABITAT threats to ALL Mammals in ALL habitats in Indiana identified above.

- Degredation by overpopulation
1. Fragmentation in farmed/heavily populated regions prevents historical movements from summer to winter ranges
2. 1) Urban sprawl  
2) Ag/Forestry (mostly ag)
3. Urban sprawl is consuming significant amounts of our forest habitat
4. Commercial and residential development.  
Agricultural and forestry practices
5. 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.
6. successional change results in habitat degredation as grasslands are invaded by woody vegetation.  
Urban sprawl has started to interrupt movements and increased accidental mortality.
7. Fragmentation of habitat forces unnatural movement and increases accidental mortality as well as the opportunity to spread disease.  
Habitat fragmentation restrict movement and hence constrict genetic mixing.
8. Habitat degradation reduces food sources as well as reproductive potential.
9. Forest habitat fragmentation and loss of habitat.
10. Development- this completely removes the habitat  
Habitat fragmentation- this also removes habitat
11. Adverse modifications to cave entrances (e.g., poorly designed bat gates), which cause a change in interior microclimates/temperatures.  
Loss/degradation/fragmentation of forested areas surrounding caves used by bats during the fall swarming period

## Appendix E-76: Mammals

swarming period.

12. 1)Agricultural policy  
2)Competing products (food)

Loss/degradation of traditional hibernacula.

13. loss, fragmentation and degradation of breeding habitat (note that breeding habitat also occurs in areas of the state not associated with caves)
14. I believe invasion of early successional grasslands by tall fescue is probably the top threat followed closely by successional change.
15. The 2 greatest threats to fox squirrel habitat in Indiana are overall loss of habitat and fragmentation, both due primarily to agricultural practices of urban sprawl.

the participant has to speculate about the meaning of successional change. Is a "change" an increase or decrease in early successional habitats? Climate change also is speculative.

16. Agriculture/Forestry practices have different effects. Grouping these practices into a single category does not appropriately represent each individual practice. Point and non point pollution may have a positive or negative effect.

The participant is forced to speculate about the meaning of successional and climate change.

17. Agriculture/Forestry practices have different effects. Grouping these practices as a single category does not appropriately represent the individual practice. Point and nonpoint pollution may have a positive or negative impact.

18. farming practices and succession  
suitable habitat is ephemeral and spread out

19. 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.

20. 1. Loss of grasslands, and grassland ground squirrel populations.  
2. Fragmentation of habitat

21. The top two threats are habitat degradation of caves by potential migration of chemicals which alter the cave ecosystem, and the loss of roost trees via a number of man-related activities (commercial, agricultural, etc.)

22. loss of habitat due to farming or development

23. habitat disappearing to development  
needs caves and mines for hibernation,

Our unpublished work on eastern red bats suggest the critical habitat is a combination of forests for roosting and edge habitat for roosting. As such the main threats are

24. 1) loss of forest habitat  
2) loss of suitable foraging habitat to development

Top threats to bobcat habitat are loss of forested habitats (or any native or non-developed habitats) to residential, commercial, industrial, etc. uses. Conversion of habitats to types dominated for human activity, on a cumulative scale, are problematic. Fragmentation, to a lesser extent, also

25.

## Appendix E-76: Mammals

human activity, on a cumulative scale, are problematic. Fragmentation, to a lesser extent, also negatively impacts bobcat habitats, but is probably less of a factor because the species is somewhat adaptable and highly mobile.

26. Loss of existing grassland/herbaceous cover to a number of factors (development, sprawl, agriculture) and fragmentation of remaining suitable habitats .... potential isolating small, remnant FGS populations.

27. Cliff habitat, in general, appears somewhat secure except for quarrying operations along the Ohio River. Forested communities in association with cliffs, however, are vulnerable to development, fragmentation, loss of hard mast producing species, etc.

The only real threat to the habitat of this bat is destruction of roosts.

28. Exeme urbanization may become a problem, but these bats are able to fly long distances to reach feeding grounds.

<b>Total Respondents</b>	<b>28</b>
(skipped this question)	11

### 13. What current monitoring efforts by state agencies are you aware of for ALL Mammals in ALL habitats in Indiana?

	<b>Yes, these efforts occur</b>	<b>Not aware of these efforts occurring</b>	<b>Response Total</b>
Statewide year-round monitoring conducted by state agencies	16% (6)	84% (32)	<b>38</b>
Statewide once a year monitoring conducted by state agencies	24% (9)	76% (28)	<b>37</b>
Periodic statewide (less than once a year but still regularly scheduled) monitoring conducted by state agencies	30% (11)	70% (26)	<b>37</b>
Occasional statewide (less than once a year and not regularly scheduled) monitoring conducted by state agencies	14% (5)	86% (32)	<b>37</b>
Regional or local year-round monitoring conducted by state agencies	8% (3)	92% (34)	<b>37</b>
Regional or local once a year monitoring conducted by state agencies	24% (9)	76% (28)	<b>37</b>
Periodic regional or local (less than once a year but still regularly scheduled) monitoring conducted by state agencies	16% (6)	84% (31)	<b>37</b>
Occasional regional or local (less than once a year and not regularly scheduled) monitoring conducted by state agencies	16% (6)	84% (31)	<b>37</b>
		<b>Total Respondents</b>	<b>297</b>

Appendix E-76: Mammals

**14.** What current monitoring efforts by other organizations are you aware of for ALL Mammals in ALL habitats in Indiana?

	Yes, these efforts occur	Not aware of these efforts occurring	Response Total
Statewide year-round monitoring conducted by other organizations	0% (0)	100% (37)	<b>37</b>
Statewide once a year monitoring conducted by other organizations	5% (2)	95% (35)	<b>37</b>
Periodic statewide (less than once a year but still regularly scheduled) monitoring conducted by other organizations	5% (2)	95% (35)	<b>37</b>
Occasional statewide (less than once a year and not regularly scheduled) monitoring conducted by other organizations	8% (3)	92% (34)	<b>37</b>
Regional or local year-round monitoring conducted by other organizations	3% (1)	97% (36)	<b>37</b>
Regional or local once a year monitoring conducted by other organizations	6% (2)	94% (34)	<b>36</b>
Periodic regional or local (less than once a year but still regularly scheduled) monitoring conducted by other organizations	11% (4)	89% (33)	<b>37</b>
Occasional regional or local (less than once a year and not regularly scheduled) monitoring conducted by other organizations	22% (8)	78% (29)	<b>37</b>
		<b>Total Respondents</b>	<b>295</b>

**15.** How crucial are these monitoring efforts by state agencies for the conservation of ALL Mammals in ALL habitats in Indiana?

	Very crucial	Somewhat crucial	Slightly crucial	Not crucial	Unknown	Response Total
Statewide year-round monitoring conducted by state agencies	8% (3)	3% (1)	0% (0)	72% (26)	17% (6)	<b>36</b>
Statewide once a year monitoring conducted by state agencies	6% (2)	14% (5)	9% (3)	57% (20)	14% (5)	<b>35</b>
Periodic statewide (less than once a year but still regularly scheduled) monitoring conducted by state agencies	11% (4)	8% (3)	8% (3)	58% (21)	14% (5)	<b>36</b>
Occasional statewide (less than once a year and not regularly scheduled) monitoring conducted by state agencies	3% (1)	11% (4)	0% (0)	63% (22)	23% (8)	<b>35</b>



## Appendix E-76: Mammals

### 17. Regional or local state agency monitoring for ALL Mammals in ALL habitats in Indiana.

1. On a statewide basis in the bloomington DNR office
2. The only monitoring I know of for coyotes is the furharvest report and they might be included on small game harvest questionnaires.
3. St Parks, Nature Preserves
4. statewide
5. Statewide, furbuyer survey
6. 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.
7. In the past, I believe the DFW logged rabbit sightings during quail whistle counts.
8. State Parks and selected urban areas.
9. Annual Bowhunter Survey
10. Hunter harvest data on State Fish and Wildlife Properties.
11. State deer check stations
12. All known I-bat hibernacula
13. DNR property harvest data  
Annual small game survey of licensed hunters!  
  
-The IDNR conducts biennial hibernacula surveys in all known Indiana bat hibernacula in the state (except Batwing and Twin Domes Caves, which are surveyed under a separate Federal contract).
14. -Occasional monitoring/research is conducted in cave habitats on a localized basis by State agencies for specific purposes (such as the swarming habitat study at Wyandotte cave).  
-Monitoring is also occasionally conducted in summer habitat (not included in this survey).
15. The small game harvest questionnaire is the only survey the agency conducts to monitor the Indiana fox squirrel population. The survey is only conducted in odd years.  
  
