





**9.** Please briefly describe the top two threats to all wildlife in all forest habitats in Indiana identified above.

1. Overpopulation will lead to an unmanageable resource and severe habitat degradation.
2. Captive cervids contaminate genetic integrity and increase chance of infection for wild deer
3. CWD will come to IN  
Trophy mgt & associated leasing will lead to overpopulation & fewer active hunters  
CWD, EHD & tuberculosis could be a management issue to a deer herd of our density.
4. Loss of habitat to rural development  
Habitat loss- Land development  
Invasive species and its relation to habitat loss  
I seek to manage 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.
5. 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.
6. Habitat fragmentation & habitat destruction.
7. The 2 greatest threats to the fox squirrel are overall loss of habitat and fragmentation of the remaining forest tracts.  
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 habitats for human use cause direct loss of habitats for bobcats and their prey items.
8. The top two threats to the eastern box turtle are habitat loss, road mortality, and human collection.
9. Loss of large blocks of mature forest and increases in forest fragmentation that causes and increase in cowbird nest parasitism and increases edge nest predators (e.g., bluejays). This causes a decrease in recruitment.
10. 1. We still have very little information on the Cerulean Warbler. We need to assess basic demography in Indiana and across the breeding range, learn how this species responds to land management, develop an understanding of post-fledging habitat use, and determine the effect of the brown-headed cowbird on this species.  
2. Because the Cerulean Warbler is an area-sensitive species, a loss of large tracts of mature forest on both the breeding and wintering grounds is a critical threat.  
Brown-headed Cowbird brood parasitism is likely a significant negative impact.
11. Nest predation may also be important.  
Habitat fragmentation may exacerbate both of these.
12. Loss of contiguous blocks of mature forest  
Low reproductive output – possibly 'sink' populations due to poor habitat quality
13. The top two threats to timber rattlesnakes in this habitat are habitat loss and human persecution.  
Timber rattlesnakes are often killed because they are large venomous snakes. There is also a

## Appendix E-32: Aggregated Forests

Timber rattlesnakes are often killed because they are large venomous snakes. There is also a market for this species in illegal trade. Individual take coupled with low reproductive rates pose a serious threat for this species.

15. 1) Lack of periodic vegetative disturbance (Man-made or natural every 5-10 yrs) that adequately opens the forest canopy well distributed throughout predominately forested management s, management in the large contiguous forested areas of the state in public ownership which form the core or heart of the residual and current grouse range. 2) Potential habitat on private lands is fragmented in distribution due to small ownership and different management objectives (lack of active timber mgmt) that does not provide a consistent continuum of management habitat for successful population dispersal. A recent population model analysis based on current habitat conditions and actual grouse population data for Indiana projects that ruffed grouse will potentially disappear as a viable species in much of their current range by 2007. Ruffed grouse population indices are now at the lowest levels recorded in over 40+ yrs.
16. 1. Loss of early successional forest age class.  
2. Preservationist (anti-management folks) and their influence on the politics of timber management and legal management to sound timber/wildlife management activities.
17. The lack of public knowledge/information regarding the importance of disturbances and early successional habitat in forested areas is the main contributing factor to the near extirpation of the ruffed grouse. The lack of early successional habitats in forested areas is causing major declines in the ruffed grouse population.
18. Potential habitat loss due development and lack of management.
19. Adequate habitat (primarily American sycamores along riparian areas) in breeding areas.
20. availability and quality of suitable nesting/feeding habitat.
21. Eastern Towhee is considered a habitat generalist that uses early successional habitats within deciduous forests. With prevailing land management that does not generate early succession habitat (such as maturation of forest on former farm lands), habitat is reduced. A second top threat is probably loss of nest and nesting females to cats, chipmunks, snakes and other ground predators.
22. Loss and degradation of breeding and foraging habitats along river corridors and uplands.
23. Little is known concerning the crowned snake in Indiana. I believe the top threats to this species in Indiana include habitat destruction, habitat fragmentation, and accidental take.
24. Adequate habitat (primarily American sycamores along riparian areas) in breeding areas.

**Total Respondents**

**24**

**10.** Please rank the following threats to the HABITAT of all wildlife in all forest 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)	17% (4)	63% (15)	21% (5)	0% (0)	0% (0)	0% (0)	<b>24</b>
Counterproductive financial incentives or regulations	0% (0)	8% (2)	29% (7)	25% (6)	13% (3)	25% (6)	<b>24</b>
Invasive/non-native species	0% (0)	12% (3)	24% (6)	44% (11)	8% (2)	12% (3)	<b>25</b>

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Nonpoint source pollution (sedimentation and nutrients)	0% (0)	0% (0)	4% (1)	42% (10)	33% (8)	21% (5)	<b>24</b>
Habitat fragmentation	20% (5)	28% (7)	44% (11)	8% (2)	0% (0)	0% (0)	<b>25</b>
Successional change	20% (5)	8% (2)	20% (5)	32% (8)	16% (4)	4% (1)	<b>25</b>
Diseases (of plants that create habitat)	0% (0)	0% (0)	21% (5)	38% (9)	17% (4)	25% (6)	<b>24</b>
Habitat degradation	17% (4)	17% (4)	33% (8)	33% (8)	0% (0)	0% (0)	<b>24</b>
Climate change	0% (0)	0% (0)	0% (0)	21% (5)	25% (6)	54% (13)	<b>24</b>
Stream channelization	0% (0)	8% (2)	8% (2)	13% (3)	54% (13)	17% (4)	<b>24</b>
Impoundment of water/flow regulation	0% (0)	0% (0)	17% (4)	17% (4)	46% (11)	21% (5)	<b>24</b>
Agricultural/forestry practices	13% (3)	25% (6)	33% (8)	13% (3)	13% (3)	4% (1)	<b>24</b>
Residual contamination (persistent toxins)	0% (0)	0% (0)	4% (1)	21% (5)	42% (10)	33% (8)	<b>24</b>
Point source pollution (continuing)	0% (0)	0% (0)	0% (0)	38% (9)	38% (9)	25% (6)	<b>24</b>
Mining/acidification	0% (0)	4% (1)	13% (3)	21% (5)	50% (12)	13% (3)	<b>24</b>
Drainage practices (stormwater runoff)	0% (0)	0% (0)	0% (0)	25% (6)	54% (13)	21% (5)	<b>24</b>
Unknown	0% (0)	0% (0)	0% (0)	8% (1)	17% (2)	75% (9)	<b>12</b>
Other (please specify below)	17% (2)	0% (0)	8% (1)	0% (0)	17% (2)	58% (7)	<b>12</b>
					<b>Total Respondents</b>		<b>411</b>

### 11. Other HABITAT threats to all wildlife in all forest habitats in Indiana.

1. Modern farm practices-the creation of large open, clean farm fields leaves no habitat for deer or many other mammals for that manner
2. Urban spread, construction, clearing for agriculture crops and fence row removal

3. Eastern hardwood forests, including those in Indiana, are relatively young and even-aged with less species diversity, vertical structure, natural canopy gaps, large woody debris, and other structural features than pre-European settlement forests. The influence of Native Americans, and particularly the subsequent wave of European expansion across the Midwest, left permanent changes across the landscape of Indiana, changes reflected in the extirpated flora and fauna of the region. Furthermore, the suppression of natural disturbances such as fire has resulted in a shift in species composition, structural complexity, and landscape pattern across much of the region. Fire-intolerant species such as sugar maple and American beech have become established at the expense of fire-adapted oak and hickory species, especially after fire control measures were. Before European settlement, fires, beavers, floods, and windstorms created extensive openings. The restoration of natural landscapes requires the re-introduction or simulation of these disturbances.

4. Not clear what is causing decline of the Cerulean Warbler, regionally brood parasitism and forest fragmentation may be negative impacts. It may be possible the species geographic range is shifting (climate?). Exact habitat associations of the species are not known -- not clear what is optimal habitat in Indiana in my view.

