Management Guidelines for Compartment-level Wildlife Habitat Features

Maintaining wildlife habitat suitable for a wide variety of native species is an essential component of forest management. The Division of Forestry strives to promote and maintain high faunal diversity at each of its properties. Though wildlife habitat requirements are species-specific, there are some habitat features that are necessary to many species. Such features include snags, cavity and den trees, and ponds. These guidelines address the management of compartment-level habitat features commonly found on DoF properties. The target densities of snags, roost trees, and cavity trees described in this document are to be applied across each management compartment and managed at the tract-level. DoF recognizes that not every managed tract will meet or exceed the targets recommended here; however, every effort should be made to manage individual tracts in such a way that the cumulative effect of forest management activities creates conditions that meet or exceed target densities at the compartment-level. Managing compartments in this way will help ensure a species' habitat needs are addressed across large portions of properties, benefiting the highest number of individuals and populations possible.

These guidelines were designed to benefit a wide-range of native wildlife species; however, the DoF recognizes species that are rare or experiencing significant population decline may require further habitat management consideration. Indiana wildlife Species of Greatest Conservation Need (SGCN) are classified as either 'endangered' or 'species of special concern' and may require habitat management guidelines that differ from those described in this document. In situations where habitat management guidelines disagree, those that provide the most benefit to SGCN should typically be given priority.

SNAGS

Justification: Essential habitat feature for foraging activity, nest/den sites, decomposers (e.g., fungi and invertebrates), bird perching, and bat roosting and important contributor to future pool of downed woody material. Snags may be one of the most important wildlife habitat features in our forests as they are used by a wide range of species. Given the ephemeral nature of snags (most will fall within 5-10 years), it is even more critical this feature is well represented on the landscape.

Definition: Standing dead or dying trees with < 10% live crown; $\geq$ 5 inch DBH and $\geq$ 8 feet tall.

Given the importance of this wildlife habitat feature, ***it is recommended that whenever possible all snags are left standing during timber harvest operations***. DoF suggests that every effort is made to manage tracts using the compartment-wide density targets shown in Table 1 (below), particularly when snags must be felled (e.g., for safety).

Table 1. Compartment-level snag density targets by diameter distribution, managed at the tract-level:

	Target Snag Density	
Diameter (DBH) Distribution	**Maintenance-level [a]**	**Optimal**
TOTAL minimum of snags per acre **≥ 5"**:	**4**	**7**
Including at least this many snags per acre **≥ 9"**:	3	6
Including at least this many snags per acre **≥ 19"**:	0.5	1

[a] approximates current system-wide density of snags

Recommendations

- Felled snags should be left on-site, particularly those with a high-degree of rot and decay.
- Where snag inventory does not meet guidelines - especially where snags are needed for the management of local Species of Greatest Conservation Need (e.g., Indiana bat) – culls can be girdled within the appropriate diameter class. Girding culls during post-harvest TSI can also serve to replace snags that had been felled for safety reasons during harvest operations.
- It is important to minimally target "maintenance-level" snag densities across management compartments, though where possible managers are encouraged to take advantage of situations that would result in "optimal" densities of snags.
- When considering snags to retain or culls to girdle to meet minimum guidelines, give priority to the most sound individuals with >25% exfoliating bark (for Indiana bat roosting habitat), especially those near water. Give highest preference to species that have been found to be important for Indiana bat roosting sites (see Table 3, below) and are relatively long-lasting, such as oaks, sugar maple, and hickories.
- For more information on snag retention and management specifically for Indiana bats, refer to the DoF document "Resource Management Strategy for Indiana bat" (Appendix I-H-1 in Procedures Manual).

LIVE TREE RETENTION (Roost and Cavity/den trees)

Justification: Forest wildlife species depend on live trees for shelter, escape cover, roosting, and as a direct (e.g., mast, foliage) or indirect (e.g., foraging substrate) food resource. The retention of live trees with certain characteristics is of particular concern to habitat specialists such as cavity nesters or Species of Greatest Conservation Need, like the Indiana bat.