Indiana Division of Fish and Wildlife. Population monitoring efforts at the state, regional and local scales are occurring to obtain annual population trends but they are not habitat specific nor do they encompass all habitat types associated with generalist mammals.
16. State Rabies Lab
17. DNR monitoring records for bat mistnet captures  
  
IDNR personnel monitor otter mortality (road-kills, trap-related, etc.) at a statewide level. Also,
18. IDNR personnel conduct winter bridge/stream surveys for otter sign. These are conducted on a county basis at a statewide level.

## Appendix E-76: Mammals

19. The Indiana Division of Fish and Wildlife and the Division of Nature Preserves maintain data on the occurrence location of road-kill, accidentally trapped or other verified human encounters with badgers.
20. Caves in southern Indiana are monitored. Currently there are 33 hibernacula reported for the Indiana bat in southern Indiana. This confidential information is available upon request.
21. Red bats are monitored as part of the regular bat sampling that occurs at Indianapolis Airport, Camp Atterbury, Newport Chemical Depot.  
Also the population trends may be assess via animals submitted to the state rabies lab.
22. Ongoing ecological studies of bobcats in southwestern section of Indiana - primarily Greene, Lawrence, and Martin counties.
23. When monitoring is done, it has been limited to the species historic range in the state. This is the 16-17 contiguous counties in the NW section of Indiana.
24. Harrison and Crawford counties.
25. Indiana State University (aka John Whitaker) and the State Board of health keep detailed records of bats submitted for rabies testing  
Wildlife Biologists at various military bases conduct regular mist-net and hibernacula surveys as do some state parks and Scott Johnson and USFWS Indiana bat surveys collect some of this data

<b>Total Respondents</b>	<b>25</b>
(skipped this question)	14

### 18. Regional or local monitoring by other organizations for ALL Mammals in ALL habitats in Indiana.

1. Some municipalities; University properties  
Purdue U
2. Beverly Shores  
US Nat'l Lkshore  
Wesselman woods (Evansville)
3. None that I am aware of
4. Private groups have helped with counts in some State Parks.
5. Not aware of any.
6. Unknown
7. Unknown
8. Rick Clawson, Missouri DOC, conducts the biennial winter surveys at Twin Domes and Batwing caves. The Indiana Karst Conservancy (Keith Dunlap) also assists with monitoring efforts, especially at hibernacula that they own or oversee. I have monitored the L bat population in Reeves Cave in

## Appendix E-76: Mammals

at hibernacula that they own or oversee. I have monitored the I-bat population in Reeves Cave in Monroe County.

9. Not aware of any!

10. There are surveys conducted at localized locations throughout the State of Indiana, primarily in summer habitat but also some cave habitat work, to address specific management or research needs. For example, surveys are conducted at all Department of Defense properties in the State.

11. I am not aware of any other monitoring.

12. monitored twice, 1975 by Ford, and 1998 by Leibacher and Whitaker

13. Indiana State University- most recently by John O. Whitaker, Jr. (Public survey soliciting for information on known bat locations)

14. None that I am aware of.

15. None known

16. See #17.

17. Biyearly monitoring for cave bats in about 18 caves in which Indiana myotis is known to hibernate.

18. I don't know of any official monitoring that is occurring.

19. None that I am aware of.

20. This is not being done in Indiana.

21. None that I am aware of.

22. Indianapolis Airport Authority

**Total Respondents** **22**

(skipped this question) **17**

**19.** Please list organizations that are monitoring ALL Mammals in ALL habitats in Indiana.

1. state Universities

2. There may be some informal monitoring by Farm Bureau or other agricultural groups but if so, it would probably be to prove there are too many.

3. see # 18

4. IDNR

5. None that I am aware of

## Appendix E-76: Mammals

6. unknown
7. Not aware of any.
8. Unknown
9. Unknown
10. Indiana DNR(Dr. Virgil Brack/ESI, Keith Dunlap, Scott Johnson), Indiana Karst Conservancy, local NSS Grotto members, and U.S. Fish and Wildlife Service
11. Not aware of any!  
  
Federal agencies (e.g., Forest Service, DoD, COE)
12. Educational institutions (e.g., Purdue, ISU)  
Local/County agencies  
Private Conservation Organizations (e.g., Indiana Karst Conservancy)  
  
The biennial small game harvest survey is the only method currently being used by the division of
13. fish and wildlife to monitor the statewide rabbit population. I am not aware of any other monitoring occurring in the state.
14. Indiana Division of Fish and Wildlife  
  
Indiana Division of Fish and Wildlife. IDF&W uses a road-kill survey to monitor annual trends in
15. raccoon populations at the state, regional and local scales. However, monitoring is not a means to associate raccoon activity with particular habitats, as inferred on the questionnaire.
16. Indiana Division of Fish and Wildlife. IDF&W uses professional surveys to monitor annual population trends at the state, regional and local scales. However, monitoring is not a means to associate opossum activity with particular habitats, as inferred in the questionnaire.
17. Indiana Division of Fish and Wildlife. Monitoring programs used by IDF&W are not habitat specific to grasslands for red foxes.
18. Indiana Division of Fish and Wildlife. Population monitoring efforts at state, regional and local scales are to monitor annual trends. Monitoring programs used by IDF&W are not habitat specific for beaver. The response to question 13 assumes aquatic systems encompass all wetland habitat types that beaver occupy.
19. Indiana Division of Fish and Wildlife. Population monitoring efforts at state, regional and local scales are to monitor annual trends. Monitoring programs used by IDF&W are not habitat specific for muskrat.
20. 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.
21. ISU
22. IDNR
23. None known

## Appendix E-76: Mammals

24. IDNR, USFWS, Indiana Karst Conservancy, Indiana Cave Survey, various ecological consultants and universities (federal permit holders)
25. Ball State University; Tom Morrell.
26. Virgil Brack and company.
27. Indiana State University  
Wildlie Biologists at Military bases
28. I hesitate to use the term "monitoring" to describe this .... but IDNR does maintain records, databases, etc. regarding reports of bobcats throughout the state. These reports are, for the most part, unsolicited and obtained as they become available. It is not a regular, routine survey ... but more of a clearinghouse for information regarding bobcat sightings, road-kills, incidental captures, etc, which is one of the few means of "monitoring" low-density and wide-ranging species such as the bobcat.
29. No private organizations. Only IDNR, Division of Fish and Wildlife has been pursuing FGS monitoring in the last 15-20 years.
30. Indiana DNR.
31. Indianapolis Airport Authority, Indiana State University, Purdue University, Crane Naval Base, Newport Chemical Depot, USFWS, IDNR
32. no monitoring done or needed for some mammals

**Total Respondents**                    **32**

(skipped this question)                    7

### 20. What are the current monitoring techniques for ALL Mammals in ALL 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	11% (3)	19% (5)	48% (13)	7% (2)	4% (1)	11% (3)	<b>27</b>
Modeling	0% (0)	25% (6)	54% (13)	0% (0)	4% (1)	17% (4)	<b>24</b>
Coverboard routes	0% (0)	6% (1)	28% (5)	33% (6)	0% (0)	33% (6)	<b>18</b>
Spot mapping	6% (1)	6% (1)	35% (6)	24% (4)	0% (0)	29% (5)	<b>17</b>
Driving a survey route	5% (1)	14% (3)	24% (5)	29% (6)	14% (3)	14% (3)	<b>21</b>



## Appendix E-76: Mammals

10. Techniques currently in use in Indiana appear to be covered by the selections above.
11. The use of Anabat as appropriate. Anabat is a bat detector that uses vocalizations to identify species.
12. Look for burrows in muck
13.
  - mist-netting stream
  - cave counts
  - rabies lab bats
  - trapping cave and mine entrances
14. Track plates have been used in other Midwestern states (Missouri, Wisconsin), but not in Indiana.
15. Presence/absence can generally be determined by searching cliff lines for fresh sign (latrines, food caches, maintained nests) usually in fall. Research underway in other areas to determine if woodrats can be genotyped through scats.

<b>Total Respondents</b>	<b>15</b>
(skipped this question)	24

### 22. What one or two monitoring techniques would you recommend for effective conservation of ALL Mammals in ALL habitats in Indiana?

1. Reporting from harvest, depredation, or unintentional take.  
Modeling
2. Harvest information  
Depredation information
3. Harvest monitor
4. Harvest surveys
5. Regulated trapping.  
  