Public resistance and acceptance of periodic vegetative disturbance (timber management) is necessary because the forest cover across the landscape no longer exists in the same continuum and natural forces no longer operate (or are allowed to operate, e.g. regional firestorms) as they did prior to settlement. The public needs to accept that man-made disturbances (e.g. even-age timber management) can be used to mimic natural

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accept that man-made disturbances (e.g. even-age timber management) can be used to mimic natural disturbances on a smaller & controlled scale to create a diversity of habitats in the residual forested landscape where once such natural disturbances operated at a larger scale in a relatively continuous forested landscape assuring early successional forest species viability. Another threat is excessive environmental review and assessment which makes timber management on public lands so costly in agency resources that it is deemed unaffordable within budgeted resources and attracts public ire as being too costly.

6. unknown
7. Although the Southeastern crowned snake is found in conjunction with upland forested habitats in Indiana, this species prefers sand and siltstone glades.

**Total Respondents 7**

### 12. Please briefly describe the top two HABITAT threats to all wildlife in all forest habitats in Indiana identified above.

1. Degredation by overpopulation  
Fragmentation in farmed/heavily populated regions prevents historical movements from summer to winter ranges
2. Urban sprawl is consuming significant amounts of our forest habitat  
Urban sprawl has started to interrupt movements and increased accidental mortality.
3. Fragmentation of habitat forces unnatural movement and increases accidental mortality as well as the opportunity to spread disease.
4. Development- this completely removes the habitat  
Habitat fragmentation- this also removes habitat  
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
5. 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 negatively impacts bobcat habitats, but is probably less of a factor because the species is somewhat adaptable and highly mobile.
6. The largest threat to the box turtle habitat is fragmentation and urbanization.
7. Forest habitat fragmentation and loss of habitat.
8. 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.
9. Loss of high quality forest habitat (over mature uneven-aged forest) and forest fragmentation (lots of cowbirds and bluejays). This results in lower quality habitat available to ceruleans.  
1. We still do not know the specific habitat preferences for this species. The types of habitats where these species were especially abundant in the past (i.e. old-growth bottomland forest) no longer exist. This area needs more research.  
2. The cerulean's dependence on large tracts of mature deciduous forests make the species
- 10.

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2. The cerulean's dependence on large tracts of mature deciduous forests, make the species especially sensitive to continuing forest fragmentation and isolation. The mechanism by which fragmentation affects populations in Indiana is unknown, but the response of this species to habitat fragmentation may be related to other factors associated with fragment size. Brood parasitism by the Brown-headed Cowbird (*Molothrus ater*), and high rates of nest predation by generalist predators such as Blue Jay (*Cyanocitta cristata*) and raccoon (*Procyon lotor*) are likely factors. Fragmentation of forest in Indiana especially in predominately agricultural landscapes has resulted in small patches of forest surrounded by open habitat that cowbirds require for feeding and nest searching.

12. Fragmentation of canopied forest habitats  
Brown-headed Cowbird brood parasitism.

13. Habitat fragmentation

The top two habitat threats to the timber rattlesnake include forest fragmentation and habitat loss.

14. The timber rattlesnakes need large continuous blocks of forest habitat. When these areas are lost rattlesnakes become susceptible to human and predator encounters.

This is somewhat repetitive of the previous questions but here we go again:

15. 1) lack of active timber management that adequately opens or removes the overhead forest canopy and allows for natural regeneration back into a forest cover. 2) the lack of public understanding and acceptance of timber management, especially even-age timber management.

2) the lack of public understanding and acceptance that vegetative disturbance whether natural or man-made

16. loss of early successional forest habitats  
fragmentation resulting in islands of habitat too far removed from others for immigration or emigration

17. The answers listed above indicate the absence of early successional habitat in forests, i.e. absence of clear-cutting, and other disturbance types in forested habitats is the major cause of ruffed grouse habitat declines. Forestry practices that do NOT lead to early successional habitat development are the problem. Grouse and many songbirds, need early forest successional stages and due to the current policies of the USFS and some state properties, the grouse is being "not-managed" to extirpation.

18. Conversion of habitat to other than pine forests  
Lack of active habitat management

19. Loss of floodplain sycamores and upland pine forests.

20. Loss of cavity trees and harvest of older forests.

21. Primary sources of loss of young forest habitats in Indiana are urban development / sprawl into remaining forest areas, and maturation of existing forest out of young forest age classes.; Primary sources of loss of young forest habitats in Indiana are urban development / sprawl into remaining forest areas, and maturation of existing forest out of young forest age classes.

22. Loss and habitat degradation of forested habitat along riparian areas and in uplands.

23. Threats to this species habitat include invasive species encroachment and habitat destruction.

24. Loss of floodplain sycamores and upland pine forests.

**Total Respondents**

**24**

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### 13. What current monitoring efforts by state agencies are you aware of for all wildlife in all forest 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	17% (4)	83% (20)	<b>24</b>
Statewide once a year monitoring conducted by state agencies	30% (7)	70% (16)	<b>23</b>
Periodic statewide (less than once a year but still regularly scheduled) monitoring conducted by state agencies	17% (4)	83% (19)	<b>23</b>
Occasional statewide (less than once a year and not regularly scheduled) monitoring conducted by state agencies	39% (9)	61% (14)	<b>23</b>
Regional or local year-round monitoring conducted by state agencies	14% (3)	86% (19)	<b>22</b>
Regional or local once a year monitoring conducted by state agencies	30% (6)	70% (14)	<b>20</b>
Periodic regional or local (less than once a year but still regularly scheduled) monitoring conducted by state agencies	10% (2)	90% (19)	<b>21</b>
Occasional regional or local (less than once a year and not regularly scheduled) monitoring conducted by state agencies	15% (3)	85% (17)	<b>20</b>
		<b>Total Respondents</b>	<b>176</b>

### 14. What current monitoring efforts by other organizations are you aware of for all wildlife in all forest 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 other organizations	0% (0)	100% (23)	<b>23</b>
Statewide once a year monitoring conducted by other organizations	48% (11)	52% (12)	<b>23</b>
Periodic statewide (less than once a year but still regularly scheduled) monitoring conducted by other organizations	13% (3)	88% (21)	<b>24</b>
Occasional statewide (less than once a year and not regularly scheduled) monitoring conducted by other organizations	4% (1)	96% (22)	<b>23</b>
Regional or local year-round monitoring conducted by other organizations	0% (0)	100% (24)	<b>24</b>
Regional or local once a year monitoring conducted by other organizations	25% (6)	75% (18)	<b>24</b>
Periodic regional or local (less than once a year but still regularly scheduled) monitoring conducted by other organizations	25% (6)	75% (18)	<b>24</b>
Occasional regional or local (less than once a year and not			

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regularly scheduled) monitoring conducted by other organizations

**Total Respondents 189**

### 15. How crucial are these monitoring efforts by state agencies for the conservation of all wildlife in all forest habitats in Indiana?

	<b>Very crucial</b>	<b>Somewhat crucial</b>	<b>Slightly crucial</b>	<b>Not crucial</b>	<b>Unknown</b>	<b>Response Total</b>
Statewide year-round monitoring conducted by state agencies	8% (2)	13% (3)	4% (1)	63% (15)	13% (3)	<b>24</b>
Statewide once a year monitoring conducted by state agencies	23% (5)	23% (5)	9% (2)	27% (6)	18% (4)	<b>22</b>
Periodic statewide (less than once a year but still regularly scheduled) monitoring conducted by state agencies	0% (0)	19% (4)	24% (5)	48% (10)	10% (2)	<b>21</b>
Occasional statewide (less than once a year and not regularly scheduled) monitoring conducted by state agencies	0% (0)	48% (10)	10% (2)	33% (7)	10% (2)	<b>21</b>
Regional or local year-round monitoring conducted by state agencies	4% (1)	8% (2)	13% (3)	50% (12)	21% (5)	<b>23</b>
Regional or local once a year monitoring conducted by state agencies	17% (4)	17% (4)	17% (4)	25% (6)	21% (5)	<b>23</b>
Periodic regional or local (less than once a year but still regularly scheduled) monitoring conducted by state agencies	0% (0)	14% (3)	24% (5)	43% (9)	19% (4)	<b>21</b>
Occasional regional or local (less than once a year and not regularly scheduled) monitoring conducted by state agencies	0% (0)	10% (2)	20% (4)	50% (10)	20% (4)	<b>20</b>
						<b>Total Respondents 175</b>

### 16. How crucial are these monitoring efforts by other organizations for the conservation of all wildlife in all forest habitats in Indiana?

