BIRD-FRIENDLY RECOMMENDATIONS FOR BOTTOMLAND FORESTS IN THE CAROLINAS: BIRDS AND PEOPLE ON COMMON GROUND

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Abstract—Bottomland hardwood forests have suffered tremendous losses in the United States. Yet they support some of the densest breeding populations of imperiled migratory song birds in the eastern US, providing nesting habitat for 49 species, 32 of which share some Conservation Status. Traditional management for bottomland hardwood forests in the southeast has tended to rely on one of two strategies- large scale clearcuts >50 acres, or no-cutting at all. As a conservation organization, Audubon and others have encouraged landowners, land trusts and conservation groups to seek the protection of bottomland hardwood forests and prescribe a "no-cut" policy to allow the forest to mature to an old growth climax community. Bottomland hardwood forests provide habitat for 140-200 species that use different niches in the forest structure. There are priority birds that require small scale openings (Swainson's warblers), some that that can tolerate thinning within the canopy (Prothonotary warblers), and some that cannot tolerate any disturbance (Red-eyed vireo). Audubon South Carolina set out to review available research in order to identify tolerance thresholds that could be incorporated into a forest management plan or conservation easement that would allow an alternative management regime, other than cut it all or cut nothing. A set of bird-friendly best management practices were identified to address the needs of the disturbance-dependent birds while not compromising the needs of the disturbance-tolerant species, and that allow some modest harvesting revenue. When these management practices are embedded at a landscape-scale where there are large tracts of no-disturbance, then the habitat needs of the entire suite of species can be addressed. Initial demonstration sites at Silver Bluff Audubon Center and Sanctuary in Jackson, SC successfully attracted the birds of interest. One year after three small clear cuts (1, 3, 5 acres) were logged within a 90-acre stand, the habitat now has shrubby thickets and sightings of Swainson's Warblers have been confirmed.

INTRODUCTION

Project Need

Bottomland hardwood forests have suffered tremendous losses in the United States, with as much as an 80 percent reduction in area (Abernethy 1987, Gosselink 1989, Twedt and others 1999). These very forests provided much of the best habitat for many forest interior bird species whose numbers have declined dramatically.

In the South Atlantic Coastal Plain of North and South Carolina today, bottomland hardwood forests associated with large river floodplains and blackwater swamps still provide much of the best remaining habitat for many of those birds, including several of conservation concern such as Swainson's Warbler, Prothonotary Warbler, Swallow-tailed Kite, and Chimney Swift. All four of these bird species have been assigned High Priority by the US Fish and Wildlife Service in its South Atlantic Migratory Bird Initiative (SAMBI) plan. The SAMBI is the mechanism within the Atlantic Coast Joint Venture (ACJV) to integrate and coordinate bird conservation efforts to meet habitat conservation goals and to address the regional priority suite of bird species identified for the South Atlantic Coastal Plain Region of the four national bird plans (North American Waterfowl Management Plan, Partners in Flight Southeast Regional Plan, US Shorebird Conservation Plan and the North American Waterbird Conservation Plan). Only two birds dependent on bottomland forests received the Highest Priority, Ivory-billed Woodpecker and Bachman's Warbler, and one or both of them are either extinct or teetering on the edge of extinction.

In South and North Carolina, there are two primary mechanisms for protecting large tracts of forest: through acquisition and management by public (state and federal) or nonprofit entities (Audubon, Land Trusts and The Nature Conservancy), and voluntary conservation easements by private landowners subject to Forest Management Plans. For example, large blocks of protected, mature and maturing bottomland

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Citation for proceedings: Schweitzer, Callie J.; Clatterbuck, Wayne K.; Oswalt, Christopher M., eds. 2016. Proceedings of the 18th biennial southern silvicultural research conference. e–Gen. Tech. Rep. SRS–212. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 614 p.

hardwood forests include the Savannah National Wildlife Refuge, Congaree National Park, Francis Beidler Forest, Lumber River, Waccamaw State Parks, and Roanoke River National Wildlife Refuge. There are also thousands of privately owned forest acres held under conservation easement. Collectively, these protected lands provide secure habitat for the species mentioned above and their habitat associates; however, much more bottomland habitat must be protected and compatibly managed to stabilize and increase their populations.