Trapping and visual surveys.
6. Trapping is expensive and visual surveys are less expensive and can be combined with other surveys.  
McWheter, Gary Randolph, 1991, Estimating Abundance of Cottontail Rabbits using live trapping and visual surveys, Master's thesis, University of Tennessee
7. Collection of harvest data from mandatory checkstations.
8. Continue Bowhunter Survey and Trapper Survey.
9. This is a research question to be answered by research personnel.
10. Harvest reports, unintentional kill  
Modeling  
White-tailed Deer Ecology and Management, Lowell K. Halls

## Appendix E-76: Mammals

11. Continue ongoing biennial winter surveys at all known hibernacula.  
  
Specifically being done for the cottontail is not warranted. However, an analysis of vegetative structure by specie or species group in early successional habitats and then correlated with selected early successional species would be relevant!
12. -Biennial hibernacula surveys (which I would classify as "professional survey/census"), are the only means currently available to track Indiana bat population trends on a statewide or rangewide basis. These surveys are conducted rangewide.
13. -Survey and monitoring activities conducted in summer habitat are used to: 1) evaluate summer distribution in the state, and 2) evaluate roosting and foraging habitat use/needs. These surveys are conducted in Indiana as well as other states throughout the range of the species.  
  
I would like to see a rural mail carrier survey initiated that would be useful for monitoring rabbits and several other wildlife species. Another method to monitor rabbit populations would be to include rabbit observations on the division's annual bobwhite whistle counts.
14. A hunter report card sent out to dedicated squirrel hunters would be a useful tool to provide an index to the fox squirrel population. I would also like to see a radio-telemetry project in northern Indiana to document fox squirrel dispersal between forest tracts. Another objective of this proposed radio-telemetry project would be to evaluate the possibility of overharvesting fox squirrel metapopulations.
15. IDF&W uses Harvest Reports and Professional Surveys. However, these techniques are not habitat specific nor do they cover the full spectrum of habitats associated with generalist species.
16. IDF&W uses Harvest Reports and Professional Surveys. However, these techniques are not habitat specific nor do they cover the full spectrum of habitats associated with generalist species.
17. IDF&W uses Harvest Reports and Professional Surveys. However, these techniques are not targeted towards grassland habitats.
18. IDF&W uses Harvest Reports and Professional Surveys. Here again, the assumption is that aquatic systems include all habitat types occupied by beaver.
19. IDF&W uses Harvest Reports and Professional Surveys. Here again, the assumption is that aquatic systems include all habitat types occupied by muskrat.
20. See #19
21. trap periphery of known range in Indiana
  - 1) Hibernacula counts to track population levels (Already being done)
22. 2) Intensive radiotelemetry that tracks roost and foraging movements of specific colonies in representative areas across the state.  
  
Mark-Recapture monitoring of representative colonies across the state.
23. Survey a sample of Indiana residents every 10 years as to whether they have bats in their home. (Follow-up affirmative responses with a visit to confirm species)
  1. Stream surveys for otter sign.
  2. Reporting (number, location, etc.) of unintentional take and biological data obtained from recovered specimens (reproductive parameters).

## Appendix E-76: Mammals

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.

26. Continue to monitor road-kills, accidental captures and other verified sightings. Review this data and if warranted (a number of verified sightings near grassland habitat) attempt a telemetry and tracking study.

27. Trapping for Indiana bat includes mist netting and harp trapping. Internal cave surveys are important and more emphasis should be placed on the use of Anabat.

28. look for burrows in muck connected with trapping

29. the first 3 of the above.

We need make sure someone continues to examine all animals submitted for rabies testing.

30. A regular monitoring program (using traps, echolocation calls, and mistnets) for bats should be initiated on a state-wide basis. This should be a combined effort by IDNR, Universities, and private organizations.

1. Continued documentation of sightings, road-kills, and accidental captures. Obtain pertinent biological data from recovered specimens such as age and reproductive parameters (pregnancy rate, litter size). These data could be used to model populations or build life tables in future years.

31. 2. Some form of questionnaire or survey that is sent to trappers, hunters, professional resource managers could also be useful. The Indiana Bowhunter Survey is a good example although reporting rates for bobcats are so low they may not be effective to detect changes and monitor trends.

I do not have a good, single reference that describes these techniques although they are commonly used by many state wildlife agencies.

32. 1. Live-trapping and mark/recapture.  
2. Radiotelemetry.

Standardized, live-trapping for 2 nights is effective for determining distribution and relative abundance.

33. Searches for woodrat sign --- at new sites or previously-occupied sites to assess recolonization potential.

34. This bat should simply be monitored by keeping track of capture rates from permit reports and the state board of health.

A statewide bat monitoring effort should also be developed.

35. If we wanted to survey some mammal species, I would develop a system counting hills.

**Total Respondents** **35**

(skipped this question) 4

## Appendix E-76: Mammals

**23.** What current HABITAT inventory and assessment efforts or activities by state agencies are you aware of for ALL Mammals in ALL 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	0% (0)	100% (36)	36
Statewide once a year inventory and assessment conducted by state agencies	6% (2)	94% (34)	36
Periodic statewide (less than once a year but still regularly scheduled) inventory and assessment conducted by state agencies	19% (7)	81% (29)	36
Occasional statewide (less than once a year and not regularly scheduled) inventory and assessment conducted by state agencies	22% (8)	78% (28)	36
Regional or local year-round inventory and assessment conducted by state agencies	3% (1)	97% (35)	36
Regional or local once a year inventory and assessment conducted by state agencies	3% (1)	97% (35)	36
Periodic regional or local (less than once a year but still regularly scheduled) inventory and assessment conducted by state agencies	14% (5)	86% (31)	36
Occasional regional or local (less than once a year and not regularly scheduled) inventory and assessment conducted by state agencies	22% (8)	78% (28)	36
		<b>Total Respondents</b>	<b>288</b>

**24.** What current HABITAT inventory and assessment efforts or activities by other organizations are you aware of for ALL Mammals in ALL 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	0% (0)	100% (36)	36
Statewide once a year inventory and assessment conducted by other organizations	3% (1)	97% (35)	36
Periodic statewide (less than once a year but still regularly scheduled) inventory and assessment conducted by other organizations	17% (6)	83% (30)	36
Occasional statewide (less than once a year and not regularly scheduled) inventory and assessment conducted by other organizations	11% (4)	89% (32)	36
Regional or local year-round inventory and assessment	3% (1)	97% (35)	36



Appendix E-76: Mammals

Occasional regional or local (less than once a year and not regularly scheduled) inventory and assessment conducted by state agencies	0% (0)	21% (7)	12% (4)	33% (11)	33% (11)	<b>33</b>
<b>Total Respondents</b>					<b>268</b>	

<b>26.</b> How crucial are these HABITAT efforts by other organizations for the conservation of ALL Mammals in ALL habitats in Indiana?	<b>These efforts are very crucial for this HABITAT</b>	<b>These efforts are somewhat crucial for this HABITAT</b>	<b>These efforts are slightly crucial for this HABITAT</b>	<b>These efforts are not crucial for this HABITAT</b>	<b>Unknown</b>	<b>Response Total</b>
Statewide year-round inventory and assessment conducted by other organizations	0% (0)	3% (1)	3% (1)	45% (15)	48% (16)	<b>33</b>
Statewide once a year inventory and assessment conducted by other organizations	0% (0)	6% (2)	6% (2)	39% (13)	48% (16)	<b>33</b>
Periodic statewide (less than once a year but still regularly scheduled) inventory and assessment conducted by other organizations	9% (3)	9% (3)	3% (1)	37% (13)	43% (15)	<b>35</b>
Occasional statewide (less than once a year and not regularly scheduled) inventory and assessment conducted by other organizations	11% (4)	6% (2)	6% (2)	37% (13)	40% (14)	<b>35</b>
Regional or local year-round inventory and assessment conducted by other organizations	0% (0)	6% (2)	3% (1)	39% (13)	52% (17)	<b>33</b>
Regional or local once a year inventory and assessment conducted by other organizations	0% (0)	6% (2)	0% (0)	42% (14)	52% (17)	<b>33</b>
Periodic regional or local (less than once a year but still regularly scheduled) inventory and assessment conducted by other organizations	3% (1)	9% (3)	3% (1)	35% (12)	50% (17)	<b>34</b>
Occasional regional or local (less than once a year and not regularly scheduled) inventory and assessment conducted by other organizations	3% (1)	11% (4)	9% (3)	29% (10)	49% (17)	<b>35</b>
<b>Total Respondents</b>					<b>271</b>	

## Appendix E-76: Mammals

### 27. Regional or local state agency HABITAT inventory and assessment for ALL Mammals in ALL habitats in Indiana.

1. State Forests  
Nature Preserves
2. None that I am aware of
3. Unknown, possibly Division of Forestry.
4. Unknown
5. IDNR
6. cave habitat is assessed when the winter surveys of hibernacula are conducted state-wide.
7. DNR property evaluations, but I know of nothing organized!  
  