	<b>Very crucial</b>	<b>Somewhat crucial</b>	<b>Slightly crucial</b>	<b>Not crucial</b>	<b>Unknown</b>	<b>Response Total</b>
Statewide year-round monitoring conducted by other organizations	0% (0)	0% (0)	8% (2)	71% (17)	21% (5)	<b>24</b>
Statewide once a year monitoring conducted by other organizations	22% (5)	22% (5)	13% (3)	39% (9)	4% (1)	<b>23</b>
Periodic statewide (less than once a year but still regularly scheduled) monitoring conducted by other organizations	0% (0)	8% (2)	8% (2)	63% (15)	21% (5)	<b>24</b>
Occasional statewide (less than once a year and not regularly scheduled) monitoring conducted by other organizations	0% (0)	13% (3)	4% (1)	67% (16)	7% (4)	<b>24</b>
Regional or local year-round monitoring	0% (0)	4% (1)	13% (3)	58% (14)	25% (6)	<b>24</b>



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15. In southern Indiana in the unglaciated forested region.

16. None known

17. periodic statewide Breeding Bird Atlas.

18. Breeding Bird Atlas - statewide

19. State-wide breeding bird atlas efforts are coordinated by the state DNR. This atlas effort was done in the 1980s, and is being redone now. Also the state DNR nongame bird program coordinates publication of a summer bird count that generates some data on towhee numbers (along with all other summer birds. No analysis is done, however.

20. The DNR occasionally monitors this species.

21. periodic statewide Breeding Bird Atlas.

**Total Respondents**

**21**

### **18.** Regional or local monitoring by other organizations for all wildlife in all forest habitats in Indiana.

1. Some municipalities; University properties

Purdue U

2. Beverly Shores  
US Nat'l Lkshore

Wesselman woods (Evansville)

3. Private groups have helped with counts in some State Parks.

4. Unknown

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

6. None that I am aware of.

7. I am not sure who else might be monitoring box turtle in Indiana

8. Unknown

9. I am not aware of any other monitoring.

10. Audubon supports May Day count throughout state which detects cerulean warblers. TNC is working on developing a research project in the state for ceruleans.

1. BBS routes provide some information for this species. However, most routes are located along roads and do not adequately monitor interior forest species such as the cerulean.

2. The Hoosier National Forest conducts breeding bird point counts each year along points located in interior forest blocks or varying fragment size. Although the cerulean is not the focus of this study, data is collected on its occurrence.

11.

3. Cornell Lab of Ornithology collects data on the cerulean warbler for their program "Birds in Forested Landscapes." I am unsure whether data has been collected and submitted in Indiana.

4. Ball State has been conducting studies on the Hoosier and Big Oaks for this species. Currently, students from this university are working in conjunction with the Hoosier.

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12. USGS roadside Breeding Bird Survey. These are not tied to this habitat type, but frequency of the other Cerulean habitats in the BBS coverage is low so most data refer to this habitat.
13. The USFS has contracted out survey work in the southern portions of the Hoosier National Forest.  
Incidental observations on Christmas Bird Counts (extremely minor)
14. Species occurrence noted during the Statewide Breeding Bird Atlas Project (only one ever done).
15. unknown
16. On state properties or USFS land where populations have been known to exist.
17. None known
18. federal Breeding Bird Survey statewide; statewide May Day Bird Counts, Summer Bird Counts.
19. federal Breeding Bird Surveys - statewide. Regional May Day Bird Counts, Summer Bird Counts, Christmas Bird Counts  
  
Other bird monitoring efforts that collect data nationwide generate information on eastern towhees. These include the Breeding Bird Surveys, Christmas Bird Counts (towhees are rare in winter, though), Cornell nest record program. The Hoosier National Forest conducts breeding bird monitoring on the forest since 1991.
20. statewide Breeding Bird Survey. Periodic area surveys in the Hoosier National Forest.
21. The nature conservancy occasionally monitors for this species.
22. federal Breeding Bird Survey statewide; statewide May Day Bird Counts, Summer Bird Counts.
23. federal Breeding Bird Survey statewide; statewide May Day Bird Counts, Summer Bird Counts.

**Total Respondents**

**23**

**19.** Please list organizations that are monitoring all wildlife in all forest habitats in Indiana.

1. state Universities
2. see # 18
3. unknown
4. Unknown
5. Indiana State University  
Wildlife Biologists at Military bases  
  
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.
6. Unknown
7. Unknown
8. Indiana Division of Fish and Wildlife

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9. USFWS, INDNR, TNC, Audubon, American Bird Conservancy, MAPS program (Point Reyes Bird Observatory), Local bird clubs, NRCS (thru WRP program monitoring)
  1. Hoosier National Forest
10. 2. Ball State University
  3. USFWS – Big Oaks
11. Indiana Department of Natural Resources (breeding bird atlas project)  
USGS roadside bird surveys
12. Ball State University, Department of Biology has been monitoring Cerulean Warbler populations at Big Oaks National Wildlife Refuge, Hoosier National Forest, and Yellowwood and Morgan-Monroe state forests during the last 5 years
13. USFS
14. Audubon Christmas Bird Counts
15. unknown
16. IDNR, Div. Fish and Wildlife
17. DNR Division of Fish and Wildlife  
USGS Breeding Bird Survey
18. bird-watchers, USGS,volunteers
19. USGS, birding groups, National Audubon Society  
USGS coordinates the Breeding Bird Survey, National Audubon Society coordinates the Christmas Bird Counts, Cornell's Laboratory of Ornithology collects the nest records, federal agencies do monitoring on lands they manage within the state (e.g., Hoosier NF).
20. USFS, universities
21. bird-watchers, USGS,volunteers

**Total Respondents 22**

**20.** What are the current monitoring techniques for all wildlife in all forest 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	14% (3)	14% (3)	50% (11)	9% (2)	5% (1)	9% (2)	<b>22</b>
Modeling	4% (1)	43% (10)	30% (7)	0% (0)	0% (0)	22% (5)	<b>23</b>
Coverboard routes	0% (0)	0% (0)	29% (4)	36% (5)	7% (1)	29% (4)	<b>14</b>
Spot mapping	13% (3)	33% (8)	29% (7)	4% (1)	0% (0)	21% (5)	<b>24</b>



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- Harvest reports, unintentional kill
4. Modeling  
White-tailed Deer Ecology and Management, Lowell K. Halls
- We need make sure someone continues to examine all animals submitted for rabies testing.
5. 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.
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.
6. I do not have a good, single reference that describes these techniques although they are commonly used by many state wildlife agencies.
7. I would recommend long term surveys and radio-telemetry of box turtle. Surveys would include mark recapture methods.
8. This is a research question to be answered by research personnel.
- 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.
9. A study that experimentally tests how forest management influences demography and presence and absence. This species needs basic life history studied, too.
10. We would benefit from obtaining basic demography data on this species. Mist-netting is not particularly feasible because the species stays so high in the canopy. Due to the difficulty of locating nests of ceruleans and of capturing adults, especially females, determination of reproductive success is problematic. Assessing survivorship of eggs, nestlings, and fledglings is also difficult. Until such reproductive success and survivorship information is available, the dynamics of populations will continue to be unknown.
11. Point counts, spot mapping, and territory mapping provide important information about ceruleans. Banding individual birds could supply information on site fidelity and survivorship.
- Regular monitoring of migratory stopover and winter habitats will also be an important part of the conservation of the cerulean warbler.
12. Roadside bird surveys on selected routes maximizing forest habitats.  
Repeated point count surveys in representative forest sites.
13. Professional Survey/Census – To locate Cerulean Warblers  
Nest search and monitoring – To assess productivity to determine if Indiana has a 'source' or 'sink' population of Cerulean Warblers  
Hutto, R.L., S.M. Pletschett, and T.P. Hendricks. 1986. A fixed-radius point-count method for nonbreeding and breeding season use. *Auk* 103:593-602.

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I would recommend the use of radio-telemetry, mark recapture techniques, and transect surveys. Due to the cryptic nature of these snakes, locating individuals without the help of telemetry is extremely difficult. Many studies conducted locally and nationally have included telemetry in their methods.

