

Appendix E-39: Mature of High Canopy Stage

6. Please rank the following threats to the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana.

| | Critical threat | Serious threat | Somewhat of a threat | Slight threat | No threat | Unknown | Response Total |
|--|------------------------|-----------------------|-----------------------------|----------------------|------------------|----------------|-----------------------|
| Invasive/non-native species | 0% (0) | 0% (0) | 20% (1) | 60% (3) | 0% (0) | 20% (1) | 5 |
| High sensitivity to pollution | 0% (0) | 0% (0) | 0% (0) | 40% (2) | 40% (2) | 20% (1) | 5 |
| Bioaccumulation of contaminants | 0% (0) | 0% (0) | 20% (1) | 20% (1) | 250% (1) | 40% (2) | 5 |
| Predators (native or domesticated) | 0% (0) | 20% (1) | 40% (2) | 20% (1) | 0% (0) | 20% (1) | 5 |
| Dependence on other species (mutualism, pollinators) | 0% (0) | 0% (0) | 0% (0) | 40% (2) | 40% (2) | 20% (1) | 5 |
| Diseases/parasites (of the species itself) | 0% (0) | 0% (0) | 0% (0) | 60% (3) | 0% (0) | 40% (2) | 5 |
| Regulated hunting/fishing pressure (too much) | 0% (0) | 0% (0) | 0% (0) | 0% (0) | 100% (5) | 0% (0) | 5 |
| Species over population | 0% (0) | 0% (0) | 0% (0) | 0% (0) | 100% (5) | 0% (0) | 5 |
| Unintentional take/ direct mortality (e.g., vehicle collisions, power line collisions, by-catch, harvesting equipment, land preparation machinery) | 20% (1) | 0% (0) | 0% (0) | 40% (2) | 40% (2) | 0% (0) | 5 |
| Unregulated collection pressure | 0% (0) | 20% (1) | 0% (0) | 20% (1) | 60% (3) | 0% (0) | 5 |
| Dependence on irregular resources (cyclical annual variations) (e.g., food, water, habitat limited due to annual variations in availability) | 0% (0) | 0% (0) | 20% (1) | 40% (2) | 0% (0) | 40% (2) | 5 |
| | | | | | | | 55 |

7. Please also rank these threats to the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana.

| | Critical threat | Serious threat | Somewhat of a threat | Slight threat | No threat | Unknown | Response Total |
|---|------------------------|-----------------------|-----------------------------|----------------------|------------------|----------------|-----------------------|
| Habitat loss (breeding range) | 60% (3) | 40% (2) | 0% (0) | 0% (0) | 0% (0) | 0% (0) | 5 |
| Habitat loss (feeding/foraging areas) | 60% (3) | 40% (2) | 0% (0) | 0% (0) | 0% (0) | 0% (0) | 5 |
| Small native range (high endemism) | 0% (0) | 20% (1) | 40% (2) | 20% (1) | 20% (1) | 0% (0) | 5 |
| Near limits of natural geographic range | 0% (0) | 0% (0) | 20% (1) | 20% (1) | 40% (2) | 20% (1) | 5 |
| Large home range requirements | 0% (0) | 40% (2) | 0% (0) | 20% (1) | 40% (2) | 0% (0) | 5 |
| Viable reproductive population size or availability | 20% (1) | 40% (2) | 20% (1) | 0% (0) | 0% (0) | 20% (1) | 5 |
| Specialized reproductive behavior or low reproductive rates | 40% (2) | 0% (0) | 40% (2) | 20% (1) | 0% (0) | 0% (0) | 5 |
| Degradation of movement/migration routes | 60% (3) | 20% (1) | 0% (0) | 0% (0) | 0% (0) | 20% (1) | 5 |