-State conducted annual monitoring of the cave environment in most major hibernacula. Human disturbance in key hibernacula is also monitored.
8. -The contractor who conducts the biennial hibernacula surveys also documents information on cave "condition" (e.g., breakdown) and makes management recommendations.
9. I am not aware of any habitat assessment being done by a state agency.  
  
I suspect some state agencies monitor and assess aquatic habitats at a statewide level ... maybe
10. 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.  
  
I believe that Purdue University and the NRCS and perhaps others keep track of grasslands created as part of the Farm Bill Programs. There are also occasional statewide assessments of grassland as part of remote-sensing, GIS based studies such as the GAP Analysis. The Division of Nature Preserves also keeps track of good examples of remnant native grassland. I am not sure any of these agencies collect the grassland habitat data specifically for badgers but other agencies applied the information to badgers.
- 11.
12. Karst regions and summer habitat in Indiana
13. Northeast Indiana  
Northwest Indiana
14. south central part of state
15. I know the forestry division keeps track of changes in forest cover.  
  
I suspect that most, if not all, public properties in the state (Hoosier National Forest, Crane NSWC, State Forests, State Reservoirs, etc.) periodically inventory and assess forested habitats under their jurisdiction. Commercial timbered lands are probably also inventoried on a regular basis. The Nature Conservancy may also have access to data.
- 16.
17. I do not know if this type of inventory is being done by any state agency in the range of FGS. I would suspect that some agencies (perhaps SWCD, SCS - on a county level) have data on distribution and abundance of grassland habitats.

## Appendix E-76: Mammals

18. The closest thing I can think of is the Division of Nature Preserves may have a decent inventory of cliff habitat in the state. As far as inventory of cliff habitat that is occupied by woodrats, Division of Fish and Wildlife has these data.
19. Given that these bats will use almost any class of habitat, any effort aimed at documenting landscape cover would count including tax records assessment
20. none

<b>Total Respondents</b>	<b>20</b>
(skipped this question)	19

### 28. Regional or local HABITAT inventory and assessment by other organizations for ALL Mammals in ALL habitats in Indiana.

1. Bev Shores  
Nat'l Lkshore  
Nat'l Forest  
Wesselman Woods
2. None that I am aware of
3. Unknown
4. Unknown
5. Unknown
6. completed by Rick Clawson, Missouri DOC, for Twin Domes and Batwing caves. USFWS- Reeves Cave and others
7. There are Farm Bill/CRP type inventories but none done specifically for the Cottontail!
8. Several organizations collect information on the location and condition of caves, as well as the presence of bats in caves, which provides useful information.
9. The Indiana GAP project categorizes land use cover types from landsat imagery. I assume that the change in cover types is being calculated over a specified period of time.
10. twice assessed
11. None known
12. Karst regions and summer habitat in Indiana
13. south central part of state
14. Local planning boards monitor land use in most localities
15. Not aware of other organizations doing this either.

## Appendix E-76: Mammals

16. None that I am aware of.
17. see above
18. none

<b>Total Respondents</b>	<b>18</b>
(skipped this question)	21

### 29. Please list organizations that are monitoring this HABITAT for ALL Mammals in ALL habitats in Indiana.

1. state Universities
2. PU  
Gov't careing for #28
3. None that I am aware of
4. Unknown
5. Unknown
6. Unknown
7. Indiana Karst Conservancy, NSS Grottos, USFWS, I-69 bat consultants
8. None specifically for the Cottontail!
9. IKC, TNC, USGS, Indiana Cave Survey, USFS

10. I am not aware of any scheduled monitoring of early successional habitat in Indiana. I would suspect that one of the universities has remotely sensed data but their objective probably isn't specifically to monitor early successional habitat.

11. Indiana GAP Project

I have already done this page twice, and had to do one other page twice when it jumped back when I hit "next"

12. ISU twice- 1995 by Ford. 1998 by Leibacher and Whitaker; ISU; 1975 by Ford, 1998 by Leibacher and Whitaker
13. See #27.
14. None known
15. IDNR, USFWS, Indiana Karst Conservancy, Indiana Cave Survey, ecological consultants and universities (federal permit holders)

## Appendix E-76: Mammals

16. Ball State University NE Ind.  
Indiana State University NW
17. Virgil Brack and his company
18. See Above
19. In addition to state and federal agencies, I suspect Indiana Hardwoods Lumberman Association or other private groups may monitor forested lands, particularly those in private ownership.
20. Maybe TNC???
21. I don't believe any organizations are truly monitoring cliff habitat in Indiana.
22. IDNR--I know the forestry section keeps % forest data, all local communities are constantly reassessing zoning and tax roles
23. none

<b>Total Respondents</b>	<b>24</b>
(skipped this question)	15

### 30. What are the current HABITAT inventory and/or assessment techniques for ALL Mammals in ALL 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	6% (2)	35% (12)	15% (5)	3% (1)	0% (0)	41% (14)	<b>34</b>
Aerial photography and analysis	9% (3)	30% (10)	12% (4)	6% (2)	0% (0)	42% (14)	<b>33</b>
Systematic sampling	6% (2)	15% (5)	12% (4)	6% (2)	6% (2)	56% (19)	<b>34</b>
Property tax estimates	3% (1)	3% (1)	3% (1)	7% (2)	7% (2)	77% (23)	<b>30</b>
State revenue data	0% (0)	3% (1)	3% (1)	6% (2)	6% (2)	81% (25)	<b>31</b>
Regulatory information	6% (2)	6% (2)	3% (1)	6% (2)	3% (1)	75% (24)	<b>32</b>
Participation in landuse programs	6% (2)	15% (5)	18% (6)	6% (2)	3% (1)	52% (17)	<b>33</b>

## Appendix E-76: Mammals

Modeling	0% (0)	9% (3)	24% (8)	9% (3)	3% (1)	56% (19)	<b>34</b>
Voluntary landowner reporting	3% (1)	9% (3)	6% (2)	6% (2)	6% (2)	69% (22)	<b>32</b>
Other (please specify below)	5% (1)	0% (0)	0% (0)	5% (1)	0% (0)	90% (19)	<b>21</b>
<b>Total Respondents</b>							<b>314</b>

### 31. Other HABITAT inventory and assessment techniques for ALL Mammals in ALL habitats in Indiana.

1. None that I am aware of
2. unknown
3. Unknown
4. Unknown
5. Temperature and Relative Humidity monitoring with remote dataloggers.
6. look for runways in muck and trap for them
7. cave survey
8. none in place, and none needed

**Total Respondents**      **8**

(skipped this question)      31

### 32. What one or two HABITAT inventory and assessment techniques would you recommend for effective conservation of ALL Mammals in ALL habitats in Indiana?

1. GIS Habitat Modeling
2. GIS mapping or examination of aerial photos
3. Not sure
4. GIS mapping and aerial photo analysis
5. GIS mapping and Aerial photos
6. Collect hunter data from DNR Properties & Private Land hunters.  
Universities keep record of habitat loss and habitat fragmentation.

## Appendix E-76: Mammals

7. GIS  
Aerial Photography
8. Cave microclimate monitoring with dataloggers should continue. A range-wide protocol for monitoring cave temperature and humidity has been developed by Bat Conservation International and is being widely used (contact Jim Kennedy or Merlin Tuttle at BCI). I believe Scott Johnson has been following this protocol in Indiana.
9. Cottontails are a mid to late early successional habitat resident. We do not know the amount of structure required to maintain optimum populations. We don't know what an optimum population is! We do know that it cycles but we don't know why! That isn't a good answer, I don't know a good answer for that!  
  
-Cave microclimate data used in conjunction with results of hibernacula surveys.  
-Techniques to link summer/winter populations (new genetic techniques such as stable isotope analysis; pit tagging).
10. -Information on habitat use/needs in the vicinity of caves during swarming is a critical need. At present, radio telemetry represents the best potential to collect this information.
11. The best habitat inventory technique would be creating a GIS with Landsat data from different time periods.
12. I would recommend a GIS analysis that examines changes in land use over the last 30+ year period.
13. same as used
14. 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.
15. Monitoring of the larger grasslands in Indiana both native and man-made such as the grassland created by stip-minning. Especially monitor the quality and quantity of these areas.
16. cave survey in winter, and net survey in summer
17. Statewide habitat mapping is needed (and mostly available if you know who to ask)  
Property tax assessments can be used as a proxy as well
18. GIS is a logical tool to inventory and assess all aspects of forested habitats in Indiana (species composition, age & size class, ownership, management regime, etc.). It would be nice to have a GIS coverage of rock outcrops in the state to supplement forest data.  
  