14. ; I would recommend the use of radio-telemetry, mark recapture techniques, and transect surveys. Due to the cryptic nature of these snakes, locating individuals without the help of telemetry is extremely difficult. Many studies conducted locally and nationally have included telemetry in their methods.
15. 24. Roadside Drumming indices
- Spring drumming routes – used nationally for spring breeding trend data.
16. On particular or “study areas”, complete spring drumming counts for accurate breeding densities. Assumes a low # of non-drumming males and requires at least three opportunities, on good mornings, to hear a drumming bird in any portion of the study area
17. Driving routes, hunter bag surveys
18. Sampling of mature pine forest habitat to better determine distribution
19. Roadside surveys, canoe surveys, local, more intensive studies
20. federal Breeding Bird Surveys annually statewide.
21. Primary technique used is point counts of singing birds in breeding season, either by roadside counts (BBS) or set survey points (e.g., Hoosier NF monitoring). Roadside surveys are probably most effective because towhees are edge/early successional species, using habitats found near roads. Long term banding programs (e.g., MAPS) provide demographic information not gained with other monitoring, but are more intensive.
22. Road/streamside surveys in appropriate habitat.
23. I would recommend the use of professional surveys and test the effectiveness of cover objects for “trapping” this species.
24. Roadside surveys, canoe surveys, local, more intensive studies

**Total Respondents 24**

**23.** What current HABITAT inventory and assessment efforts or activities by state agencies are you aware of for all wildlife in all forest 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	5% (1)	95% (21)	22
Statewide once a year inventory and assessment conducted by state agencies	0% (0)	100% (21)	21
Periodic statewide (less than once a year but still regularly scheduled) inventory and assessment conducted by state agencies	14% (3)	86% (18)	21
Occasional statewide (less than once a year and not regularly			

## Appendix E-32: Aggregated Forests

scheduled) inventory and assessment conducted by state agencies			
Regional or local year-round inventory and assessment conducted by state agencies	5% (1)	95% (21)	<b>22</b>
Regional or local once a year inventory and assessment conducted by state agencies	0% (0)	100% (21)	<b>21</b>
Periodic regional or local (less than once a year but still regularly scheduled) inventory and assessment conducted by state agencies	18% (4)	82% (18)	<b>22</b>
Occasional regional or local (less than once a year and not regularly scheduled) inventory and assessment conducted by state agencies	24% (5)	76% (16)	<b>21</b>
		<b>Total Respondents</b>	<b>171</b>

<b>24. What current HABITAT inventory and assessment efforts or activities by other organizations are you aware of for all wildlife in all forest habitats in Indiana?</b>			
	<b>Yes, these efforts occur</b>	<b>No effort that I'm aware of</b>	<b>Response Total</b>
Statewide year-round inventory and assessment conducted by other organizations	0% (0)	100% (22)	<b>22</b>
Statewide once a year inventory and assessment conducted by other organizations	0% (0)	100% (22)	<b>22</b>
Periodic statewide (less than once a year but still regularly scheduled) inventory and assessment conducted by other organizations	32% (7)	68% (15)	<b>22</b>
Occasional statewide (less than once a year and not regularly scheduled) inventory and assessment conducted by other organizations	14% (3)	86% (19)	<b>22</b>
Regional or local year-round inventory and assessment conducted by other organizations	0% (0)	100% (22)	<b>22</b>
Regional or local once a year inventory and assessment conducted by other organizations	9% (2)	91% (20)	<b>22</b>
Periodic regional or local (less than once a year but still regularly scheduled) inventory and assessment conducted by other organizations	9% (2)	91% (20)	<b>22</b>
Occasional regional or local (less than once a year and not regularly scheduled) inventory and assessment conducted by other organizations	14% (3)	86% (19)	<b>22</b>
		<b>Total Respondents</b>	<b>176</b>

<b>25. How crucial are these HABITAT efforts by state agencies for the conservation of all wildlife in all forest habitats in Indiana?</b>						
	<b>These efforts are very crucial</b>	<b>These efforts are somewhat crucial for</b>	<b>These efforts are slightly</b>	<b>These efforts are not crucial</b>	<b>Unknown</b>	<b>Response Total</b>

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	for this HABITAT	this HABITAT	crucial for this HABITAT	for this HABITAT		
Statewide annual inventory and assessment conducted by state agencies	14% (3)	9% (2)	5% (1)	45% (10)	27% (6)	<b>22</b>
Statewide once a year inventory and assessment conducted by state agencies	10% (2)	19% (4)	5% (1)	33% (7)	33% (7)	<b>21</b>
Periodic statewide (less than once a year but still regularly scheduled) inventory and assessment conducted by state agencies	14% (3)	29% (6)	10% (2)	19% (4)	29% (6)	<b>21</b>
Occasional statewide (less than once a year and not regularly scheduled) inventory and assessment conducted by state agencies	0% (0)	24% (5)	10% (2)	33% (7)	33% (7)	<b>21</b>
Regional or local year-round inventory and assessment conducted by state agencies	5% (1)	19% (4)	5% (1)	29% (6)	43% (9)	<b>21</b>
Regional or local once a year inventory and assessment conducted by state agencies	10% (2)	14% (3)	5% (1)	33% (7)	38% (8)	<b>21</b>
Periodic regional or local (less than once a year but still regularly scheduled) inventory and assessment conducted by state agencies	0% (0)	24% (5)	14% (3)	24% (5)	38% (8)	<b>21</b>
Occasional regional or local (less than once a year and not regularly scheduled) inventory and assessment conducted by state agencies	0% (0)	24% (5)	14% (3)	29% (6)	33% (7)	<b>21</b>
				<b>Total Respondents</b>		<b>169</b>

26. How crucial are these HABITAT efforts by other organizations for the conservation of all wildlife in all forest habitats in Indiana?						
	These efforts are very crucial for this HABITAT	These efforts are somewhat crucial for this HABITAT	These efforts are slightly crucial for this HABITAT	These efforts are not crucial for this HABITAT	Unknown	Response Total
Statewide year-round inventory and assessment conducted by other organizations	5% (1)	0% (0)	10% (2)	60% (12)	25% (5)	<b>20</b>
Statewide once a year inventory and assessment conducted by other organizations	10% (2)	5% (1)	15% (3)	40% (8)	30% (6)	<b>20</b>
Periodic statewide (less than once a year but still regularly scheduled)	10% (2)	25% (5)	5% (1)	40% (8)	20% (4)	<b>20</b>



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Indiana Div. of Forestry, IDNR.

13. On state and national forest. There is no need to do habitat evaluations at this point. As a specialist species and tied very closely to early successional forest habitats, we know the reason for the decline in grouse populations, and we know nothing is being done to provide habitat for the ruffed grouse and other early forest successional species.
14. None known
15. unknown
16. None
17. Forest inventory plots in established forest management lands give some information on trends in early succession habitat. But I am unaware of any regular coordinated effort by state or other agencies to monitor young forest age classes. Analysis of remote sensing data can provide some trend information where young forest classes can be mapped.
18. unknown
19. I am not sure how often state agencies survey the crowned snakes habitat. The division of nature preserves monitors these habitats.

**Total Respondents**

**19**

### **28.** Regional or local HABITAT inventory and assessment by other organizations for all wildlife in all forest habitats in Indiana.

1. Bev Shores  
Nat'l Lkshore  
Nat'l Forest  
Wesselman Woods
2. Unknown
3. Unknown
4. Local planning boards monitor land use in most localities
5. 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.
6. Unknown
7. TNC and USFWS and Forest Service uses habitat models to examine forest habitat in Indiana (Hoosier NF and Big Oaks NWR).
8. 1. Hoosier National Forest and Ball State University are collecting data on habitat use by cerulean warblers on the northern portion of the Forest.  
2. Cornell's "Birds in Forested Landscapes" collects some data on habitat use. I am not sure if data has been submitted from Indiana.
9. These habitat assessments might occur in Indiana, but I am not positive how often these activities take place.
10. None known

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11. statewide aerial imagery of habitats in Indiana
12. Periodical aerial imagery
13. See above #17
14. USDA, USGS? statewide
15. statewide aerial imagery of habitats in Indiana

**Total Respondents**

**15**

**29.** Please list organizations that are monitoring this HABITAT for all wildlife in all forest habitats in Indiana.

1. state Universities
2. PU  
Gov't careing for #28
3. Unknown
4. Unknown
5. See Above
6. 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.
7. I would assume the Nature Conservancy, IDNR, and other Federal Agencies monitor these habitats
8. Indiana GAP Project
9. Unknown
10. INDNR, USFWS, USFS, TNC
11. 1. Hoosier National Forest  
2. Ball State University  
3. Cornell Lab of Ornithology
12. Ball State University, Department of Biology has been monitoring Cerulean Warbler populations at Big Oaks National Wildlife refuge, Hoosier national Forest, and Yellowwood and Morgan-Monroe state forests during the last 5 years
13. I would assume the Nature Conservancy, IDNR, USFS, and other organizations monitor these habitats
14. None known
15. unknown
16. USDA?, USGS?
17. See above #13 Q. 28
18. USFS, USDA?