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(overwintering habitats, nesting and staging sites)

| | | | | | | | |
|-----------------------------------|--------|---------|--------|---------|---------|---------|-----------|
| Genetic pollution (hybridization) | 0% (0) | 0% (0) | 0% (0) | 20% (1) | 80% (4) | 0% (0) | 5 |
| Unknown | 0% (0) | 25% (1) | 0% (0) | 25% (1) | 25% (1) | 25% (1) | 4 |
| Other (please specify below) | 0% (0) | 66% (2) | 0% (0) | 0% (0) | 33% (1) | 0% (0) | 3 |
| Total Respondents | | | | | | | 52 |

8. Other threats to the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana.

1. Brown-headed cowbird nest parasitism
2. We need to know how the Cerulean Warbler is affected by silviculture and other land management, and how these effect demography.
3. Brood parasitism by Brown-headed Cowbird likely has moderate to strong negative impact on population's success.
4. Brood parasitism by Brown-headed Cowbirds in some Cerulean Warbler populations due to fragmentation of forested habitat

Total Respondents 4

9. Please briefly describe the top two threats to the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana identified above.

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.

1. We still have very little information on Cerulean Warblers. We need to assess basic demography in Indiana and across the breeding range, learn how some species responds to land management, develop an understanding of post-fledging habitat use, and determine the effect of the brown-headed cowbird on some 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.
Nest predation may also be important.
Habitat fragmentation may exacerbate both of these.

Loss of contiguous blocks of mature forest
Low reproductive output - possibly 'sink' populations due to poor habitat quality

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 market for this species in illegal trade. Individual take coupled with low reproductive rates pose a serious threat for this species.

Total Respondents 4

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natural landscapes requires the re-introduction or simulation of these disturbances.

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

Total Respondents 2

12. Please briefly describe the top two HABITAT threats to the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana identified above.

1. 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 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.
3. Fragmentation of canopied forest habitats
Brown-headed Cowbird brood parasitism.
4. Habitat fragmentation
5. The top two habitat threats to the timber rattlesnake include forest fragmentation and habitat loss. The timber rattlesnakes need large continuous blocks of forest habitat. When these areas are lost rattlesnakes become susceptible to human and predator encounters.

Total Respondents 5

13. What current monitoring efforts by state agencies are you aware of for the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana?

| | Yes, these efforts occur | Not aware of these efforts occurring | Response Total |
|---|--------------------------|--------------------------------------|----------------|
| Statewide year-round monitoring conducted by state agencies | 0% (0) | 100% (5) | 5 |
| Statewide once a year monitoring conducted by state agencies | 40% (2) | 60% (3) | 5 |
| Periodic statewide (less than once a year but still regularly scheduled) monitoring conducted by state agencies | 40% (2) | 60% (3) | 5 |
| Occasional statewide (less than once a year and not regularly scheduled) monitoring conducted by state agencies | 40% (2) | 60% (3) | 5 |

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| | | | |
|---|---------|--------------------------|-----------|
| Regional or local year-round monitoring conducted by state agencies | 0% (0) | 100% (5) | 5 |
| Regional or local once a year monitoring conducted by state agencies | 40% (2) | 60% (3) | 5 |
| Periodic regional or local (less than once a year but still regularly scheduled) monitoring conducted by state agencies | 20% (1) | 80% (4) | 5 |
| Occasional regional or local (less than once a year and not regularly scheduled) monitoring conducted by state agencies | 20% (1) | 80% (4) | 5 |
| | | Total Respondents | 40 |

14. What current monitoring efforts by other organizations are you aware of for the Wildlife in Mature or High Canopy Stage Forest 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% (5) | 5 |
| Statewide once a year monitoring conducted by other organizations | 60% (3) | 40% (2) | 5 |
| Periodic statewide (less than once a year but still regularly scheduled) monitoring conducted by other organizations | 40% (2) | 60% (3) | 5 |
| Occasional statewide (less than once a year and not regularly scheduled) monitoring conducted by other organizations | 20% (1) | 80% (4) | 5 |
| Regional or local year-round monitoring conducted by other organizations | 0% (0) | 100% (5) | 5 |
| Regional or local once a year monitoring conducted by other organizations | 80% (4) | 20% (1) | 5 |
| Periodic regional or local (less than once a year but still regularly scheduled) monitoring conducted by other organizations | 40% (2) | 60% (3) | 5 |
| Occasional regional or local (less than once a year and not regularly scheduled) monitoring conducted by other organizations | 20% (1) | 80% (4) | 5 |
| | | Total Respondents | 40 |

