# Indiana Division of Forestry
# Properties Section Wildlife Habitat Program
# 2009 Annual Report

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## Executive Summary

Monitoring wildlife habitat availability and use is essential to the sustainable management of forests. Healthy, productive forests provide a wide variety of habitats for a diverse array of species. The Wildlife Habitat Program of the Division of Forestry's Property Section is responsible for the monitoring and study of wildlife habitats on state forest properties and the effects of forest management activities on wildlife populations.

Several habitat monitoring and assessment programs have been developed for Indiana state forests in recent years. Monitoring programs track long-term changes in habitat availability or use, while assessment programs are intended to provide "snapshots" of conditions and impacts currently occurring on state forests. Programs have been designed to monitor changes in the abundance of important structural elements in forests, as well the availability and use of various community types across forest landscapes. Additionally, impacts on sensitive forest indicator or keystone populations are monitored in relation to forest change. Finally, the deer browse assessment program evaluates current impacts of state forest deer populations on forest vegetation and regeneration development.

## Snag and Cavity Tree Inventory

**Properties:** All properties that completed ≥1 tract management inventory in a given year.

**Purpose/Need:** Snags and live cavity trees are among the most important wildlife habitat elements found in forests. Snags are used by a wide variety of vertebrate and invertebrate species and are a critical part of healthy, functioning forest ecosystems. Cavity trees provide unique opportunities for the many species that nest, den, or roost within tree cavities and hollows. The Division of Forestry (DoF) manages snags and cavity trees by monitoring densities across each state forest property and working to ensure the abundance of each is maintained above minimum target levels.

**Project Objective:** Monitor snag and cavity tree abundance on each state forest property using data collected during tract management inventories and the Continuous Forest Inventory (CFI).

**Approach:** A portion of management tracts receive inventories each year on most state forest properties. Data from these inventories are summarized to produce annual estimates of snag and cavity trees density and contribute to a 3-year rolling average that provides a larger sample of tracts and more robust estimates. In most cases inventories are not completed in such a way that they are representative of forest conditions across properties, so estimates from annual tract inventories should be interpreted simply as "snapshots" of current snag and cavity tree densities. CFI data are collected systematically across properties to ensure results represent complete forest condition; therefore estimates from CFI data are likely to be the most accurate indicator of snag and cavity tree density. Property-level estimates from the CFI are available every five years, with the current inventory due for completion in 2013.

**Results**: Snag densities in ≥5" and ≥9" diameter classes exceeded DoF maintenance target densities and densities of large snags were consistent with maintenance levels in both the 2008-09 and 2007-09 inventories (Table 1). Densities of all snags >5" dbh greatly exceeded the optimal target level from DoF habitat guidelines. In relation to all public forestland in Indiana, the state forest 3-year averages in each size class meet or exceed snag densities reported from both reserved (no harvesting, e.g., nature preserves) and harvestable public lands (Table 2). Additionally, state forest snag densities meet or exceed those reported for all forestland (private and public) in Indiana. Perhaps most interesting is that state forest large snag densities greatly exceed those from reserved public lands, where timber harvesting is restricted. This may be a positive consequence of DoF snag management guidelines which includes routine snag inventory, retention, and creation through girdling.

**Table 1**. Average snag densities (snags per acre) across nine (2008-09) and ten (2007-09) Indiana state forest properties.

| | 2008-09 "Snapshot" (n=9) | | | | 2007-09 3-Yr Average (n=10) | | |
|---|---|---|---|---|---|---|---|
| | ≥5" dbh | ≥9" dbh | ≥19" dbh | | ≥5" dbh | ≥9" dbh | ≥19" dbh |
| **Avg. Density** | **11.6** | **5.4** | **0.58** | | **12.0** | **5.1** | **0.5** |
| **SD** | 3.97 | 2.15 | 0.41 | | 3.46 | 1.57 | 0.23 |
| **CV** | 0.34 | 0.40 | 0.70 | | 0.29 | 0.31 | 0.45 |
| **DoF Guidelines** | | | | | | | |
| **Maintenance:** | 4.0 | 3.0 | 0.5 | | 4.0 | 3.0 | 0.5 |
| **Optimal:** | 7.0 | 6.0 | 1.0 | | 7.0 | 6.0 | 1.0 |