To a lesser extent, interpretation of aerial photographs would also be useful.
19. GIS is logical tool to use to depict grassland/herbaceous communities.
20. GIS is the best tool available to depict (inventory) cliff, outcrops, talus slopes, caves, or other rocky habitats within the range of the Allegheny woodrat.
21. Habitat for this bat should simply be assessed by examining large-scale changes in landuse patterns

## Appendix E-76: Mammals

<b>Total Respondents</b>	<b>21</b>
(skipped this question)	18

### 33. What is the current body of science for ALL Mammals in ALL habitats in Indiana?

		<b>Response Total</b>	<b>Response Percent</b>
Complete, up to date and extensive		2	5%
Adequate		14	37%
Inadequate		12	32%
Nonexistent		1	3%
Other (please explain below)			
1. There is lots of research, but also great need due to endangered status.			
2. There is very little habitat specific research on coyotes in IN. Particularly when generalizing across generalist habitat types.			
3. Literature focuses on rural, as opposed to urban, areas and therefore does not encompass all the habitats used by generalist.			
4. I am not aware of any opossum literature as it pertains to generalist habitats in Indiana.		9	24%
5. I am not aware of any literature devoted strictly to red fox use of grassland habitat			
6. I am not familiar with any literature related to beaver habitat use in IN.			
7. Literature is not habitat specific for muskrats in Indiana			
8. I'm am not aware of any literature on mink focused strictly to rivers and streams.			
9. Somewhere between Adequate & Inadequate			

## Appendix E-76: Mammals

**Total Respondents** 38

(skipped this question) 1

- 34.** Please provide a citation (title, author, date, publisher) that would give the best overview of ALL Mammals in ALL habitats in Indiana, if available. This resource may be used if further detail is needed.

Title = White-tailed Deer Ecology and Management;  
Author = Halls, L. K. (editor);  
Date = 1984;  
Publisher = Stackpole Books

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

Title = Population Ecology and Harvest of the Cottontail Rabbit;  
Author = Heraold A.Demaree, Jr;  
Date = 1978;  
Publisher = Indiana DFW

Title = White-tailed Deer Ecology & Management;  
Author = Wildlife Management Institute Book;  
Date = 1984;  
Publisher = Stackpole Books

Title = None known

Title = White-tailed Deer Ecology and Management;  
Author = Lowell K. Halls;  
Date = 1984;  
Publisher = Stackpole Books

Title = Wintering populations of bats in Indiana, with emphasis on the endangered Indiana Myotis, *Myotis sodalis*;  
Author = Virgil Brack, Jr., Scott A. Johnson, and R. Keith Dunlap;  
Date = 2003;  
Publisher = Proceedings of the IN Academy of Science

Title = I can't

Title = Management of hibernacula in the state of Indiana;  
Author = Johnson, Brack, Dunlap;  
Date = 2002;  
Publisher = Bat Conservation International

Title = Population ecology and harvest of the cottontail rabbit on the Pigeon River fish and wildlife area, 1962-1970;  
Author = Harold Demaree Jr.;  
Date = 1978;  
Publisher = Indiana Division of Fish and Wildlife

Title = Gray and Fox Squirrel Management in Indiana;  
Author = John M. Allen;  
Date = 1964;

## Appendix E-76: Mammals

Publisher = Indiana Department of Conservation

Title = Ecology of coyotes as influenced by landscape fragmentation;  
Author = Todd Attwood;  
Date = May 2002;  
Publisher = Purdue University

Title = Raccoon density, home range, and habitat use on south-central Indiana farmland.;  
Author = Larry Lehman;  
Date = 1984;  
Publisher = IDF&W

Title = Fur animals of Indiana;  
Author = David Brooks;  
Date = 1959;  
Publisher = IDF&W

Title = Distribution of the western harvest mouse in Indiana;  
Author = Leibacher and Whitaker;  
Date = 1998;  
Publisher = Ind, Acad. Sci. 107:167-170

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 = Mammals of the Eastern United States;  
Author = J.O. Whitaker, Jr. and W. J. Hamilton, Jr.;  
Date = 1998;  
Publisher = Cornell University Press

Title = Home range near hibernacula in spring and autumn;  
Author = Russell C. Romme, Amy B. Henry, R. Andrew King, T. Glueck, and K. Tyrell;  
Date = 2002;  
Publisher = The Indiana Bat: Biology and Management of an Endangered Species. Bat Conservation International

Title = A 14-year study of BLARINA BREVICAUDA in east-central Illinois.;  
Author = Getz, L. L.;  
Date = 1989;  
Publisher = J. Mammalogy 70:58-66.

Author = Mumford and Whitaker 1982

Title = Brack, Johnson and Dunlap, 2003.;  
Publisher = Proc. Ind. Acad, Sci. 112:-61-74.

Title = Mammals of Indiana;  
Author = John Whitaker;  
Date = IN Press;  
Publisher = IU Press

Title = The bobcat in Illinois;  
Author = Alan Woolf and Clayton Nielsen;  
Date = 2002;

## Appendix E-76: Mammals

Publisher = Southern Illinois University Carbondale

Title = Reduction in the Eastern Limit of the Range of the Franklin's Ground Squirrel;  
Author = Scott Johnson and Jane Choromanski-Norris;  
Date = 1992;  
Publisher = American Midland Naturalist 128:325-331.

Title = Reassessment of the Allegheny woodrat in Indiana;  
Author = Scott Johnson;  
Date = 2002;  
Publisher = Proceedings of the Indiana Academy of Science 111:56-66.

Title = Mammals of Indiana;  
Author = John Whitaker;  
Date = 2005 (currently in press);  
Publisher = IU Press

Title = Mamm. IN;  
Author = M & W 1982

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

Title = Mammals of the Great Lake States;  
Author = ?;  
Date = ?;  
Publisher = ?

Title = None known

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

Title = I can't

Title = Biennial hibernacula survey reports;  
Publisher = reports submitted to IDNR

Title = see above for more

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

Author = [www.natureserve.org/explorer](http://www.natureserve.org/explorer)

Title = The nonhibernating ecology of bats in Indiana with emphasis on the endangered Indiana bat, *Myotis sodalis*;  
Author = Virgil Brack, Jr.;  
Date = 1983;

Appendix E-76: Mammals

Publisher = Purdue University

Title = Blarina brevicauda;

Author = George, S. B., J. R. Choate, and H. H. Genoways;

Date = 1986;

Publisher = Mammalian Species 261:1-9

Title = Mumford and Whitaker 1982

Title = Nocturnal Behavior of Eastern Red Bats;

Author = Brianne Everson;

Date = 2005?;

Publisher = MS Thesis, Indiana State University (not yet complete)

Title = Status and management of bobcats in the United States over three decades;

Author = Woolf, A. and G.F. Hubert, Jr.;

Date = 1998;

Publisher = Wildlife Society Bulletin 26:287-293.

Title = Franklin's Ground Squirrel in Illinois: A Declining Prairie Mammal?;

Author = Jason Martin, Edward Heske, Joyce Hofman;

Date = 2003;

Publisher = American Midland Naturalist 150:130-138.

Title = 2002 Allegheny woodrat monitoring program;

Author = Scott Johnson, Heather Walker, Cassie Conrad, Aaron Holbrook;

Date = 2003;

Publisher = Indiana Department of Natural Resources (internal report)

Title = Foraging-habitat selection by bats at an urban-rural interface: comparison between a successful and a less successful species.;

Author = Duchamp, Sparks, Whitaker;

Date = 2004;

Publisher = Canadian Journal of Zoology

**36.** What is the current HABITAT body of science for ALL Mammals in ALL habitats in Indiana?

		Response Total	Response Percent
Complete, up to date and extensive		2	6%
Adequate		12	34%
Inadequate		13	37%
Nonexistent		1	3%
Other (please explain below)			
1. unknown			
2. unknown			

## Appendix E-76: Mammals

3. unknown
4. unknown
5. unknown
6. unknown
7. unknown
8. unknown
9. Unknown - I suspect it exists, just not of aware of who or where!!
10. Somewhere between Adequate and Inadequate

**Total Respondents**      **35**

(skipped this question)      4

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

Title = White-tailed Deer Ecology and Management;  
Author = Halls, L. K. (editor);  
Date = 1984;  
Publisher = Stackpole Books

Title = Not aware of any

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

Title = Mammals of Indiana;  
Author = Mumford/Whitaker;  
Date = 1982;  
Publisher = IU Press

Title = Unknown

Title = White-tailed Deer Ecology and Management;  
Author = Lowell K. Halls;  
Date = 1984;  
Publisher = Stackpole Books

Title = see previous reference

Title = I can't

Title = same as Q34

Title = Habitat-relative abundance relationship for bobcats in southern Illinois;

## Appendix E-76: Mammals

Title = Habitat-relative abundance relationship for bobcats in southern Illinois.;

Title = The bobcat in Illinois;

Author = C.K. Nielsen and A. Woolf;

Date = 2002;

Publisher = Wildlife Society Bulletin 30:222-230.;

Title = Hibernacula of the endangered Indiana bat in Indiana;

Author = Brack, Virgil Jr., A.M. Wilkenson, R.E. Mumford;

Date = 1984;

Publisher = Proceedings of the Indiana Academy of Science, vol. 93:463-468

Title = A4-year study study of BLARINA BREVICAUDA un east-central Illinois;

Author = Getz, L. L.;

Date = 1989;

Publisher = J. Mammalogy 70:58-66.