15. How crucial are these monitoring efforts by state agencies for the conservation of the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana?

| | Very crucial | Somewhat crucial | Slightly crucial | Not crucial | Unknown | Response Total |
|--|---------------------|-------------------------|-------------------------|--------------------|----------------|-----------------------|
| Statewide year-round monitoring conducted by state agencies | 0% (0) | 0% (0) | 20% (1) | 80% (4) | 0% (0) | 5 |
| Statewide once a year monitoring conducted by state agencies | 60% (3) | 0% (0) | 20% (1) | 20% (1) | 0% (0) | 5 |

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17. Regional or local state agency monitoring for the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana.

1. Local breeding bird surveys done on State properties and private land. State cooperates in national breeding bird survey. State biologists also survey in local habitats (e.g., Patoka River)
Indiana Breeding Bird Atlas project through DNR determines statewide distribution periodically.
2. Does not produce quantitative measure of population size. 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.
3. IDNR has monitored timber rattlesnake in Brown, Monroe, and Morgan counties.

Total Respondents 3

18. Regional or local monitoring by other organizations for the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana.

1. 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.
2. 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.
3. 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.
4. The USFS has contracted out survey work in the southern portions of the Hoosier National Forest.

Total Respondents 4

19. Please list organizations that are monitoring the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana.

1. 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
 2. Ball State University
 3. USFWS - Big Oaks
3. Indiana Department of Natural Resources (breeding bird atlas project)
USGS roadside bird surveys
4. 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

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21. Other monitoring techniques for the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana.

1. Nest monitoring, territory mapping, call playback, and color banding (same as mark recapture?)
2. Point count surveys.
3. Nest search and monitoring

Total Respondents 3

22. What one or two monitoring techniques would you recommend for effective conservation of the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana?

1. A study that experimentally tests how forest management influences demography and presence and absence. Some wildlife species need basic life history studied, too.

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.

2. 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.

3. Roadside bird surveys on selected routes maximizing forest habitats.
Repeated point count surveys in representative forest sites.

Professional Survey/Census - To locate Cerulean Warblers

4. 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.

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.

5. ; 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.

Total Respondents 6

23. What current HABITAT inventory and assessment efforts or activities by state agencies are you aware of for the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana?

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| | 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% (4) | 4 |
| Statewide once a year inventory and assessment conducted by state agencies | 0% (0) | 100% (4) | 4 |
| Periodic statewide (less than once a year but still regularly scheduled) inventory and assessment conducted by state agencies | 0% (0) | 100% (4) | 4 |
| Occasional statewide (less than once a year and not regularly scheduled) inventory and assessment conducted by state agencies | 25% (1) | 75% (3) | 4 |
| Regional or local year-round inventory and assessment conducted by state agencies | 0% (0) | 100% (4) | 4 |
| Regional or local once a year inventory and assessment conducted by state agencies | 0% (0) | 100% (4) | 4 |
| Periodic regional or local (less than once a year but still regularly scheduled) inventory and assessment conducted by state agencies | 0% (0) | 100% (4) | 4 |
| Occasional regional or local (less than once a year and not regularly scheduled) inventory and assessment conducted by state agencies | 25% (1) | 75% (3) | 4 |
| | | Total Respondents | 32 |