**Table 2.** Snag densities (snags per acre) by size class and reserve status for all public forestland in Indiana. Complied from 2004-2008 FIA data, U.S. Forest Service; available online: http://fiatools.fs.fed.us/fido/index.html.

| | ≥5" dbh | ≥9" dbh | ≥19" dbh |
|---|---|---|---|
| **State Forests (2007-2009)** | **12.0** | **5.1** | **0.5** |
| **Reserved Public Forestland** | 11.9 | 1.9 | 0.23 |
| **Harvestable Public Forestland** | 11.4 | 3.5 | 0.31 |
| **All Indiana Forestland** | 11.2 | 3.7 | 0.47 |

Cavity tree densities exceed maintenance levels across all diameter classes (Table 3). Estimated densities from a 3-year average of inventories done 2007-2009 indicate cavity tree abundance exceeds optimal levels across all diameter classes.

**Table 3**. Average live cavity tree densities (trees per acre) across nine (2008-09) and ten (2007-09) Indiana state forest properties.

| | 2008-09 "Snapshot" (n=9) | | | | 2007-09 3-Yr Average (n=10) | | |
|---|---|---|---|---|---|---|---|
| | ≥7" dbh | ≥11" dbh | ≥19" dbh | | ≥7" dbh | ≥11" dbh | ≥19" dbh |
| **Avg. Density** | 6.8 | 5.0 | 1.8 | | 7.0 | 5.1 | 1.9 |
| **SD** | 4.7 | 3.91 | 1.52 | | 3.65 | 3.0 | 1.26 |
| **CV** | 0.69 | 0.78 | 0.86 | | 0.52 | 0.59 | 0.66 |
| **DoF Guidelines** | | | | | | | |
| **Maintenance:** | 4.0 | 3.0 | 0.5 | | 4.0 | 3.0 | 0.5 |
| **Optimal:** | 7.0 | 6.0 | 1.0 | | 6.0 | 4.0 | 1.0 |

## Large Log Survey

**Properties:** All properties that conducted a timber harvest in 2008 or 2009.

**Purpose/Need**: Large logs provide unique opportunities for many ground-dwelling species, including forest amphibians, reptiles, small mammals, and invertebrates. Though minimum standards exist for state forest properties, no formal inventories currently exist to monitor downed woody debris levels; although, standards for data collection will be included in the system-wide Continuous Forest Inventory after 2013. To determine if large log densities across harvested tracts meet DoF guidelines, a survey was conducted in 2009 at each property that had ≥1 harvest within the previous year.

**Project Objective**: Estimate large log densities across recently harvested tracts on state forest properties.

**Approach**: At each state forest property having had ≥1 timber harvest within 6 months prior to the survey, 1-2 managed tracts were selected for study. Tracts were chosen non-randomly, with those having large regeneration openings having highest selection priority. Large logs (≥11" large-end diameter, ≥4 foot length) were tallied along transects within tracts, following methodology described by Bate et al. (2008). Density estimates were calculated using SnagPro software (Bate et al. 2008). Logs were classified by the amount of decay using U.S. Forest Service Forest Inventory Analysis standards (Woodall and Williams 2005).

Pre-harvest large log density was estimated by including only logs with decay classes that indicated they been downed prior to harvest. This estimate of pre-harvest density is likely to be an underestimate as it ignores live trees with no decay that had fallen naturally prior to harvest.

**Results:** Post-harvest large log density estimates were considerably higher than the DoF minimum target of 2 per acre (Table 4). All tracts at all properties surveyed exceeded minimum standards by >400%, suggesting management activities typically used on state forest properties contribute to the large log resource and minimum targets for managed tracts are regularly exceeded. State forest post-harvest estimates were also much higher than state-wide estimates calculated from 63 forested FIA plots, even when considering the large variance associated with the FIA data (Table 4).

Estimates of pre-harvest levels are considered minimal as they likely underestimate true pre-harvest levels; these were similar to state-wide estimates but also considerably higher than DoF target density (Table 4).