While managers and owners of such protected forests may choose to manage for maximum benefit of forest birds, forgoing most or all potential revenue from timber, many private bottomland forest owners cannot. Audubon South Carolina, and Audubon North Carolina and their conservation partners want to provide information to private landowners and managers describing how they can manage their forests to create and sustain habitat vital to some of the forest birds in greatest need, while also generating modest timber revenue.

Species Background – Clearcuts and Canopy Gaps

Swainson's Warbler is considered by many to be one of the most endangered songbirds in the Southeast (Savage and others 2010, Thompson 2005). In the southeastern coastal plain, this species is strongly associated with large blocks of bottomland hardwood forest, specifically dense stands of cane and palmetto and/or vine tangles which develop in natural or created canopy gaps (Wright 2002, Savage and others 2010).

Small scale canopy gaps are essential for many forest birds (Pashley and Barrow 1993, Hunter 2001, Moorman & Guynn 2001, Thompson 2005, Bowen 2007). Thompson (2005) reported that understory thickets (often in canopy gaps) provide important habitat for Swainson's Warbler, one of our surrogate species, and its associates. Artificially creating these gaps mimics a natural tree-fall event (Zimmerman 2010), similar to tornado touchdowns, lightning strikes, and hurricanes.

Thompson (2005) further stated that larger understory thickets provide better habitat than smaller ones. Thickets in Thompson's core Swainson's Warbler habitats at the Woodbury Tract study site (Britton's Neck, South Carolina) were larger (784 square meters/2.1 acres) than in the non-core areas (518 square meters/1.38 acres). That said, the best evidence available suggests that patch clear-cuts of at least two acres, located on the best high bottomland hardwood sites, should develop into productive habitat for Swainson's Warbler and its associates. Furthermore, Thomas (1996) states that creating small canopy openings, less than 4 ha (10 ac), will promote and sustain the growth of understory plant species, including cane (*Arundinaria* spp.).

To drive home the dense tangles point, Thompson (2005) describes Swainson's core breeding habitat as understory thickets "requiring a machete to traverse". She further states that thickets providing the best and most productive habitat occur on the highest bottomland hardwood sites, frequently dominated by cane, dwarf palmetto, greenbriar, peppervine, grape, poison ivy, and blackberry. Graves (2001) and Peters (1999) paint a similar picture of the structure and plant composition of Swainson's Warbler habitat. Stems and limbs of seedlings and shrubs frequently contribute to the jungle of vines, briars and other plant parts which collectively compose the nesting habitat for Swainson's Warbler (Graves 2002). The trees most commonly associated with the core breeding areas on Thompson's study area were sweetgum, red maple, ironwood, green ash and hawthorn. Those same trees species and others including laurel oak, water tupelo, elm species and persimmon describe Swainson's habitat at Audubon's Francis Beidler Forest (Brunswig 2012, personal communication). Thompson (2005) further described the most productive Swainson's understory thickets as being close to swamp sloughs but not cypress-tupelo flats and streams, with lots of dry leaves on the ground and little or no grass. They should also be as far as possible from a forest edge, ideally 1000 m or more, to reduce Brown-headed Cowbird parasitism (Twedt and others 1999). These high bottomland hardwood forest sites, where the best thickets develop, not surprisingly experience infrequent and short duration flooding, leaving the dry leaves on the forest floor loose, fluffy and easy to turn for the foraging warblers. In fact, a dense leaf litter layer seems to be an essential component of good Swainson's Warbler habitat (Savage and others 2010).

There is a real premium associated with locating these understory thickets in the best possible places. The best thickets allowed Swainson's to establish and defend smaller territories (1.19 ha vs 1.56 ha on the site at large), preserving energy for the males and allowing more pairs to utilize a portion of each thicket, resulting in clusters of birds in and near the best thickets (Meanley 1969, Thompson 2005). In such situations, Thompson (2005) describes them as semi-colonial. In the very best thickets, Swainson's sometimes produced two and rarely three successful broods, greatly increasing seasonal fecundity (Meanley 1969, Thompson 2005). According to Thompson, 90 percent of the Swainson's Warblers nesting in the high density area of her study site were located less than 5 meters from an understory thicket, with 2/3 nesting inside thickets. According to Graves (2002), scattered understory thickets were the most conspicuous characteristic of Swainson's Warbler breeding territories.