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19. Nature Conservancy and IDNR nature preserves.

**Total Respondents 19**

**30.** What are the current monitoring techniques for all wildlife in the Forest Habitats in Indiana. If a technique is not applicable to all wildlife do not select a response in that row.

	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	20% (4)	40% (8)	5% (1)	5% (1)	0% (0)	30% (6)	<b>20</b>
Aerial photography and analysis	20% (4)	35% (7)	15% (3)	5% (1)	0% (0)	25% (5)	<b>20</b>
Systematic sampling	14% (3)	33% (7)	10% (2)	0% (0)	10% (2)	33% (7)	<b>21</b>
Property tax estimates	5% (1)	0% (0)	0% (0)	5% (1)	0% (0)	89% (16)	<b>18</b>
State revenue data	0% (0)	0% (0)	0% (0)	5% (1)	0% (0)	95% (18)	<b>19</b>
Regulatory information	0% (0)	5% (1)	0% (0)	5% (1)	0% (0)	89% (16)	<b>18</b>
Participation in landuse programs	5% (1)	36% (7)	5% (1)	5% (1)	0% (0)	47% (9)	<b>19</b>
Modeling	5% (1)	50% (10)	10% (2)	0% (0)	0% (0)	35% (7)	<b>20</b>
Voluntary landowner reporting	0% (0)	16% (3)	5% (1)	0% (0)	0% (0)	79% (15)	<b>19</b>
Other (please specify below)	7% (1)	14% (2)	0% (0)	0% (0)	0% (0)	79% (11)	<b>14</b>
							<b>Total Respondents 188</b>

**31.** Other HABITAT inventory and assessment techniques for all wildlife in all forest habitats in Indiana.

1. unknown
2. Unknown
3. I am not sure of the techniques to monitor this habitat
4. Unknown
5. Samples at known nest sites are compared with random sites at Big Oaks NWR

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- There have been several Master's projects on habitat selection for the Cerulean Warbler in Indiana. These studies have collected the following information on habitat use: diameter at breast height (DBH) and identification of tree species in a nested plot at the center of a territory, number of saplings (trees <3cm DBH) , number and DBH of standing dead trees (snags) , Canopy cover, ground cover, canopy height, percent canopy coverage and ground cover, canopy height, and vertical stratification of foliage
- 6.
  7. I am not sure what techniques are being applied to assess this habitat
  8. Unknown
  9. I believe this habitat "siltstone glade in upland forest" is monitored through surveys preformed in this habitat.

**Total Respondents 9**

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

1. GIS Habitat Modeling
2. GIS mapping and aerial photo analysis
3. GIS  
Aerial Photography
4. 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  
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.
5. Collect hunter data from DNR Properties & Private Land hunters.
6. Universities keep record of habitat loss and habitat fragmentation.
7. I would recommend a GIS analysis that examines changes in land use over the last 30+ year period.
8. GIS modeling, and intensive study to determine habitat quality (source vs. sink)  
1. I think that a crucial piece of habitat data for the cerulean warbler is the size and distribution of canopy gaps within territories. At this point, researchers have not determined an effective means to quantify this data.
9. 2. Another important habitat inventory would be looking at landscape characteristics of cerulean occurrence and distribution in relation to forest fragmentation. Monitoring should incorporate the occurrence of the species in relation to landscape characteristics such as proportion of agricultural use, tract size and shape, and amount of edge.
10. Habitat association studies to determine which habitat types used/ preferred in IN.  
GIS/aerial photo analysis to map these habitat types.

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11. Systematic sampling/survey techniques – To locate Cerulean Warblers  
Hutto et al. 1986. Auk 103:593-602
12. Statewide Forest Inventory
13. GIS and current aerial photos
14. Statewide inventory and mapping of mature pine forest communities to determine more accurate potential distribution of pine warbler. References suggested would be Flora of Indiana by Charles Deam 1940 and unpublished data/files from Division of Forestry.
15. Aerial imagery of riparian and pine habitats coupled with habitat modeling.
16. Aerial imagery and modeling
17. As stated before, I am unaware of efforts to monitor young age classes of forest. GIS mapping can certainly generate amounts and trends of habitat if forest type and age are mapped. Aerial photography can be used when young age classes appear distinct from other habitat classes.
18. Aerial imagery coupled with modeling.
19. Aerial imagery of riparian and pine habitats coupled with habitat modeling.

**Total Respondents 19**

### 33. What is the current body of science for all wildlife in all forest habitats in Indiana?

		Response Total	Response Percent
Complete, up to date and extensive		2	9%
Adequate		10	43%
Inadequate		9	39%
Nonexistent		0	0%
Other (please explain below)	The science is adequate in some aspects of the turtles life history, but inadequate in others Breeding Bird Atlas and Breeding Bird Survey data	2	9%
<b>Total Respondents</b>		<b>23</b>	

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

	Response Total	Response Percent
1. White-tailed Deer Ecology and Management		
2. IN Mammals		
3. White-tailed Deer Ecology & Management		
4. White-tailed Deer Ecology & Management		
5. Mammals of Indiana		
6. The bobcat in Illinois		

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	7.A long term study of a box turtle ( <i>Terrapene carolina</i> ) population at Allee Memorial Woods, Indiana, with emphasis on survivorship		
	8.None known		
	9.Gray and Fox Squirrel Management in Indiana		
	10.Cerulean Warbler MS Thesis		
	11.Habitat Selection and Territory Size of Cerulean Warblers in Southern Indiana		
	12.Habitat selection and reproductive success of Cerulean Warblers in Southern Indiana		
	13.Spatial Ecology of the Timber Rattlesnake in south central Indiana		
	14. Population status of ruffed grouse in Indiana;		
	15. Ruffed Grouse Restoration in IN		
	16. Atlas of Breeding Birds in Indiana		
	17. Breeding Bird Atlas of Indiana		
	18. Breeding Bird Atlas of Indiana		
	19. Eastern Towhee, Birds of North American account #262		
	20. Atlas of Breeding Birds of Indiana		
	21. Amphibians and Reptiles of Indiana		
	1.Halls, L. K. (editor)		
	2.Whittaker		
	3.Wildlife Management Institute Book		
	4.Lowell K. Halls		
	5.John Whitaker		
	6.Alan Woolf and Clayton Nielsen		
	7.Williams and Parker		
	8.John M. Allen		
	9.		
	10. Kirk Roth		
Author	11.Cynthia M. Basile	5	100%
	12.Kamal Islam and Kirk L.Roth		
	13.Walker and Kingsbury		
	14. Steven E. Backs		
	15. Steve Backs		
	16. Castrale, Hopkins, and Keller		
	17. Castrale, J.S., E. Hopkins, C. Keller		
	18. Castrale, Hopkins, Keller		
	19. Greenlaw, J.S.		
	20. Castrale, JS., E Hopkins, C Keller		
	21. Minton		
	1. 1984		
	2. 1984		
	3. 1984		
	4. IN Press		
	5. 2002		
	6. 1987		
	7.1964		
	8.		
	9.		
	10. 2004		
Date	11.6/02	4	75%
	12. December 2004		
	13. 2000		
	14. Annual Progress Reports		
	15. 1984		