**Table 4**. Average large log density (logs per ace) across 14 management tracts on 10 state forest properties and from 63 forested FIA plots sampled 2004-2008. FIA estimates obtained from data available online: http://199.128.173.17/fiadb4downloads/datamart.html.

| | State Forest Post-harvest | State Forest Pre-harvest (minimum) | Indiana FIA Plots |
|---|---|---|---|
| **Avg. Density** | 20.9 | 8.9 | 7.9 |
| **SD** | 5.69 | 4.83 | 15.28 |
| **CV** | 0.30 | 0.50 | 1.93 |

## Spring Resident Bird Monitoring Program

**Properties:** Yellowwood SF during pilot survey (2009-2010)

**Purpose/Need:** Unlike migratory species that only spend a portion of their life on state forest properties, residents use properties year-round and therefore have unique habitat needs. Ruffed grouse is an Indiana forest resident that requires

several habitat types during its life cycle, though appears most limited by its need for early successional forest patches during the breeding season. Woodpeckers are good indicators of standing dead wood (snags) availability and avian diversity in general. Woodpeckers are thought to be a "keystone" forest guild as they create habitat for other species by excavating cavities in live trees and snags. The presence and abundance of pileated woodpeckers, in particular, are thought to be an indicator of extensive mature forest habitat. These species are ideal indicators of unique forest habitat (ruffed grouse: early successional forest patches, pileated woodpeckers: large mature forest patches) and overall forest health and diversity (woodpeckers).

**Project Objectives:** 1) Initiate pilot project at Yellowwood SF in 2009-2010 to develop an efficient and effective methodology to monitor distribution, abundance, and occupancy rates for representative species of resident forest birds; 2) Initiate monitoring program at properties beyond Yellowwood SF in 2011.

**Approach:** Road-based point count surveys conducted during the last week of March and first two weeks of April. In 2009 25 stops along two routes were surveyed at YWSF for ruffed grouse only; in 2010 24 stops along two routes will be surveyed for both ruffed grouse and resident woodpecker species. Ruffed grouse were surveyed during a 4 minute passive listening period at each stop, where survey index value will be the number of males heard drumming at each stop. Starting in 2010 resident woodpeckers will be surveyed during a call-playback period immediately following the 4 minute passive listening period.

**Results:** Ruffed grouse drumming surveys were conducted March 27-April 9, 2009. Drumming individuals were heard at a total of 2 stops along one of two routes at YWSF. Across the two routes, an average 0.028 drums per stop were heard.

## Summer Migratory Bird Monitoring Program

**Properties:** Morgan-Monroe SF during pilot survey (2009-2010).

**Purpose/Need:** Many neotropical migrant bird species can serve as important indicators of forest condition and relative habitat availability. These species have well-known habitat preferences and strong fidelity to forest patches of a certain age or structural condition, particularly in regards to nesting habitat. Rates of occupancy for these representative "indicator" species across forested properties can suggest habitat availability for a suite of species needing similar habitat conditions. Monitoring changes in species occupancy, habitat availability, and forest condition over time are important to the management of forests and the species that use them.

**Project Objective**: 1) 2009-2010: Initiate pilot project at Morgan-Monroe SF to develop an efficient and effective methodology to monitor species distribution, occupancy, and abundance of forest birds of regional conservation concern that are also known to be representative of particular habitat types; 2) 2011: Initiate occupancy monitoring at properties beyond Morgan-Monroe SF.

**Approach:** Road-based point count surveys conducted late May through mid-June. In 2009 a total of fifty (50) listening stations are surveyed along two routes of gated and un-gated roads throughout Morgan-Monroe SF. At each stop the observer passively listened for the target species over a period of 6 minutes. Occupancy rates were calculated using the software Presence (Hines 2006).

For the 2009 survey, the following species were targeted: ovenbird, wood thrush, Acadian flycatcher, cerulean warbler, yellow-breasted chat, and blue-winged warbler. Target species were chosen because they 1) are found throughout forests in central and southern Indiana and 2) characteristically select breeding season habitat indicative of a particular intensity of forest disturbance. In 2010 hooded and prairie warblers will be added as target species.