Title = Mumford and Whitaker 1982

Title = Natural Heritage of Indiana;

Author = Marion Jackson;

Date = 1999;

Publisher = IU Press

Title = The bobcat in Illinois;

Author = Alan Woolf and Clayton Nielsen;

Date = 2002;

Publisher = Southern Illinois University Carbondale

Title = not aware of any!!

Title = Natural Features of Indiana?;

Author = Alton Lindsey (editor);

Date = 1966;

Publisher = Indiana Academy of Science

Title = Natural Heritage of Indiana;

Author = MT Jackson;

Publisher = IU Press

**38.**

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

## Appendix E-76: Mammals

Title = Unknown

Title = I can't

Title = same as Q35

Title = Habitat-relative abundance relationship for bobcats in southern Illinois;  
 Author = Nielsen, C.K, and A. Woolf;  
 Date = 2002;  
 Publisher = Wildlife Society Bulletin 30:222-230

Title = Distribution and ecology in Indiana. Pp 48-54 in Indiana Bat: Biology and Management of an Endangered Species (A. Kurta and J. Kennedy, Eds.);  
 Author = John Whitaker Jr. & Virgil Brack Jr.;  
 Date = 2002;  
 Publisher = Bat Conservation International

Title = Veilleux et al. 2003.;  
 Publisher = J. Mamm, 841068-1075.

Title = Nocturnal Behavior of Eastern Red Bats;  
 Author = Brianne Everson;  
 Date = 2005?;  
 Publisher = Unpublished MS Thesis (should be complete by may 2005)

Title = not aware of any!!

Title = Indiana GAP data;  
 Date = Unpublished available form ISU dept of Geography

### 39. What are the research needs for ALL Mammals in ALL habitats in Indiana?

	<b>Urgently needed</b>	<b>Greatly needed</b>	<b>Needed</b>	<b>Slightly needed</b>	<b>Not needed</b>	<b>Unknown</b>	<b>Response Total</b>
Life cycle	0% (0)	12% (5)	28% (11)	22% (9)	38% (15)	0% (0)	<b>40</b>
Distribution and abundance	8% (3)	15% (6)	22% (9)	20% (8)	35% (14)	0% (0)	<b>40</b>
Limiting factors (food, shelter, water, breeding sites)	12% (5)	8% (3)	25% (10)	20% (8)	35% (14)	0% (0)	<b>40</b>
Threats (predators/competition, contamination)	10% (4)	18% (7)	25% (10)	22% (9)	25% (10)	0% (0)	<b>40</b>
Relationship/dependence on specific habitats	10% (4)	18% (7)	20% (8)	25% (10)	28% (11)	0% (0)	<b>40</b>
Population health (genetic and physical)	5% (2)	23% (9)	26% (10)	23% (9)	23% (9)	0% (0)	<b>39</b>
Other (please specify below)	19% (4)	19% (4)	5% (1)	0% (0)	10% (2)	48% (10)	<b>21</b>
					<b>Total Respondents</b>		<b>260</b>

## Appendix E-76: Mammals

### 40. Other research needs for ALL Mammals in ALL habitats in Indiana.

1. A deer harvest analysis and modeling program  
Baseline life history data.
2. CWD all aspects
3. None that I am aware of.
4. The aging techniques (tooth wear) biologists use were developed in New York and may not be accurate for deer of the midwest. My personal experience with deer of known ages indicates that wear is less than the aging charts we currently use. Additional local research needs to be done if we are interested in accurately aging deer over 2 1/2 years.
5. Unknown
6. Research needs explore the role of age and social structure in deer herd health.
7. We need urgently need to determine the effects of the loss/fragmentation/timber management of summer habitat/forest on maternity colonies/reproductive success not just caves/winter habitat.
8. Determine what affect feral cats have on a local cottontail population!  
  
Due to the high fragmentation of forest tracts in Indiana (especially northern Indiana) I believe that dispersal distance is a critical area of research. I also would like to see a research project that evaluates the amount of harvest pressure can be sustained by isolated metapopulations of squirrels.
10. The above research needs are at the landscape level not strictly habitat specific.
11. The above research needs are needed on a landscape scale, not habitat specific.
12. The above research needs are not limited to grassland habitats.
13. As above assuming aquatic systems include all habitats occupied by beaver.
14. Research needs as related to muskrats are not habitat specific.
15. Research needs are not limited to river and stream habitats
16. Relationship(s) between population levels and population indices.
17. The relationship between badgers and land use and soil type, especially soil types that support borrows both for the badger and its prey.
18. More information is needed on autumn swarming and spring staging. Similarly new hibernacula need to be recorded.
19. need to know more about rabies in some mammals
20. We desperately need to know how bats interact with each other in terms of competition.

## Appendix E-76: Mammals

21. We desperately need to know how this omnipresent bat influences other species.
22. We need more information on the reproduction of some mammals in various habitats.

<b>Total Respondents</b>	<b>22</b>
(skipped this question)	14

### 41. What are the HABITAT research needs for ALL Mammals in ALL habitats in Indiana?

	<b>Urgently needed</b>	<b>Greatly needed</b>	<b>Needed</b>	<b>Slightly needed</b>	<b>Not needed</b>	<b>Unknown</b>	<b>Response Total</b>
Successional changes	0% (0)	13% (5)	26% (10)	24% (9)	34% (13)	3% (1)	<b>38</b>
Distribution and abundance (fragmentation)	13% (5)	21% (8)	26% (10)	16% (6)	21% (8)	3% (1)	<b>38</b>
Threats (land use change/competition, contamination/global warming)	5% (2)	27% (10)	30% (11)	11% (4)	22% (8)	5% (2)	<b>37</b>
Relationship/dependence on specific site conditions	8% (3)	16% (6)	24% (9)	16% (6)	27% (10)	8% (3)	<b>37</b>
Growth and development of individual components of the habitat	0% (0)	12% (4)	21% (7)	15% (5)	41% (14)	12% (4)	<b>34</b>
Other (please specify below)	0% (0)	18% (3)	12% (2)	0% (0)	0% (0)	71% (12)	<b>17</b>
	<b>Total Respondents</b>						<b>201</b>

### 42. Other HABITAT research needs for ALL Mammals in ALL habitats in Indiana.

1. None that I am aware of
2. unknown
3. Unknown
4. Research needs explore the effects of land development.
5. How much forest habitat needs to remain around a hibernaculum to sustain a population of size x during the fall swarming period?  
-How does cave environment, especially temperature and temperature stability, affect suitability and use of cave by Indiana bats
6. -What components of the habitat immediately surrounding the cave are most important to Indiana bats during fall swarming and spring staging. How is this habitat used.

## Appendix E-76: Mammals

7. distribution and dispersal factors with regard to habitat factors including streams to large rivers
8. The difference between native, warm-season-grass/native forb grasslands; planted, non-native, cool-season grasslands; and CRP grasslands relative to suitability for badgers.
9. Recommend a detailed analysis of forest canopy to openness ratio and habitat intricacies that provide preferred home range requirements, e.g. primary roosts, secondary roosts, water, night roosts, food.
10. need to know more of the relationship between winter and summer habitat, and also of migration.
11. Obtaining data on habitat for this bat would provide a nearly complete picture of the status of various habitat types in Indiana.
12. Additional information on all phases of the biology of some mammals would be helpful. However, other mammals are in no current danger.