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	16. 1998		
	17. 1988		
	18. 1988		
	19. 1996		
	20. 1988		
	21. 2001		
	1. Stackpole Books		
	2. Stackpole Books		
	3. Stackpole Books		
	4. IU Press		
	5. Southern Illinois University Carbondale		
	6. Herpetologica		
	7. Indiana Department of Conservation		
	8.		
	9.		
	10. Ball State University		
	11. N/A		
Publisher	12. Department of Biology Technical Report No. 4, Ball State University, submitted to U.S. Fish & Wildlife Service, Fort Snelling, MN	<b>3</b>	<b>75%</b>
	13. Masters Thesis, IPFW		
	14. Indiana Div. Fish and Wildlife		
	15. N. Central Section of the Wildlife Soc.		
	16. Indiana Department of Natural Resources		
	17. IDNR		
	18. IDNR		
	19. The Birds of North America, Inc.		
	20. IDNR		
	21. Indiana Academy of Science		
		<b>Total Respondents</b>	<b>11</b>

<b>35.</b>	If possible, please provide a second citation (title, author, date, publisher) that would give another good overview of all wildlife in all forest habitats in Indiana. This resource may also be used if further detail is needed.		
		<b>Response Total</b>	<b>Response Percent</b>
	1. Mammals of Indiana		
	2. Nocturnal Behavior of Eastern Red Bats		
	3. Status and management of bobcas in the United States over three decades		
	4. North American Box Turtles		
	5. None known		
	6. Cerulean Warbler MS Thesis		
	7. Master's Thesis (Title Unknown)		
	8. Relative abundance and habitat selection of Cerulean Warblers in Southern Indiana		
Title	9. Blank	<b>1</b>	<b>100%</b>
	10. The historic and present distribution of ruffed grouse in Indiana;		
	11. Characteristics of Drumming Habitat of Grouse in IN		
	12. BNA Account - Yellow-throated Warbler		
	13. BNA Account - Pileated Woodpecker		
	14. Decline of the Rufous-sided Towhee in the eastern United States		
	15. BNA Account - Red-shouldered Hawk		

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	16. Snakes of the United States and Canada		
	1. Russell E. Mumford and John O. Whitaker, Jr.		
	2. Brianne Everson		
	3. Woolf, A. and G.F. Hubert, Jr.		
	4. Dodd		
	5.		
	6. Cindy Basile		
	7. Kirk Roth		
Author	8. Kamal Islam and Cynthia Basile	1	100%
	9. Gibson and Kingsbury		
	10. Steven E. Backs		
	11. Backs, Kelly, Major, Miller		
	12. G.A. Hall		
	13. E.L. Bull and J.A. Jackson		
	14. Hagan, J.M.		
	15. ST Crocoll		
	16. Ernst and Ernst		
	1. 1982		
	2. 2005?		
	3. 1998		
	4. 2001		
	5.		
	6. 2002		
	7. 6/2004		
Date	8. December 2002	1	100%
	9. 2003		
	10. 1984		
	11. 1984		
	12. 1996		
	13. 1995		
	14. 1993		
	15. 1994		
	16. 2003		
	1. Indiana University Press		
	2. MS Thesis, Indiana State University (not yet complete)		
	3. Wildlife Society Bulletin 26:287-293.		
	4. University of Oklahoma Press		
	5.		
	6. Ball State University		
	7. Department of Biology Technical Report No. 1, Ball State university, final report submitted to U.S. Fish & Wildlife Service,		
Publisher	8. Fort Snelling, MN	1	100%
	9. Masters Thesis, IPFW		
	10. Ind. Acad. Sci. 93:161-166.		
	11. Proceedings of Indiana Academy of Science: 94:227-230		
	12. American Ornithologists' Union		
	13. American Ornithologists' Union		
	14. Auk 110:863-874.		
	15. American Ornithologists' Union		
	16. Smithsonian Institute		
		<b>Total Respondents</b>	<b>8</b>

**36.** What is the current HABITAT body of science for all wildlife in all forest habitats in Indiana?

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		Response Total	Response Percent
Complete, up to date and extensive		1	4%
Adequate		9	39%
Inadequate		8	35%
Nonexistent		2	9%
Other (please explain below)	Unknown I am not sure on the habitat's body of science... I would assume complete and up to date Unknown unknown	3	13%
<b>Total Respondents</b>		<b>23</b>	

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

		Response Total	Response Percent
Title	1. White-tailed Deer Ecology and Management 2. White-tailed Deer Ecology and Management 3. Natural Heritage of Indiana 4. The bobcat in Illinois 5. Cerulean Warbler MS Thesis 6. The natural regions of Indiana 7. Statewide Forest Inventory 8. Indiana Natural Heritage Data Center	3	100%
Author	1. Halls, L. K. (editor) 2. Lowell K. Halls 3. Marion Jackson 4. Alan Woolf and Clayton Nielsen 5. Kirk Roth 6. Homoya, M.A., D.B. Abrell, J.R. Aldrich, and T.W. Post 7. 8.	2	100%
Date	1. 1984 2. 1984 3. 1999 4. 2002 5. 2004 6. 1985 7. periodic 8.	2	100%
Publisher	1. Stackpole Books 2. Stackpole Books 3. IU Press 4. Southern Illinois University Carbondale 5. Ball State University 6. Proceedings of the Indiana Academy of Science 94:245-268 7. US Forest Service/IDNR	2	100%

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8. unpublished data

**Total Respondents 3**

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

		<b>Response Total</b>	<b>Response Percent</b>
Title	1. Nocturnal Behavior of Eastern Red Bats 2. Cerulean Warbler MS Thesis 3. The Natural Regions of Indiana	<b>2</b>	<b>0%</b>
Author	1. Brianne Everson 2. Cindy Basile 3. Homoya, Abrell, Aldrich, and Post	<b>1</b>	<b>0%</b>
Date	1. 2005? 2. 2002 3. 1985	<b>1</b>	<b>0%</b>
Publisher	1. Unpublished MS Thesis (should be complete by may 2005) 2. Ball State University 3. Indiana Academy of Science	<b>1</b>	<b>0%</b>
<b>Total Respondents</b>		<b>2</b>	

**39.** What are the research needs for all wildlife in Forest 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	13% (3)	13% (3)	29% (7)	21% (5)	25% (6)	0% (0)	<b>24</b>
Distribution and abundance	21% (5)	8% (2)	38% (9)	21% (5)	13% (3)	0% (0)	<b>24</b>
Limiting factors (food, shelter, water, breeding sites)	17% (4)	0% (0)	46% (11)	13% (3)	25% (6)	0% (0)	<b>24</b>
Threats (predators/competition, contamination)	17% (4)	13% (3)	46% (11)	17% (4)	8% (2)	0% (0)	<b>24</b>
Relationship/dependence on specific habitats	17% (4)	13% (3)	33% (8)	29% (7)	8% (2)	0% (0)	<b>24</b>
Population health (genetic and physical)	13% (3)	26% (6)	22% (5)	13% (3)	26% (6)	0% (0)	<b>23</b>
Other (please specify below)	31% (4)	15% (2)	23% (3)	0% (0)	8% (1)	23% (3)	<b>13</b>
<b>Total Respondents</b>							<b>156</b>

**40.** Other research needs for all wildlife in Forest Habitats in Indiana.

1. A deer harvest analysis and modeling program  
Baseline life history data.

## Appendix E-32: Aggregated Forests

2. CWD all aspects

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.

3. Research needs explore the role of age and social structure in deer herd health.

4. We desperately need to know how bats interact with each other in terms of competition.

5. WHY DOES THIS PAGE SAY I'M DOING THE OTTER QUESTIONNAIRE??? I ANSWERED #39 ABOVE FOR BOBCATS IN FORESTED HABITATS .... NOT OTTERS IN AQUATIC SYSTEMS!

6. Unknown

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.

7. Effects of Forestry practices on demography and presence and absence of cerulean warblers (TNC) proposed study

Whether the distribution of early successional habitat is now so poor and low (as are ruffed grouse populations) that the disappearance of ruffed grouse from local areas now expand into a more regional or complete extinction.

10. We don't need more reserch. We need habitat management for early successional forest species, including but not limited to the ruffed grouse.

11. unknown

The eastern towhee is a well-known, fairly common species. The general life-history literature is extensive. Population trends, habitat needs and threats are not well defined for Indiana. The documented population declines in databases such as the Breeding Bird Surveys are poorly explained.

13. General life history information is needed for the Southeastern crowned snake in Indiana. Due to this species secretive nature, little is known about Indiana's populations.