**Results:** Mature forest species dominated Morgan-Monroe SF with 3 mature forest specialists (ovenbird, Acadian flycatcher, and wood thrush) occurring across an estimated 75-85% of the surveyed property (Table 5). Cerulean warbler, an endangered species in Indiana restricted to the most forested portions of the state, occupied approximately 38% of the survey area. The most habitat-restricted species at M-MSF was yellow-breasted chat, an area-sensitive species requiring large, regenerating forest patches. This species was heard at only 1 stop (estimated 2.1% property-wide occupancy), adjacent to a recent 5 acre regeneration opening.

**Table 5.** Occupancy rates of migratory forest breeding birds at Morgan-Monroe SF, May-June 2009.

| Species | Occupancy Rate | Habitat Type |
|---|---|---|
| Ovenbird | 0.850 | Mature Forest |
| Acadian Flycatcher | 0.756 | Mature Forest |
| Wood Thrush | 0.748 | Mature Forest |
| Cerulean Warbler | 0.378 | Mature Forest |
| Blue-winged Warbler | 0.221 | Shrublands, regenerating forest openings and edges |
| Yellow-breasted Chat | 0.021 | Shrublands, regenerating forest openings |
| ***Species to be added in 2010…*** | | |
| Hooded Warbler | | Mature forest with canopy gaps or dense understory |
| Prairie Warbler | | Shrublands, regenerating forest openings |

**Table 6.** Relative abundance, standard deviation (SD), and coefficient of variance (CV) of forest migratory breeding birds at Morgan-Monroe SF, May-June 2009.

| Species | Average Individuals/Stop | SD | CV |
|---|---|---|---|
| Ovenbird | 0.9 | 0.22 | 0.24 |
| Acadian Flycatcher | 0.472 | 0.056 | 0.12 |
| Wood Thrush | 0.478 | 0.203 | 0.42 |
| Cerulean Warbler | 0.114 | 0.122 | 1.07 |
| Blue-winged Warbler | 0.044 | 0.039 | 0.88 |
| Yellow-breasted Chat | 0.023 | 0.02 | 0.87 |

These results reflect the history of selection silviculture practiced at M-MSF. Single-tree selection has dominated timber harvests resulting in a generally closed-canopy, mature forest condition favorable to species such as ovenbird and wood thrush. The occasional creation of relatively small regeneration openings (typically $\leq$ 5 acres) has resulted in a limited amount of early successional forest-patch habitat for area-sensitive specialists such as the yellow-breasted chat.

Preliminary results of this pilot survey suggests monitoring these species over time will likely reflect any changes that may occur in the relative distribution of habitat types across state forest properties.

## Forest Amphibian Monitoring Project

**Properties:** In 2009 and 2010 breeding ponds were identified and mapped across state forest properties; pilot survey to be initiated on 1-2 properties to be determined in 2011.

**Purpose/Need:** Pond breeding forest amphibians are indicators of both aquatic and terrestrial habitat quality and availability and are one of the most imperiled vertebrate groups in North America. Pond-breeding frogs, toads, and salamanders are useful monitoring subjects because they congregate in pools and ponds during spring and summer breeding seasons and can be readily identified and located by their breeding calls or, in many cases, by their egg masses. Most forest amphibians range over relatively small areas, so changes in abundance or occupancy rates can typically be traced to relatively local habitat changes or other impacts. Monitoring changes in species occupancy, abundance, habitat availability, and forest condition over time are important to the management of forests and the species that use them.

**Project Objectives**: 1) 2009-2010: Identify and map forest amphibian breeding ponds across state forest properties; 2) 2011: Initiate pilot project to develop an efficient and effective methodology to monitor species distribution, occupancy, abundance, and reproductive success of forest amphibians on state forest properties.

**Progress to Date:** Hundreds of forest ponds have been identified across state forest properties and their location and condition included within a geodatabase maintained by DoF. Ponds will be visited in 2010 to evaluate condition and suitability for amphibian survey. Survey routes will be determined and monitoring will begin in 2011.