Definition: Live trees ≥ 7 inch DBH will need to be retained compartment-wide to satisfy the life requirements of many forest wildlife species. Specific densities and characteristics necessary for tree-roosting bats (e.g., Indiana bats) and cavity nesting/denning species are described below. Where possible, one tree with characteristics suitable for both habitat features (i.e. a bat roost tree with a cavity) can be used towards meeting both categories' recommended target densities.

Live Roost Trees for Indiana Bat

Justification: Provide roosting habitat for the federally endangered Indiana bat and other species. Roosting trees are used by Indiana bats (and other species) during the spring,

summer, and fall. Roost trees are particularly important to female bats raising young in maternity colonies during the summer. When preferred mast trees (e.g., oaks and hickories) are retained for this objective, a valuable food resource is also provided for many forest wildlife species.

Definition: Roost trees are live individuals ≥ 11" DBH and species within the oak-hickory, mixed hardwoods, and bottomland hardwoods cover types, with priority given to the retention of the preferred species listed in Table 3 (see below).

Table 2. Compartment-level roost tree density targets by diameter distribution, managed at the tract-level (*from* DoF Resource Management Strategy for Indiana Bat on Indiana State Forests, Procedures Manual)

Diameter (DBH) Distribution	Roost Trees per Acre
TOTAL minimum roost trees per acre ≥ 11":	**9**
Including at least this many roost trees ≥ 20":	3

Table 3. Species found to be preferred roost trees for Indiana bat (*from* USFWS Bloomington Field Office)

Tree Species	Scientific Name	Tree Species	Scientific Name
Shagbark hickory	*Carya ovata*	Sugar maple	*Acer saccharum*
Bitternut hickory	*C. cordiformis*	Silver maple	*A. saccharinum*
Shellbark hickory	*C. laciniosa*	White ash	*Fraxinus americana*
Northern red oak	*Quercus rubra*	Green ash	*F. pennnsylvanica*
Post oak	*Q. stellata*	Slippery elm	*Ulmus rubra*
White oak	*Q. alba*	American elm	*U. Americana*
Black locust	*Robinia pseudoacacia*	Eastern cottonwood	*Populus deltoides*

Recommendations

- When considering retention of roost trees, give priority to preferred species shown in Table 3 – particularly shagbark and shellbark hickory.
- Solar radiation is important to the energetic requirements of roosting Indiana bats – perhaps more than to most other bat species in Indiana. Active roosts often occur around openings and within open canopy situations where large trees receive unobstructed or partially obstructed solar radiation throughout much of the day. Additionally, open understories beneath partially opened canopies create an optimal environment for bat foraging activities. Where possible leave live trees that can serve as suitable roosting sites around openings, at edges, and within open forest where they will receive abundant solar radiation.
- Refer to the DoF document "Resource Management Strategy for Indiana bat" (Appendix I-H-1 in Procedures Manual) for more information on the retention and management of roost trees.

Live Cavity Trees

Justification: Important for long-term availability of cavity nests, dens, and, potentially, future snags. Trees retained as cavity trees need to appeal to a wide range of wildlife species, from those that only use existing cavities to primary excavators that create new cavities in trees exhibiting injury or evidence of advanced decay.

Definition: Live trees ≥ 7 inch DBH with at least one cavity opening ≥ 1 inch across its narrowest dimension. Openings should appear to lead into a hollow cavity or a deeply recessed area of advanced decay in the sapwood suitable for further excavation. Decay should appear to be advanced enough to support a sharpened pencil pushed into it. Openings can be created by excavation or other natural process (e.g., injury, dead limb) and can occur at any location on the tree (including large limbs and base).