24. What current HABITAT inventory and assessment efforts or activities by other organizations are you aware of for the Wildlife in Mature or High Canopy Stage Forest 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% (4) | 4 |
| Statewide once a year inventory and assessment conducted by other organizations | 0% (0) | 100% (4) | 4 |
| Periodic statewide (less than once a year but still regularly scheduled) inventory and assessment conducted by other organizations | 0% (0) | 100% (4) | 4 |
| Occasional statewide (less than once a year and not regularly scheduled) inventory and assessment conducted by other organizations | 25% (1) | 75% (3) | 4 |
| Regional or local year-round inventory and assessment conducted by other organizations | 0% (0) | 100% (4) | 4 |
| Regional or local once a year inventory and assessment conducted by other organizations | 25% (1) | 75% (3) | 4 |
| Periodic regional or local (less than once a year but still regularly scheduled) inventory and assessment conducted by other organizations | 0% (0) | 100% (4) | 4 |
| Occasional regional or local (less than once a year and not regularly scheduled) inventory and assessment conducted by other organizations | 25% (1) | 75% (3) | 4 |

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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.
3. These habitat assessments might occur in Indiana, but I am not positive how often these activities take place.

Total Respondents 3

29. Please list organizations that are monitoring this HABITAT for the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana.

1. INDNR, USFWS, USFS, TNC
 1. Hoosier National Forest
2. Ball State University
 2. Ball State University
 3. Cornell Lab of Ornithology
3. 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
4. I would assume the Nature Conservancy, IDNR, USFS, and other organizations monitor these habitats

Total Respondents 4

30. If a technique is not applicable to the Wildlife in Mature or High Canopy Stage Forest Habitats 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 | 67% (2) | 0% (0) | 0% (0) | 0% (0) | 0% (0) | 33% (1) | 3 |
| Aerial photography and analysis | 33% (1) | 33% (1) | 0% (0) | 0% (0) | 0% (0) | 33% (1) | 3 |
| Systematic sampling | 33% (1) | 67% (2) | 0% (0) | 0% (0) | 0% (0) | 0% (0) | 3 |
| Property tax estimates | 0% (0) | 0% (0) | 0% (0) | 50% (1) | 0% (0) | 50% (1) | 2 |
| State revenue data | 0% (0) | 0% (0) | 0% (0) | 50% (1) | 0% (0) | 50% (1) | 2 |
| Regulatory information | 0% (0) | 0% (0) | 0% (0) | 50% (1) | 0% (0) | 50% (1) | 2 |
| Participation in | 0% (0) | 0% (0) | 0% (0) | 50% (1) | 0% (0) | 50% (1) | 2 |

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33. What is the current body of science for the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana?

| | Response Total | Response Percent |
|------------------------------------|----------------|------------------|
| Complete, up to date and extensive | 0 | 0% |
| Adequate | 0 | 0% |
| Inadequate | 5 | 100% |
| Nonexistent | 0 | 0% |
| Other (please explain below) | 0 | 0% |
| Total Respondents | 5 | |

34. Please provide a citation (title, author, date, publisher) that would give the best overview of the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana, if available. This resource may be used if further detail is needed.

| | | Response Total | Response Percent |
|-----------|---|----------------|------------------|
| | Cerulean Warbler MS Thesis | | |
| Title | Habitat Selection and Territory Size of Cerulean Warblers in Southern Indiana | 4 | 100% |
| | Habitat selection and reproductive success of Cerulean Warblers in Southern Indiana | | |
| Author | Spatial Ecology of the Timber Rattlesnake in south central Indiana Kirk Roth | 4 | 100% |
| | Cynthia M. Basile | | |
| | Kamal Islam and Kirk L.Roth | | |
| Date | Walker and Kingsbury 2004 | 4 | 100% |
| | 6/02 | | |
| | December 2004 | | |
| | 2000 | | |
| Publisher | Ball State University | 4 | 100% |
| | N/A | | |
| | Department of Biology Technical Report No. 4, Ball State University, submitted to U.S. Fish & Wildlife Service, Fort Snelling, MN | | |

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Masters Thesis, IPFW

Total Respondents 4

35. If possible, please provide a second citation (title, author, date, publisher) that would give another good overview of the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana. This resource may also be used if further detail is needed.