## Deer Impact Assessment Program

**Properties**: 2009 pilot assessment at Yellowwood SF; additional properties starting in 2010.

**Purpose/Need**: White-tailed deer herbivory can create profound changes in forest understory composition and structure that have long-term implications on forest development and health. Overabundant deer populations primarily affect ecosystem processes through excessive herbivory and can reduce abundance and change the developmental patterns of both herbaceous and woody plant species. Additionally, changes in forest understory plant communities from excessive herbivory can affect habitat quality for other wildlife species.

Excessive deer herbivory can be a challenging problem for forest managers tasked with sustaining healthy forest communities. Forest regeneration can be severely affected by deer herbivory and long-term successional patterns may be altered, perhaps permanently. Regeneration impacts include shifts in species composition, reduced stocking levels, and even total regeneration failure. Obvious impacts such as the appearance of browse lines and regeneration failures are extreme results of excessive browsing that occur at very high deer densities - generally when populations exceed 60% of ecological carrying capacity. However, subtle though important changes in forest plant communities can occur and much lower densities and may go undetected. Herbaceous and shrub species appear most vulnerable to heavy browsing pressure, though significant impacts have been frequently detected in forest regeneration even at relatively moderate deer densities. In light of this, and the long-term consequence of deer impacts on forest communities, deer browse assessment should be a fundamental practice for those managing forests within the range of white-tailed deer.

**Project Objectives**: To implement a deer browse impact assessment program for Indiana state forests that includes 1) periodic evaluation of browse pressure on forest regeneration, and 2) property-specific estimates of deer density.

**Approach**: Six (6) deer impact assessment areas (DIAA) were established and sampled at Yellowwood SF in 2009. To estimate browse impact on forest regeneration, 80 6-ft radius plots were systematically sampled within each DIAA. Within each plot browse rates (proportion of stems browsed) were estimated for each of 7 genera or species: oaks, maples, ashes, sassafras, yellow poplar, black cherry, and American beech. Though not sampled in 2009, hickories will be included starting in 2010. Browse impact was evaluated by species/genera across all individuals 1-5 feet tall that occurred within browse impact plots. For each species/genera browse intensity was classified as one of four categories: "no browse", "light" (< 50% browse), "moderate" ($\underline{\geq}$ 50% browsed but no hedge appearance), and "high" (100% browsed and most individuals have a hedged appearance). Additionally, several other metrics were measured in browse impact plots, including the percent cover of herbaceous vegetation.

Deer abundance was estimated using pellet group sampling within 2 of the DIAA. Pellet plots were sampled immediately after snowmelt in March, thus resulting abundance estimates represent over-winter populations. Pellet groups were sampled within 200 6-ft radius plots systematically sampled within each DIAA.

**Results**: American beech, oaks, and ashes were among the most often encountered species/genera in browse impact plots; each occurring in approximately one-third of all plots sampled at YWSF during the summer of 2009 (Figure 1). Maple showed the highest impact of browsing pressure, with 40% of plots in which it occurred classified as having 'high' browse intensity. Most maple stems showed at least 'moderate' levels of browsing; only 20% of plots with maple were classified as having 'low' or 'no' browsing activity on maple stems. Ashes, sassafras, and black cherry showed moderately-high impacts; each had approximately three-quarters of plots classified as having 'high' or 'moderate' impact levels. Just over one-half of plots with oaks and yellow poplar were classified as having 'moderate' or 'high' impact levels. As expected, American beech had the lowest browsing intensity level, with 82% of plots showing 'no' or 'low' levels of browse on the

species. Beech is generally believed to have low palatability to deer, and is typically only eaten as fresh stump sprouts or as a "stuffing" food of last resort.