Table 4. Compartment-level cavity tree density targets by diameter distribution, managed at the tract-level:

	Live Cavity Trees per Acre	
Diameter (DBH) Distribution	**Maintenance-level**	**Optimal**
TOTAL minimum cavity trees per acre ≥ 7":	**4**	**6**
Including at least this many cavity trees per acre ≥ 11":	3	4
Including at least this many cavity trees per acre ≥ 19":	0.5	1

Recommendations

- It is important to minimally target "maintenance-level" cavity-tree densities across management compartments, though where possible managers are encouraged to take advantage of situations that would result in "optimal" densities.
- Where live cavity tree inventory does not meet guideline, live culls can be reserved that are within the appropriate diameter class and have evidence of heart/sapwood decay, broken limbs, or similar defects.
- Individual live cavity trees should not be located within the interior of regeneration openings unless included as a leave tree within residual structure (see below). Cavity trees can be located along the edge of openings.
- Live cavity tree retention priorities: 1) give preference to species of live cavity trees that have been found to be important roost trees for Indiana bats - especially shagbark and shellbark hickories (Table 3), 2) where possible, give preference to trees with cavity openings ≥ 5 inches in diameter, 3) retain cavity trees at edges of openings and just outside of openings, 4) retain cavity trees close to water sources.

Considerations for Cull Retention

Culls, especially those with excessive damage and/or decay, are the most likely sources of future cavity trees and, where practical, should be retained for their wildlife value. Girdling culls can create snags while retaining live culls with cavities or decay can serve to satisfy guidelines for cavity trees. Live culls may also provide benefits as roost trees and sources of mast.

When considering the fate of culls…

1. Are there any deficiencies in the number of snags, cavity trees, or roost trees as suggested above?
2. If deficiencies exist in a category, do the characteristics of the cull satisfy the category's requirements? Is it within a suitable size class? Is it a suitable species?
3. Always satisfy guidelines for roost trees and maintenance-level snags first, as they benefit the Indiana bat, a federally endangered species.
4. If deficient in the number of cavity trees and no culls with cavities exist, retain live culls that are damaged or have advanced decay.
5. If all guidelines have been satisfied, consider:
    a. Will the continued growth of the cull interfere with stand development? If so, consider girdling to create snag.
    b. Would retention of the cull as a snag create an unsafe situation, affect regeneration, or jeopardize the integrity of nearby crop trees? If so, consider felling the cull for use as downed woody material (see below).
    c. Is the cull an important mast species that won't interfere with stand development? If so, consider leaving for a cavity or roost tree.

DOWNED WOODY MATERIAL

Justification: Critical cover and foraging habitat component for wildlife, such as small mammals, ground-dwelling birds, reptiles, and amphibians. Discarded tops and limb piles provide cover for birds and small mammals and forage for herbivores. Logs provide persistent cover for small mammals, reptiles, and amphibians; logs in advanced stages of decay are particularly important in recent regeneration openings that are susceptible to soil desiccation.

Definition: Includes all discarded tops, limbs, and logs.

Recommendations

- Retain tops and limbs within regeneration openings whenever possible. Distribute tops and limbs across regeneration opening in such a way so as not to interfere with regeneration processes and future stand development.
- Retain at least 2 large logs ($\geq$ 11" large-end diameter, $\geq$ 4 ft length) per opening-acre within each regeneration opening. Where this guideline cannot be met, fell culls (unless needed to meet snag or live cavity/roost tree guidelines) or distribute suitable debris from log yard back into regeneration opening.
- Firewood cutting should not deplete supply of large logs ($\geq$ 11" large-end diameter, $\geq$ 4 ft length) below 2 per opening-acre across any given regeneration opening.
- Where possible, protect large logs in an advanced state of decay that were present before the harvest operation.
- If intending a prescribed burn after harvest, separate logs from large top/limb piles to prevent prolonged exposure to intensely burning fuels and to keep them from being totally consumed

by the fire. However, light to moderate exposure of green logs to fire is encouraged to accelerate decay processes.
- Snags/culls felled for safety considerations should be left within regeneration openings.