**Total Respondents**

**14**

**41.** What are the HABITAT research needs for all wildlife in Forest 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	14% (3)	10% (2)	38% (8)	19% (4)	19% (4)	0% (0)	<b>21</b>
Distribution and abundance (fragmentation)	18% (4)	27% (6)	41% (9)	9% (2)	5% (1)	0% (0)	<b>22</b>
Threats (land use change/competition, contamination/global warming)	19% (4)	5% (1)	57% (12)	14% (3)	5% (1)	0% (0)	<b>21</b>
Relationship/dependence on specific site conditions	24% (5)	0% (0)	38% (8)	19% (4)	19% (4)	0% (0)	<b>21</b>

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Growth and development of individual components of the habitat	10% (2)	5% (1)	33% (7)	19% (4)	29% (6)	5% (1)	<b>21</b>
Other (please specify below)	0% (0)	0% (0)	29% (2)	0% (0)	14% (1)	57% (4)	<b>7</b>
							<b>Total Respondents 113</b>

### 42. Other HABITAT research needs for all wildlife in Forest Habitats in Indiana.

1. unknown
2. Research needs explore the effects of land development.
3. Unknown
4. Effects of forestry practices on cerulean warbler presence or absence and on demography
5. We do not need research on grouse habitat. We know what they need, it just needs to be provided before the ruffed grouse is extirpated.
6. unknown
7. Forest succession is well understood in Indiana. But the relationship between towhee occupancy and habitat age is not explicitly well studied here.

**Total Respondents 7**

### 43. How well do the following conservation efforts address the threats to all wildlife in Forest 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 (use below for details)	35% (8)	52% (12)	4% (1)	4% (1)	4% (1)	<b>23</b>
Population management (hunting, trapping)	13% (3)	25% (6)	8% (2)	50% (12)	4% (1)	<b>24</b>
Population enhancement (captive breeding and release)	0% (0)	0% (0)	8% (2)	92% (22)	0% (0)	<b>24</b>
Reintroduction (restoration)	0% (0)	0% (0)	17% (4)	83% (20)	0% (0)	<b>24</b>
Food plots	4% (1)	13% (3)	17% (4)	67% (16)	0% (0)	<b>24</b>
Threats reduction	4% (1)	25% (6)	8% (2)	42% (10)	21% (5)	<b>24</b>
Native predator control	0% (0)	8% (2)	21% (5)	50% (12)	21% (5)	<b>24</b>
Exotic/invasive species control	0% (0)	17% (4)	13% (3)	46% (11)	25% (6)	<b>24</b>
Regulation of collecting	8% (2)	29% (7)	13% (3)	38% (9)	13% (3)	<b>24</b>
Disease/parasite management	0% (0)	13% (3)	13% (3)	48% (11)	25% (6)	<b>23</b>
Translocation to new geographic range	0% (0)	0% (0)	17% (4)	79% (19)	4% (1)	<b>24</b>
Protection of migration routes	8% (2)	13% (3)	17% (4)	50% (12)	13% (3)	<b>24</b>
Limiting contact with pollutants/contaminants	0% (0)	13% (3)	13% (3)	46% (11)	29% (7)	<b>24</b>
Public education to reduce human disturbance	0% (0)	33% (8)	17% (4)	29% (7)	21% (5)	<b>24</b>
Culling/selective removal	0% (0)	4% (1)	17% (4)	79% (19)	0% (0)	<b>24</b>

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Stocking	0% (0)	0% (0)	13% (3)	88% (21)	0% (0)	<b>24</b>
Other (please specify below)	0% (0)	0% (0)	0% (0)	44% (4)	56% (5)	<b>9</b>
<b>Total Respondents</b>						<b>391</b>

### 44. Other current conservation practices for all wildlife in Forest Habitats in Indiana.

1. Contraceptives; currently not used due to efficacy and economical reasons

2. unknown

3. Unknown

4. Instead of the word "protection" perhaps "enhancement" would be a better choice as the "protection" of habitat for ruffed grouse requires active vegetative management. While hunting is not responsible for the declining population trends and hunting pressure is self-limiting/regulated by diminishing returns, the question does eventually come to the point (with the continuous decline of habitat and subsequently low populations) where one must ask if there is an available surplus or are we shooting the last grouse in an area that was doomed anyway due to the lack of habitat.

5. N/A

6. What is needed is habitat management in the form of producing early successional forest stages in large tracts throughout the forested regions of the state, especially on public lands. If this is not provided, the grouse will soon be extirpated.

7. unknown

8. Education of public to reduce losses due to exotic predators such as cats is probably important to some local populations.

**Total Respondents 8**

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

1. Population management via hunting

2. Ban cervid farming & canned hunting

3. Woodland habitat protection

4. Control of forest habitat fragmentation

5. Habitat Protection  
Invasive species control

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

6. 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).

7. I would recommend preserving large continuous blocks of forested habitat and prohibiting the collection of box turtles. If possible, I would attempt to lower meso predator numbers and protect

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collection of box turtles. If possible, I would attempt to lower meso predator numbers and protect nest cavities.

7. Unknown

8. 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.

9. Increasing the area of mature forest in the landscape and decreasing fragmentation. The conservation of existing forest land is also critical.

1. We desperately need to learn how silvicultural activities and land management affect this species. Are there silvicultural activities (such as single-tree selection) that actually improve cerulean warbler habitat.

10. 2. Increasing the size and reducing the fragmentation of forest blocks within the state will likely improve habitat for this species.

11. Maintenance of contiguous forest areas.

Habitat protection (maintenance of old-growth/mature forest components in Indiana)  
Additional research (nest productivity, annual monitoring of populations to assess trends in population numbers)

Hamel, P.B. 2000. Cerulean Warbler (*Dendroica cerulea*). In *The Birds of North America*, no. 511 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc., Philadelphia.

12. Islam, K. and K.L. Roth. 2004. Habitat Selection and Reproductive Success of Cerulean Warblers in Southern Indiana. Final report submitted to U.S. Fish and Wildlife Service, Fort Snelling, MN, December 2002. Department of Biology Technical Report No. 4, Ball State University, Muncie, Indiana 51pp.

Islam, K. and C. Basile. 2002. Relative abundance and habitat selection of Cerulean Warblers in Southern Indiana. Final report submitted to U.S. Fish and Wildlife Service, Fort Snelling, MN, December 2002. Department of Biology Technical Report No. 1, Ball State University, Muncie, Indiana 76pp.

13. I would recommend public education and habitat protection.

14. Active timber management, especially on the larger blocks of public forest lands, especially those timber management practices that remove at least 75% of the overhead canopy.

15. Habitat decline must be addressed - methods to initiate active timber/wildlife management on the landscape is necessary to stem the serious decline of ruffed grouse in the state.

16. Immediate production of early successional stages of vegetation on public lands. Forstry practices such as clear-cutting and certain select cutting methods are needed to provide the habitat that is essential to returning ruffed grouse populations to earlier levels.

17. Prescription burning to maintain sparse understory in mature pine forests may potentially help this species, for example on DNR lands. Suggested reference: Rodewald, P.G., J.H. Withgott, and K.G. Smith. 1999. Wildlife. In *The Birds of North America*, No. 438 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

18. Conservation of habitats.

19. Conservation of forests and wise timber management emphasizing older forests.

20. The major need is regional land management plans that retain young forest age classes and mixes of habitats within regional landscapes. Second practice may be exotic plant control. Garlic mustard and Amur honeysuckle have the ability to change vegetative structure of ground and understory layers. As ground nester and ground forager, towhees could be affected, but this is unstudied.

21. Incentives to conserve wooded riparian corridors and responsible forestry practices.

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22. Habitat protection and research of general life history requirements.