| | | Response Total | Response Percent |
|------------------|--|---------------------------|-----------------------------|
| | Cerulean Warbler MS Thesis | | |
| | Master's Thesis (Title Unknown) | | |
| Title | Relative abundance and habitat selection of Cerulean Warblers in Southern Indiana | 3 | 75% |
| | Blank | | |
| Author | Cindy Basile | | |
| | Kirk Roth | 4 | 100% |
| | Kamal Islam and Cynthia Basile | | |
| Date | Gibson and Kingsbury 2002 | | |
| | 6/2004 | 4 | 100% |
| | December 2002 | | |
| | 2003 | | |
| Publisher | Ball State University | | |
| | Department of Biology Technical Report No. 1, Ball State university, final report submitted to U.S. Fish & Wildlife Service, Fort Snelling, MN | 3 | 75% |
| | Masters Thesis, IPFW | | |
| | | Total Respondents | 3 |

36. What is the current HABITAT body of science for the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana?

| | | Response Total | Response Percent |
|------------------------------------|---|---------------------------|-----------------------------|
| Complete, up to date and extensive | | 0 | 0% |
| Adequate |  | 1 | 20% |

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| | | | |
|------------------------------|---|--------------------------|----------|
| Inadequate |  | 3 | 60% |
| Nonexistent |  | 1 | 20% |
| Other (please explain below) | | 0 | 0% |
| | | Total Respondents | 5 |

37. Please provide a citation (title, author, date, publisher) that would give the best HABITAT overview of the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana, if available. This resource may be used if further detail is needed.

| | | Response Total | Response Percent |
|-----------|---|--------------------------|---------------------|
| Title | Cerulean Warbler MS Thesis see earlier entries The natural regions of Indiana | 3 | 100% |
| Author | Kirk Roth | 2 | 67% |
| Date | Homoya, M.A., D.B. Abrell, J.R. Aldrich, and T.W. Post 2004 | 2 | 67% |
| Publisher | Ball State University Proceedings of the Indiana Academy of Science 94:245-268 | 2 | 67% |
| | | Total Respondents | 3 |

38. If possible, please provide a second citation (title, author, date, publisher) that would give another good HABITAT overview of the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana. This resource may also be used if further detail is needed.

| | | Response Total | Response Percent |
|-----------|----------------------------|--------------------------|---------------------|
| Title | Cerulean Warbler MS Thesis | 1 | 100% |
| Author | Cindy Basile | 1 | 100% |
| Date | 2002 | 1 | 100% |
| Publisher | Ball State University | 1 | 100% |
| | | Total Respondents | 1 |

39. What are the research needs for the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana?

| | Urgently needed | Greatly needed | Needed | Slightly needed | Not needed | Unknown | Response Total |  |
|----------------------------|--------------------|-------------------|---------|--------------------|---------------|---------|-------------------|---|
| Life cycle | 60% (3) | 0% (0) | 0% (0) | 20% (1) | 20% (1) | 0% (0) | 5 | |
| Distribution and abundance | 40% (2) | 40% (2) | 20% (1) | 0% (0) | 0% (0) | 0% (0) | 5 | |

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| | | | | | | | |
|---|----------|---------|---------|--------|---------|--------|-----------------------------|
| Limiting factors (food, shelter, water, breeding sites) | 80% (4) | 0% (0) | 20% (1) | 0% (0) | 0% (0) | 0% (0) | 5 |
| Threats (predators/competition, contamination) | 80% (4) | 0% (0) | 20% (1) | 0% (0) | 0% (0) | 0% (0) | 5 |
| Relationship/dependence on specific habitats | 80% (4) | 20% (1) | 0% (0) | 0% (0) | 0% (0) | 0% (0) | 5 |
| Population health (genetic and physical) | 40% (2) | 40% (2) | 0% (0) | 0% (0) | 20% (1) | 0% (0) | 5 |
| Other (please specify below) | 100% (1) | 0% (0) | 0% (0) | 0% (0) | 0% (0) | 0% (0) | 1 |
| | | | | | | | Total Respondents 31 |