<b>Total Respondents</b>	<b>12</b>
(skipped this question)	26

### 43. How well do the following conservation efforts address the threats to ALL Mammals in ALL habitats in Indiana?

	Very well	Somewhat	Not at all	Not used	Unknown	Response Total
Habitat protection (use below for details)	18% (7)	47% (18)	26% (10)	8% (3)	0% (0)	<b>38</b>
Population management (hunting, trapping)	26% (10)	34% (13)	3% (1)	34% (13)	3% (1)	<b>38</b>
Population enhancement (captive breeding and release)	0% (0)	0% (0)	13% (5)	87% (33)	0% (0)	<b>38</b>
Reintroduction (restoration)	3% (1)	0% (0)	11% (4)	84% (32)	3% (1)	<b>38</b>
Food plots	5% (2)	13% (5)	11% (4)	68% (26)	3% (1)	<b>38</b>
Threats reduction	5% (2)	11% (4)	8% (3)	50% (19)	26% (10)	<b>38</b>
Native predator control	0% (0)	5% (2)	26% (10)	66% (25)	3% (1)	<b>38</b>
Exotic/invasive species control	3% (1)	11% (4)	16% (6)	68% (26)	3% (1)	<b>38</b>
Regulation of collecting	16% (6)	29% (11)	13% (5)	39% (15)	3% (1)	<b>38</b>
Disease/parasite management	0% (0)	5% (2)	5% (2)	84% (32)	5% (2)	<b>38</b>
Translocation to new geographic range	0% (0)	0% (0)	14% (5)	86% (32)	0% (0)	<b>37</b>
Protection of migration routes	3% (1)	3% (1)	18% (7)	68% (26)	8% (3)	<b>38</b>

## Appendix E-76: Mammals

Limiting contact with pollutants/contaminants	0% (0)	11% (4)	16% (6)	55% (21)	18% (7)	<b>38</b>
Public education to reduce human disturbance	5% (2)	26% (10)	26% (10)	37% (14)	5% (2)	<b>38</b>
Culling/selective removal	5% (2)	3% (1)	13% (5)	76% (29)	3% (1)	<b>38</b>
Stocking	0% (0)	0% (0)	11% (4)	89% (34)	0% (0)	<b>38</b>
Other (please specify below)	0% (0)	0% (0)	6% (1)	19% (3)	75% (12)	<b>16</b>
				<b>Total Respondents</b>		<b>623</b>

### 44. Other current conservation practices for ALL Mammals in ALL habitats in Indiana.

1. Contraceptives; currently not used due to efficacy and economical reasons
2. None that I am aware of
3. vegetative succession control
4. unknown
5. Unknown
6. posting signs at caves, installing-bat friendly gates, land acquisition, installing fake video cameras to deter cave visits, using light-sensitive "spelloggers" to monitor levels of human visitation  
  
Provide additional habitats through programs, agricultural and other. Rabbits are a by product of an economy. The more human needs placed on the landscape the less amount of by products will be produced. As I mentioned above: If we select for beef and corn there will be less rabbits. By selecting for you simultaneously select against something else. Maybe we need to find out how many steaks we need will determine how many rabbits we have!
- 7.
8. Note, I included regulation of research and research related disturbance under "regulation of collecting"
9. Preserve wetlands
10. Protect some caves and mines in which some mammals occur.
11. There are no current conservation practices for woodrats in place in Indiana at this time. Monitoring population levels and trying to determine factors limiting woodrats have been focus of work in state.
12. Saving grassland (and woodland) will help this animal.

**Total Respondents** **12**

(skipped this question) **26**

## Appendix E-76: Mammals

45. What one or two specific practices would you recommend for more effective conservation of ALL Mammals in ALL habitats in Indiana?

1. Population management via hunting
2. Ban cervid farming & canned hunting
3. Habitat protection and habitat creation
4. Regulated trapping and nuisance animal control policies.
5. Woodland habitat protection  
Control of forest habitat fragmentation
6. Population management  
Regulation of collecting
7. Unknown
8. Habitat Protection  
Invasive species control
9. Negotiate with the owner of Ray's Cave and other hibernacula to allow them to be gated or employ one or more of the other techniques above.
10. Promote early succession associated with structure similar to *L. japonica*.  
-Gating, securing conservation easements, or purchasing unprotected hibernacula (prioritizing based on current numbers or potential of hibernacula to harbor large numbers if disturbance is presently limiting numbers).  
-Protecting surface features and forest cover surrounding hibernacula and managing for high quality swarming habitat.
11. The best strategy would be to protect as much early successional habitat as possible but that habitat must be manipulated periodically to set back natural succession.
12. Protecting existing forest tracts and maintaining or creating corridors between fragments would, in my opinion, be the 2 most effective conservation practices for fox squirrels in Indiana.  
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 coyote management programs.
13. 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 effective raccoon management programs.
14. 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 effective opossum management and it's alternatives.
15. 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
16. 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
17. 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

## Appendix E-76: Mammals

accurately educate citizens about wildlife (game and non-game), the wildlife conservation model (for game and non-game) and the need for effective red fox management programs.

18. 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 beaver management programs.

19. 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 muskrat management programs.

20. 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.

21. about the only one that would be effective would be to manage succession such that proper habitat was more abundant and closer together

22. Protect bats as part of historic home preservation.

Further research into how to allow peaceful and safe coexistence between bats and homeowners.

23. 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.; Protect natural communities and habitats. Management of forested lands to provide early/mid successional stage habitats.;

24. Conservation and restoration of ground squirrel and pocket gopher populations. Limit human access to all parts of large grasslands.

25. The purchasing and protection of recorded Indiana bat hibernacula and summer habitat. Similarly, public education is needed on the importance of caves, snags, and the importance of this species to man.

26. Manage lands for early successional grassland habitat - would require land use change every 3 to 5 years.

27. protect caves and mines  
continued education of people about bats.

Studies of migration routes are needed so these areas can be protected.

28. Care should be taken in approving wind turbine power stations because of the large direct take associated with these structures. We also need some studies of these power stations in this section of the Midwest (Indiana, Ill, OH).

29. In my opinion, there are not any truly active, ongoing conservation efforts for FGS in Indiana. Most of the work has been focused on documenting distribution and relative abundance. Periodic burning of railroad ROWs (an important land use type for FGS in IN) to maintain a strong grassy component has been beneficial in the past. Before effective conservation strategies can be implemented, one must know the limiting factors for the species. FGS will probably always have a tenuous status in Indiana. They were never common and suitable habitats are now limited to railroad ROWs and widely scattered tracts of natural grasslands. Additionally, populations are reported to be cyclic, have

Appendix E-76: Mammals

widely scattered tracts of natural grasslands. Additionally, populations are reported to be cyclic, have a discontinuous or patchy distribution, and appear to be somewhat nomadic or transitory in nature.

- 1. Research aimed to identify factors that limit woodrat populations is a high priority.
- 30. 2. Periodic monitoring of extant populations.
- 3. Revisit previously-occupied sites to assess recolonization potential.

General conservation measures for this and other bats are described in Mammals of Indiana, America's Backyard Bats (MD Tuttle, Bat Conservation International), and Sparks, D. W., and J. R.

- 31. Choate. 2000. Distribution, natural history, conservation status, and biogeography of bats in Kansas. Pp: 173-228 In Reflections of a naturalist: papers honoring professor Eugene D. Fleharty (J. R. Choate, ed.), Fort Hays Studies, Special Issue 1: 1-241. (which I can provide)
- 32. Save natural habitats. n

**Total Respondents 33**

(skipped this question) 6

**46.** How well do the following conservation efforts address the HABITAT threats to ALL Mammals in ALL habitats in Indiana?

	<b>Very well</b>	<b>Somewhat</b>	<b>Not at all</b>	<b>Not used</b>	<b>Unknown</b>	<b>Response Total</b>
Habitat protection through regulation	6% (2)	51% (18)	31% (11)	6% (2)	6% (2)	<b>35</b>
Habitat protection on public lands	26% (9)	54% (19)	20% (7)	0% (0)	0% (0)	<b>35</b>
Habitat protection incentives (financial)	6% (2)	50% (17)	24% (8)	9% (3)	12% (4)	<b>34</b>
Habitat restoration through regulation	0% (0)	40% (14)	29% (10)	26% (9)	6% (2)	<b>35</b>
Habitat restoration on public lands	11% (4)	57% (20)	14% (5)	9% (3)	9% (3)	<b>35</b>
Habitat restoration incentives (financial)	3% (1)	56% (19)	18% (6)	15% (5)	9% (3)	<b>34</b>
Artificial habitat creation (artificial reefs, nesting platforms)	0% (0)	9% (3)	17% (6)	74% (26)	0% (0)	<b>35</b>
Selective use of functionally equivalent exotic species in place of extirpated natives	3% (1)	0% (0)	23% (8)	71% (25)	3% (1)	<b>35</b>
Succession control (fire, mowing)	11% (4)	31% (11)	11% (4)	40% (14)	6% (2)	<b>35</b>
Corridor development/protection	6% (2)	34% (12)	17% (6)	40% (14)	3% (1)	<b>35</b>
Managing water regimes	0% (0)	14% (5)	17% (6)	57% (20)	11% (4)	<b>35</b>
Pollution reduction	0% (0)	17% (6)	20% (7)	43% (15)	20% (7)	<b>35</b>
Protection of adjacent buffer zone	6% (2)	31% (11)	17% (6)	37% (13)	9% (3)	<b>35</b>
Restrict public access and disturbance	9% (3)	23% (8)	31% (11)	29% (10)	9% (3)	<b>35</b>