RESIDUAL STRUCTURE IN EVEN-AGE STANDS

Justification: Wildlife species differ in their response to regeneration methods as a result of differences in the scale and intensity of disturbance. For instance, birds most commonly found in late succession forests have been found to react positively to uneven-age systems like selection harvests, while species preferring early succession forest reach highest abundance and species diversity in large, recently harvested even-age stands. Where there is concern that forest structural elements attractive to mature forest species are not being retained in even-age systems, residual structure reserved within regeneration openings has been found beneficial to some late successional species.

Definition and Applicability: Residual structure includes "islands" of sound, mature trees, understory trees, shrubs, live cavity trees, and snags left in reserve within even-aged regeneration openings $\geq$ 20 acres. Residual structure should total **at least 5%** of the regeneration opening area, configured as an individual island or several islands, each no smaller than 1/5 acre. For example, a 20 acre shelterwood would require either one 1 acre island or several islands >1/5 acre that total 1 acre. Residual structure is retained throughout the entire rotation of the even-age stand.

The decision to include residual structure in even-age stands should rest with the community needs across the entire compartment and property. Recent research has found that many early successional species are experiencing population declines, and as a result researchers caution against systematically managing for only late succession species when planning land management activities. Throughout their recent history, DoF properties have been managed using primarily uneven-aged systems - typically single-tree and group selection - that have resulted in generally mature forest conditions not favorable to many area-sensitive early successional species. While prescription of even-age systems has been infrequent on DoF properties, the creation of regeneration openings of sufficient size (approximately 20 acres) to maximize the abundance and diversity of early successional species has been an even rarer occurrence.

As long as DoF properties are primarily managed using uneven-age systems, we should seek out opportunities to achieve maximum diversity and abundance among wildlife species that require early successional forest habitat by allowing for some large harvest openings suitable for these species, where it is silviculturally justifiable. To this end, residual structure is not recommended in even-age stands up to 20 acres so as to maximize benefit for early successional species; however, stands $\geq$ 20 acres should receive residual structure as described above to accommodate both late and early successional species.

Recommendations

- Where necessary, each reserve "island" should include as much of the following as possible:
  - Relatively vigorous hard and/or soft mast trees and shrubs
  - Trees in the canopy, midstory, and understory strata; shrubs and groundstory vegetation

  - Live cavity trees or trees with high den/cavity potential (large broken limbs, evidence of heart rot, portions of dead or dying tops); including species that are typically prone to cavities (black/red oak, white ash, silver maple, cottonwood)
  - Snags
- Where appropriate, plan reserves to incorporate important wildlife habitat features such as semi-permanent pools.
- Where possible, reserve islands should be of regular shape (e.g., circular) to obtain the highest ratio of area-to-edge.

WILDLIFE POOLS AND PONDS

Permanent Wildlife Ponds and Impoundments

Justification: On many DoF properties impoundments have been created in forest management areas to provide for wildlife. In most cases these "wildlife ponds" or "water holes" were created by the Division of Fish and Wildlife and were designed to permanently hold water throughout the year. These ponds provide for wildlife foraging activity, drinking, cover, and also important breeding habitat for forest amphibians. These ponds are especially important to forest amphibians that typically breed in naturally occurring forest pools, as they are a reliable source of habitat, even during dry winters, and are free of fish that would feed on eggs and young.

Definition: Small impoundments and dug-out ponds designed to permanently provide a reliable source of water to forest wildlife year-round.