40. Other research needs for the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana.

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

Total Respondents 1

41. What are the HABITAT research needs for the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana?

| | Urgently needed | Greatly needed | Needed | Slightly needed | Not needed | Unknown | Response Total |
|---|------------------------|-----------------------|---------------|------------------------|-------------------|----------------|-----------------------------|
| Successional changes | 20% (1) | 40% (2) | 40% (2) | 0% (0) | 0% (0) | 0% (0) | 5 |
| Distribution and abundance (fragmentation) | 60% (3) | 40% (2) | 0% (0) | 0% (0) | 0% (0) | 0% (0) | 5 |
| Threats (land use change/competition, contamination/global warming) | 80% (4) | 20% (1) | 0% (0) | 0% (0) | 0% (0) | 0% (0) | 5 |
| Relationship/dependence on specific site conditions | 80% (4) | 0% (0) | 20% (1) | 0% (0) | 0% (0) | 0% (0) | 5 |
| Growth and development of individual components of the habitat | 40% (2) | 20% (1) | 20% (1) | 0% (0) | 20% (1) | 0% (0) | 5 |
| Other (please specify below) | 0% (0) | 0% (0) | 0% (0) | 0% (0) | 0% (0) | 0% (0) | 0 |
| | | | | | | | Total Respondents 25 |

42. Other HABITAT research needs for the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana.

1. Effects of forestry practices on cerulean warbler presence or absence and on demography

Total Respondents 1

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43. How well do the following conservation efforts address the threats to the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana?

| | Very well | Somewhat | Not at all | Not used | Unknown | Response Total |
|---|-----------|----------|------------|--------------------------|---------|----------------|
| Habitat protection (use below for details) | 60% (3) | 20% (1) | 0% (0) | 0% (0) | 20% (1) | 5 |
| Population management (hunting, trapping) | 0% (0) | 0% (0) | 40% (2) | 60% (3) | 0% (0) | 5 |
| Population enhancement (captive breeding and release) | 0% (0) | 0% (0) | 40% (2) | 60% (3) | 0% (0) | 5 |
| Reintroduction (restoration) | 0% (0) | 0% (0) | 40% (2) | 60% (3) | 0% (0) | 5 |
| Food plots | 0% (0) | 0% (0) | 60% (3) | 40% (2) | 0% (0) | 5 |
| Threats reduction | 20% (1) | 20% (1) | 0% (0) | 40% (2) | 20% (1) | 5 |
| Native predator control | 0% (0) | 40% (2) | 0% (0) | 40% (2) | 20% (1) | 5 |
| Exotic/invasive species control | 0% (0) | 0% (0) | 40% (2) | 40% (2) | 20% (1) | 5 |
| Regulation of collecting | 20% (1) | 0% (0) | 40% (2) | 40% (2) | 0% (0) | 5 |
| Disease/parasite management | 0% (0) | 0% (0) | 40% (2) | 40% (2) | 20% (1) | 5 |
| Translocation to new geographic range | 0% (0) | 0% (0) | 40% (2) | 60% (3) | 0% (0) | 5 |
| Protection of migration routes | 20% (1) | 0% (0) | 20% (1) | 20% (1) | 40% (2) | 5 |
| Limiting contact with pollutants/contaminants | 0% (0) | 20% (1) | 20% (1) | 40% (2) | 20% (1) | 5 |
| Public education to reduce human disturbance | 0% (0) | 40% (2) | 40% (2) | 0% (0) | 20% (1) | 5 |
| Culling/selective removal | 0% (0) | 0% (0) | 40% (2) | 60% (3) | 0% (0) | 5 |
| Stocking | 0% (0) | 0% (0) | 40% (2) | 60% (3) | 0% (0) | 5 |
| Other (please specify below) | 0% (0) | 0% (0) | 0% (0) | 0% (0) | 0% (0) | 0 |
| | | | | Total Respondents | | 80 |

44. Other current conservation practices for the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana.

No responses were entered for this question.