## Appendix E-76: Mammals

Land use planning	9% (3)	26% (9)	18% (6)	41% (14)	6% (2)	<b>34</b>
Technical assistance	12% (4)	32% (11)	12% (4)	29% (10)	15% (5)	<b>34</b>
Cooperative land management agreements (conservation easements)	9% (3)	54% (19)	11% (4)	11% (4)	14% (5)	<b>35</b>
Other (please specify below)	7% (1)	0% (0)	0% (0)	7% (1)	86% (12)	<b>14</b>
<b>Total Respondents</b>						<b>605</b>

### 47. Other current HABITAT conservation practices for ALL Mammals in ALL habitats in Indiana.

1. None that I am aware of
2. unknown
3. Unknown
4. Restriction of motorized access into habitat
5. Strip spraying/interseeding
6. Fire and mowing could be beneficial to grassland habitats even though there were no threats (question 10) to grassland habitats as it pertains to red fox. Maybe Not Applicable is more appropriate than Unknown.
7. none for some mammals
8. Generally educate the public on retaining old, dead or dying trees that provide habitat for wildlife, including the Indiana bat.

**Total Respondents**      **8**  
(skipped this question)      31

### 48. What one or two specific HABITAT practices would you recommend for more effective conservation of ALL Mammals in ALL habitats in Indiana?

1. Habitat protection through incentives  
Habitat protection through purchasing  
  
Prescribed burning, because it is useful in controlling vegetative succession. Uncontrolled vegetative succession eventually excludes rabbits and makes future management difficult due to concerns for the Indiana Bat.
2. Stribling, H.L. and Speake, D. W. 1991. Responses of Bobwhite WQuail and Eastern Cottontail Rabbit Populations to Prescribed Burning, Cover Enhancement and Food Plots. Alabama Game & Fish Division/Auburn University  
  
Restricting housing development in forested areas.

## Appendix E-76: Mammals

Incentives for establishing new forested areas and protection of existing ones.

4. Habitat restoration on public lands  
Habitat restoration incentives (financial)
5. Legislation to protect habitat.
6. Habitat Protection  
Habitat Restoration
7. Conservation easements on private property containing important swarming habitat and connected karst features around key hibernacula.
8. Maintenance of early successional components!
9. same as Q45
10. Successional control is the best method to maintain useable rabbit habitat.
11. The 2 specific habitat practices that I would recommend would be to create corridors between forest tracts and provide financial incentives to protect or create forest habitat.
12. see above
13. 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.
14. Grassland often have to be maintained by fire. Control-burns are becoming more difficult to conduct due to lack of trained personnel, restricted burn windows, and encroaching development. Grassland management difficulties need to be addressed.
15. See #45.
16. Early successional grassland habitat maintenance would require "restart succession" in areas. Disturbance of a magnitude to create bare ground, such as a complete burn, plowing, etc. would be required to accomplish this goal.
17. anything that helps to preserve wetlands could help this animal.
18. Preservation of both forest and agricultural landscapes will protect some mammal habitat.  
Most forest conservation practices (including corridors and greenways) are likely success stories for some mammals
19. Protection of large blocks of natural communities and habitats. Management of forested lands to provide early/mid successional stage habitats.
20. Considering current land use practices in NW Indiana, railroad ROWs may provide the most abundant source of grassland communities. Prescribed burning to maintain grass/forb and prairie communities along ROWs is important. Larger blocks of grassland habitats in the range are often found in state nature preserves. These are often isolated from one another ..... reducing fragmentation to the extent possible would be another beneficial habitat tool.

## Appendix E-76: Mammals

fragmentation to the extent possible would be another beneficial habitat tool.

21. Encourage retention and development of hard mast trees (oaks, hickories) in close proximity to woodrat cliffs.

As noted the biggest issue would be to further reduce disturbance by the lay public--particularlry in terms of avoiding removal of hibernacula and maternal sites.

22. We should also remind those interested in preserving historical buildings and sites, that the bat colonies may also be part of that history.

References available in Mammals of Indiana and Bats of Kansas (Cited Earlier)

<b>Total Respondents</b>	<b>22</b>
(skipped this question)	17

### 49. Do you have any additional comments or information on ALL Mammals in ALL habitats that you feel would be useful in the development of the Indiana Comprehensive Wildlife Strategy?

1. Historical records show that coyotes were present in Indiana in settlement times. Ever since, one of the goals of the residents of the state seemed to be to eliminate them. Poisoning, unregulated hunting, virtually no closed season on hunting/trapping, paying bounties have done little to reduce the population. In fact, some evidence points to an increasing population in spite of all these attempts. About the only real threat to coyotes would be urban sprawl cutting into their numbers or over-population creating an outbreak of mange or disease. Coyotes will be a part of Indiana's wildlife for a long time.

2. No

3. Evaluate current harvest and hunting strategies to determine if we need to better balance opportunity with harvest. Continue to monitor QDM practices (quality deer management) in other areas. I believe we already have quality deer in Indiana without getting involved in QDM restrictions or regulations.

4. None

5. Research into the how the elimination of the older age classes of deer effects the health of the deer herd.

6. I am consulting with FHWA and INDOT on their proposed I-69 extention which is traversing karst terrain in Monroe and Greene counties. INDOT consultants are surveying many previously unsurveyed caves (n = 60 in 2004-05) that are potential Indiana bat hibernacula. New data will be available by March 2005.

7. The FWS is also currently revising the Indiana Bat Recovery Plan, which once completed will be an excellent source of information for this effort. Lori Pruitt is the best contact to keep up with the plan's status.

7. No!

Western Harvest Mouse entered Indiana by range expansion from Illinois about 1969 in or near Newton County (Willow Slough) and has continued to spread since then until it occurred in at least

## Appendix E-76: Mammals

Newton County (Willow Slough) and has continued to spread since then until it occurred in at least 18 counties. We can always learn more about it, but and we could attempt to learn more about how it spreads and what deters it from spreading (the latter seems to be larger rivers).

Maintain bat friendly human barriers at hibernacula

Research needs:

9. 1) determine adequate levels of snag retention in managed forests
- 2) Include snag retention and snag decay rate in models of forest composition
- 3) estimate reproductive success or survival

10. 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.

11. Work closely with all appropriate federal and state environmental agencies in coordinating efforts on the Indiana bat.

This is still a common bat, but threats to its migration routes are a critical issue.

12. Little is known about population dynamics for any bat--this one in particular.

A state-wide monitoring effort should be undertaken.

In summary, FGS is extremely rare in Indiana - probably always was and probably always will be.

13. Current occupied range is greatly reduced from historical occurrence ... maybe only 3 of 16 previously-occupied counties. Suitable habitats are limited to isolated tracts of grassland and narrow stretches of railroad ROWs, the latter of which may function as ecological traps. Management options and recovery strategies are limited .... and evaluating their effectiveness can be confounded by the species' population dynamics and habitat preferences. The species presents a very challenging conservation opportunity.

Factors responsible for the decline and local extirpation of woodrats, rangewide and in Indiana, remain unclear. Suspected causes include habitat fragmentation, increased predation from ubiquitous predators (owls, raccoons), changes in forest composition, severe winters, fatal exposure to raccoon roundworm, and decreased production of hard mast. Remnant populations in Indiana are exceedingly small and probably vulnerable to extirpation from any number of stochastic events.

14. Such small colonies may also suffer inbreeding and loss of genetic variation as seen in Illinois. Invasion by exotic plant species, such as garlic mustard, was evident at several Indiana sites ... which may affect availability of green vegetation, soft mass, fungi, or other food items. Hard mast is an important, high energy food resource for woodrats, and low acorn crops may impact local populations. Raccoon roundworm is present at woodrat localities in Indiana, but contamination levels and impacts to the species are unknown.

15. This is a common animal in grassy fields and also in woods. It is doing fine at present, so nothing is needed.

Off the subject I wondered why you left off such species as the shrews *Sorex hoyi* and *S. fumeus*.

**Total Respondents** **15**

(skipped this question) **24**