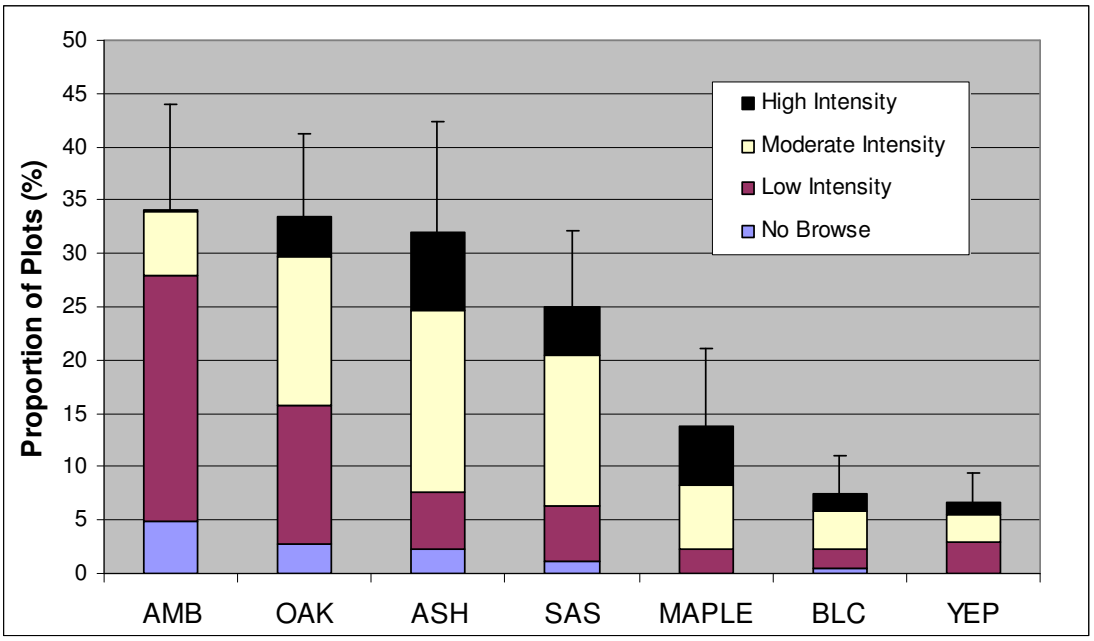
Overall, 'moderate' (≥50% of stems browsed) was the most common browse intensity classification across all palatable indicator species/genera (excluding American beech). The average proportion of plots classified as 'high' intensity was similar to those classified as 'low' intensity. Sixty-nine percent of plots had one or more species/genera with ≥50% of stems browsed ('high' and 'moderate' classifications combined).

Over-winter deer density was estimated on two DIAA using pellet sampling techniques. Average estimated density was 19.4 deer per square mile (SD = 0.8). This estimate likely represents a minimal annual estimate as it reflects the population after the hunting season and prior to the fawning season and recruitment.

Given an estimated population of approximately 20 deer/mi$^2$ and regeneration impacts generally classified as 'moderate', it is likely that deer browsing is negatively affecting the development and composition of forest regeneration at YWSF. Decades of research has resulted in a good understanding of how deer populations impact forest regeneration and development. In the northern hardwood forests of the northeastern U.S., deer populations have been found to impact regeneration composition at approximately 18-20 deer/mi$^2$ in forested areas where there is a limited availability of alternative, preferred food resources (e.g., agricultural crops) (Tilghman 1989, Marquis et al. 1992, Horsley et al. 2003). At this density level, where 'moderate' impacts are observed on regeneration, species shifts are likely to occur as deer preferentially browse some species and reduce their opportunity for recruitment in the stand, while species of no or low palatability to deer (like beech), are competitively favored by the relative lack of browse pressure. At YWSF beech was among the species most often encountered during sampling; this may be an effect of the focused browse pressure on more palatable competitors.

Negative impacts to forest herbaceous and shrub vegetation often occur at densities much lower than those necessary for species shifts in regeneration. At Yellowwood SF, low herbaceous cover (< 20% cover in all DIAA) was observed at levels comparable to estimates reported by Webster et al. (2001) for Indiana state parks that had "heavy" and "severe" damage from deer browsing. Future research at the Hardwood Ecosystem Experiment (http://www.heeforeststudy.org/) study area at YWSF should better quantify how deer are impacting forest vegetation and how browse-induced changes could shape the future forest community.

**Figure 1.** Average proportion of plots within each browse intensity category across six 1-mile$^2$ sampling areas at Yellowwood State Forest, summer 2009. Species/genera ranked by frequency of occurrence in browse intensity plots. Error bars show one standard deviation around the total proportion of plots averaged across sampling areas. AMB=American beech, OAK= all oaks, ASH=all ashes, SAS=sassafras, MAPLE=all maples, BLC=black cherry, and YEP=yellow poplar.

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