**Total Respondents 22**

**46.** How well do the following conservation efforts address the HABITAT threats to all wildlife in Forest 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	9% (2)	52% (12)	13% (3)	22% (5)	4% (1)	<b>23</b>
Habitat protection on public lands	26% (6)	65% (15)	4% (1)	0% (0)	4% (1)	<b>23</b>
Habitat protection incentives (financial)	13% (3)	61% (14)	9% (2)	9% (2)	9% (2)	<b>23</b>
Habitat restoration through regulation	9% (2)	43% (10)	9% (2)	26% (6)	13% (3)	<b>23</b>
Habitat restoration on public lands	17% (4)	65% (15)	0% (0)	9% (2)	9% (2)	<b>23</b>
Habitat restoration incentives (financial)	9% (2)	52% (12)	9% (2)	4% (1)	26% (6)	<b>23</b>
Artificial habitat creation (artificial reefs, nesting platforms)	0% (0)	0% (0)	5% (1)	95% (21)	0% (0)	<b>22</b>
Selective use of functionally equivalent exotic species in place of extirpated natives	4% (1)	0% (0)	17% (4)	73% (17)	4% (1)	<b>23</b>
Succession control (fire, mowing)	9% (2)	39% (9)	13% (3)	30% (7)	9% (2)	<b>23</b>
Corridor development/protection	9% (2)	39% (9)	4% (1)	39% (9)	9% (2)	<b>23</b>
Managing water regimes	0% (0)	9% (2)	5% (1)	68% (15)	18% (4)	<b>22</b>
Pollution reduction	0% (0)	27% (6)	5% (1)	45% (10)	23% (5)	<b>22</b>
Protection of adjacent buffer zone	0% (0)	48% (11)	9% (2)	30% (7)	13% (3)	<b>23</b>
Restrict public access and disturbance	4% (1)	26% (6)	30% (7)	30% (7)	9% (2)	<b>23</b>
Land use planning	18% (4)	41% (9)	5% (1)	18% (4)	18% (4)	<b>22</b>
Technical assistance	0% (0)	73% (16)	0% (0)	9% (2)	18% (4)	<b>22</b>
Cooperative land management agreements (conservation easements)	10% (2)	67% (14)	0% (0)	5% (1)	19% (4)	<b>21</b>
Other (please specify below)	0% (0)	0% (0)	0% (0)	17% (1)	83% (5)	<b>6</b>
						<b>Total Respondents 390</b>

**47.** Other current HABITAT conservation practices for all wildlife in Forest Habitats in Indiana.

1. unknown
2. Restriction of motorized access into habitat
3. Unknown

4. Under the habitat through "protection and regulation", some states have "policies or regulations" that specifically mandate that a certain percentage of their public lands will be maintained in early successional and transitional forest types

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successional and transitional forest types

5. There are very few if any "current habitat conservation practices" being implemented for the ruffed grouse. That is the major problem with the critically low population levels for this species.
6. unknown

**Total Respondents**

**6**

### **48.** What one or two specific HABITAT practices would you recommend for more effective conservation of all wildlife in Forest Habitats in Indiana?

1. Restricting housing development in forested areas.  
Incentives for establishing new forested areas and protection of existing ones.
2. Habitat Protection  
Habitat Restoration  
  
Preservation of both forest and agricultural land scapes will protect this species habitat.
3. Most forest conservation practices (including corridors and greenways) are likely success stories for this species
4. Protection of large blocks of natural communities and habitats. Management of forested lands to provide early/mid successional stage habitats.
5. Preserve large tracts of forested habitat.
6. Legislation to protect habitat.
7. 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.
8. Land use planning and habitat protection and restoration on public and private land.  
  
Due to natural succession and the reduction of natural disturbance, sugar maple and American beech are increasing in stand density and basal area at the expense of the oak-hickory overstory throughout many of the forests in the state. A shift in forest composition from oak-hickory to maple-beech dominated forests has implications for many wildlife species. This shift could result in a reduction of species richness and abundance within forest bird communities and may negatively influence the cerulean warbler. Differences in foliage and bark structure may affect arthropod (spiders and related species) availability for this species. And, the short-petioled leaves and furrowed bark of oak trees compared to maples may provide better foraging opportunities for these birds.
9. Promotion of older growth forest on public and private lands.  
  
Habitat protection (maintenance of old growth/mature forest components in Indiana)  
Additional research (nest productivity, annual monitoring of populations to assess trends)
10. Hamel P.B. 2000. (see complete citation elsewhere)  
Islam and Roth. 2004. (see complete citation elsewhere)  
Islam and Basile. 2002. (see complete citation elsewhere)
11. I thought I answered this already but here we go:  
ACTIVE TIMBER MANAGEMENT THAT REMOVES AT LEAST 75% OF THE EXISTING FOREST CANOPY ON A PROPORTION OF THE FORESTED LANDSCAPE EVERY 5-10 YEARS ON A 80-120 YEAR ROTATION (DEPENDING SITECONSTRAINTS AND MGMT OBJECTIVES) USING PRIMARILY EVEN-AGE TIMBER MANAGEMENT TECHNIQUES.
- 12.

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### 13. TIMBER MANAGEMENT

Implement forestry practices that will benefit early successional species including grey fox, bobcat, and woodcock, as well as ruffed grouse.

14. Educate the public so they understand that "nature knows best" and that "letting things go back to nature" are ignorant and foolish concepts. Educate the public to understand that habitat management in this day and age is necessary if we are to provide habitat for specialist species whose populations are in peril.

15. Potentially prescribed burning on public lands to maintain mature forests with sparse understory. Rodewald et al. 1999. Pine Warbler in Birds of North America

16. Incentives to conserve floodplain forests.

17. Incentives to preserve forests and use good timber managements practices.

18. Encouragement of forest management plans that retains / creates mix of young and older forest should retain towhees in regional avifaunas. Forest habitat restoration provides habitat in early stages. Encouragement of forest management plans that retains / creates mix of young and older forest should retain towhees in regional avifaunas. Forest habitat restoration provides habitat in early stages.

19. Incentives to conserve wooded riparian corridors.

20. Conservation of habitats.

**Total Respondents**

**20**

### 49. Do you have any additional comments or information on all wildlife in Forest Habitats that you feel would be useful in the development of the Indiana Comprehensive Wildlife Strategy?

1. 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.

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

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

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

A state-wide monitoring effort should be undertaken.

4. None

5. There is still a lot unknown about cerulean warblers. We need to improve our knowledge and to see what is limiting population growth (could be wintering area habitat loss or poor survival in addition to breeding habitat problems). We need to encourage a forest landscape wherever possible (that includes actively managed forest lands) to increase the amount of forest in the landscape and actively encourage a percentage of that landscape to be in mature forests.

Recently The Nature Conservancy has held meetings with many agencies and universities to determine the feasibility of conducting a landscape ecology project for the cerulean warbler. This

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determine the feasibility of conducting a landscape ecology project for the cerulean warbler. This project would focus on the response of this species to silvicultural practices and could yield very useful information. Basic demography data could also be collected. With proper funding, many other species that use this habitat type could be studied as well. A key issue to cerulean warbler conservation is research. Before effective conservation strategies can be developed, a lot of questions will need to be answered.

7. Ruffed grouse should be viewed as an interior forest dependent species requiring early successional forests. While their populations will also benefit to some degree from the transitional habitats that develop from abandoned fields going into forested cover, they are primarily dependent on the larger tracts of contiguous forests. They are not an "edge" species even though that is commonly found in the popular literature and some older technical publications. Grouse are often found on forest edges because that is the only early successional habitat they can find. They are also more vulnerable to natural and man-induced (hunting) predation when forced up to the edge or limit of good or marginal habitat.

8. Indiana mirrors other states, especially on the southern periphery of the ruffed grouse range in the severe reduction of suitable habitats and consequently, populations. As land abandonment and reverting farmlands are a thing of the past, only timber management on public (especially) and private lands can rebalance successional age classes in forest lands to benefit grouse and a host of other early successional species.

9. In terms of breeding habitat, this species appears to be closely tied to native Virginia pine in southern Indiana and in some mature pine plantations at scattered locations around the state. At some point in the future, many of the pine plantations that were established since the 1930's will undoubtedly be replaced by native deciduous forest. Thus, it may be prudent to conduct more intensive inventories of native Virginia pine and its distribution as well as assessing the habitat and potential management strategies for pine warbler.

10. Eastern towhee is a non-endangered but declining species across much of the United States. It is not the focus of specific monitoring efforts (because it is not on threatened lists), but it has shown sharp declines. Indiana populations on the Breeding Bird Survey show a negative (-1%/year) but nonsignificant decline. The species is best used as an indicator on young forest age-classes within a management district or region.

**Total Respondents**

**10**