- At a minimum follow Best Management Practices guidelines when harvesting near permanent ponds.
- To protect the structural integrity of impoundments, keep trees from establishing on levees or raised impoundment walls. However, some trees left around perimeter where they will not compromise the impoundment's structure will benefit many forest species using the pond. Whenever possible, remove no more than 25% of the canopy cover within a 50 foot buffer around the pond perimeter.
- To provide cover for wildlife using pond, minimize disturbance to groundstory vegetation within 50 foot buffer around perimeter of pond. This does not preclude forest management activities (including tree harvesting and invasive species management) around ponds; however, one objective of such activities should be to retain > 50% of native groundstory vegetation around pond perimeter.
- Maintain natural water levels and seasonal fluctuations.
- Maintain water quality and quantity; keep ponds from filling with soil or woody debris.
- Where possible, retain all snags and logs within 100 feet of ponds.
- When ponds are present in even-age stands that require residual structure, plan retention structure around pond site to meet both features' recommendations.

Ephemeral (seasonal) forest pools

Justification: Forest pools that hold water through the spring and early summer provide essential breeding habitat for forest amphibians, such as wood frog and spotted, Jefferson, and

marbled salamanders. Such pools are free of fish, which are a major predator on the eggs and young of forest amphibians. While these species may breed in any soil depression holding water in late-winter or early-spring (e.g., tire ruts), naturally occurring breeding pools are preferable and should not be degraded.

Definition: Seasonal breeding pools most suitable for forest amphibians are relatively shallow, semi-permanent (holding water at least January-June), often shaded by forest canopy, and are free of fish. These pools typically occur on poorly drained forest soils and/or in places where the water table is close to ground surface.

Recommendations

- To protect the integrity of area around forest pools:
    - restrict heavy equipment from entering pools and immediate area around pool perimeter
    - remove no more than 50% of basal area within 100 feet of the pool
    - retain canopy cover over pool to encourage shading and limit evaporation
    - where possible, retain all snags and logs within 100 feet of pools.
- To provide cover for wildlife using pool, minimize disturbance to groundstory vegetation around perimeter of pool.
- Maintain natural water levels and seasonal fluctuations of pool.
- Maintain water quality and quantity; keep pools from filling with soil or woody debris.
- When pools are present in even-age stands that require residual structure, plan retention structure around pool site to meet both features' recommendations.

MAST TREES AND SHRUBS; FRUIT-PRODUCING VINES

Justification: Hard and soft mast are critical food resources for a wide variety of forest wildlife.

Recommendations

- Retain all native mast producing shrubs whenever possible, except where shrub growth interferes with the regeneration of important trees species and/or stand development. Retention of mast producing shrubs is particularly important within any residual structure reserved in large openings.
- Use mast trees to fulfill residual structure and live cavity tree requirements whenever possible.
- Retain wild grape vines except where their growth jeopardizes the integrity of regeneration openings and/or future stand development.

Monitoring, Reporting, and Evaluating the Availability of Compartment-level Wildlife Habitat Features

Monitoring habitat availability and quality are important aspects to wildlife habitat management. Some monitoring can be accomplished at the tract level using routine inventory

data collected in preparation for timber harvesting. These data will be useful for tract-level estimates of features such as snags, cavity trees, and roost trees to help determine appropriate retention quantities; however, the guidelines described in this document are applicable at the broader compartment-level. Appropriate compartment-wide estimates can include those calculated from cumulative tract-level inventories or those derived from other comprehensive monitoring programs, such as DoF's continuous forest inventory. Additional monitoring programs to estimate habitat availability will be coordinated by the Forest Wildlife Specialist on an as-needed basis. Properties should maintain data relating to habitat feature inventories in such a way that allows for efficient reporting at the tract- compartment- , and property-level. Properties are encouraged to spatially document where features such as ponds, pools, and wetlands occur, accurately delineating boundaries of these features whenever possible.

Trends in habitat feature abundance across compartments should be reviewed by the Forest Wildlife Specialist periodically to ensure appropriate availability is maintained on each DoF property. Furthermore, the needs of native forest wildlife species, especially those designated as Species of Greatest Conservation Need, should be evaluated on a similar periodic basis to make certain habitat requirements are addressed as new information becomes available. Updates and changes to these guidelines should occur when warranted, though such adjustments should continue to reflect applicability at the compartment scale and benefit the full compliment of native species residing on DoF properties.