Total Respondents 0

45. What one or two specific practices would you recommend for more effective conservation of the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana?

1. 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.
- 2.

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

3. 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.

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.

4. 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.

5. I would recommend public education and habitat protection.

Total Respondents

5

46. How well do the following conservation efforts address the HABITAT threats to the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana?

| | Very well | Somewhat | Not at all | Not used | Unknown | Response Total |
|--|------------------|-----------------|-------------------|-----------------|----------------|-----------------------|
| Habitat protection through regulation | 0% (0) | 40% (2) | 0% (0) | 60% (3) | 0% (0) | 5 |
| Habitat protection on public lands | 60% (3) | 40% (2) | 0% (0) | 0% (0) | 0% (0) | 5 |
| Habitat protection incentives (financial) | 0% (0) | 40% (2) | 0% (0) | 40% (2) | 20% (1) | 5 |
| Habitat restoration through regulation | 20% (1) | 20% (1) | 0% (0) | 40% (2) | 20% (1) | 5 |
| Habitat restoration on public lands | 40% (2) | 40% (2) | 0% (0) | 0% (0) | 20% (1) | 5 |
| Habitat restoration incentives (financial) | 0% (0) | 40% (2) | 20% (1) | 0% (0) | 40% (2) | 5 |
| Artificial habitat creation (artificial reefs, nesting platforms) | 0% (0) | 0% (0) | 0% (0) | 100% (5) | 0% (0) | 5 |
| Selective use of functionally equivalent exotic species in place of extirpated natives | 0% (0) | 0% (0) | 20% (1) | 60% (3) | 20% (1) | 5 |
| Succession control (fire, mowing) | 0% (0) | 20% (1) | 0% (0) | 60% (3) | 20% (1) | 5 |
| Corridor development/protection | 0% (0) | 40% (2) | 0% (0) | 60% (3) | 0% (0) | 5 |
| Managing water regimes | 0% (0) | 0% (0) | 0% (0) | 80% (4) | 20% (1) | 5 |
| Pollution reduction | 0% (0) | 20% (1) | 0% (0) | 60% (3) | 20% (1) | 5 |
| Protection of adjacent buffer zone | 0% (0) | 40% (2) | 0% (0) | 40% (2) | 20% (1) | 5 |
| Restrict public access and disturbance | 20% (1) | 0% (0) | 60% (3) | 20% (1) | 0% (0) | 5 |
| Land use planning | 20% (1) | 40% (2) | 0% (0) | 0% (0) | 40% (2) | 5 |
| Technical assistance | 0% (0) | 60% (3) | 0% (0) | 20% (1) | 20% (1) | 5 |

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| | | | | | | |
|---|---------|---------|--------|--------|---------|-----------|
| Cooperative land management agreements (conservation easements) | 40% (2) | 40% (2) | 0% (0) | 0% (0) | 20% (1) | 5 |
| Other (please specify below) | 0% (0) | 0% (0) | 0% (0) | 0% (0) | 0% (0) | 0 |
| Total Respondents | | | | | | 85 |

47. Other current HABITAT conservation practices for the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana.

No responses were entered for this question.

Total Respondents 0

48. What one or two specific HABITAT practices would you recommend for more effective conservation of the Wildlife in Mature or High Canopy Stage Forest Habitats in Indiana?

1. 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.

2. 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)

3. Hamel P.B. 2000. (see complete citation elsewhere)
4. Islam and Roth. 2004. (see complete citation elsewhere)
- Islam and Basile. 2002. (see complete citation elsewhere)

Total Respondents 4

49. Do you have any additional comments or information on the Wildlife in Mature or High Canopy Stage Forest Habitats that you feel would be useful in the development of the Indiana Comprehensive Wildlife Strategy?

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- 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.
- 1.

- 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 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.
- 2.

Total Respondents

2