Thickets developed for Swainson's Warbler will provide good habitat for several other bottomland birds in need of conservation action, such as Hooded Warbler, Kentucky Warbler, White-eyed Vireo and Eastern Towhee. Kentucky Warbler and Eastern Towhee are rated High Priority and Hooded Warbler and White-eyed Vireo are rated Moderate Priority on the SAMBI list, providing the opportunity to assist a suite of birds with one management prescription.

While not used for nesting, understory thickets can provide good habitat for post-fledging Prothonotary Warbler families. At Francis Beidler Forest, these birds were frequently seen in late summer in a 10-acre thicket located more than 2000 feet from the nearest good Prothonotary Warbler nesting habitat (Personal Communication, Norman Brunswig). When planning to create new understory thickets, proximity to Prothonotary Warbler nesting habitat should be considered in the decision making process. Additionally, any bottomland hardwood stand located on the upland/wetland ecotone being considered for harvest by clearcut and natural regeneration, should be considered a likely future Swainson's Warbler nesting area and Prothonotary Warbler post-fledging habitat area (i.e. natural regeneration thickets).

Species Background – Bottomland Hardwood Thinning

In their studies of bird responses to bottomland hardwood forest management in 124 timber stands on 12 Louisiana wildlife management areas, Norris and others, (2009) reported that some interior species such as Red-eyed Vireo and Yellow-throated Vireo, which are most abundant in mature bottomland hardwood forests, experienced population declines in response to any forest harvest regime (individual selection, group selection or extensive harvest with more than a 40 percent reduction of canopy closure). For these species, maintaining large areas of closed canopy, interior forest is critically important. However, they also found that the densities of other species that prefer mature bottomlands with closed or near closed canopies, such as Prothonotary Warbler, Acadian Flycatcher and Yellow-billed Cuckoo, did not decline dramatically in response to selective timber harvest which did not reduce canopy closure to below 60-70 percent. Additionally, they found that eight other species, including Eastern Wood Peewee, Carolina Wren, Red-bellied Woodpecker and Wood Thrush, achieved their greatest densities in stands which had been harvested using single tree selection and maintaining the same 60-70 precent canopy closure limit.

It is important to note that three of the species mentioned above as not experiencing dramatic population declines in response to single tree selection (Prothonotary Warbler, Acadian Flycatcher and Yellow-billed Cuckoo), and two of the species that reached their greatest densities in stands which had been harvested using single tree selection, both with the minimum canopy closure limit of 60-70 percent, (Eastern Wood Peewee and Red-bellied Woodpecker) appear on the South Atlantic Migratory Bird Initiative (SAMBI) list of bottomland hardwood bird species needing conservation attention. Prothonotary Warbler, Yellow-billed Cuckoo and Eastern Wood Peewee are listed as High Priority and Red-bellied Woodpecker and Acadian Flycatcher as Moderate Priority.

To add additional weight to the very high conservation priority we assign to Prothonotary Warbler (US Fish and Wildlife Service Species of Conservation Concern), we should also acknowledge the special Responsibility Species status enjoyed by Prothonotary Warbler, Northern Parula, Yellow-throated Warbler and Yellow-throated Vireo, which are all bottomland hardwood species. All four species are also ranked as High Priority for conservation in the Partners in Flight Physiographic Plans and will respond well to no harvest and/or single tree selection harvest in bottomland hardwoods. The following is a list of the four Responsibility Species with an estimate of the total global population of each thought to nest in North and South Carolina (Partners in Flight Science Committee 2013): Northern Parula (11.5 percent), Yellow-throated Warbler (20 percent), Prothonotary Warbler (24.4 percent), and Yellow-throated Vireo (10.4 percent).

Results reported by Norris and others (1999) suggest that thinning established bottomland hardwood stands, using single tree selection which does not reduce canopy closure below 60-70 percent, improves habitat for several birds that need conservation action, while not dramatically degrading the habitat for several others that also need such help. Additionally, while small clearcuts can create habitat for Swainson's Warbler, thinning may improve their habitat too (Somershoe and others 2003).

For Red-eyed Vireo, Yellow-throated Vireo and other species which are very sensitive to any opening of the canopy, large areas of no-harvest forest should be retained where possible. This outcome might be achieved by thinking and planning across ownership boundaries, such that nearby stands and forests known to be managed with a mature, old growth, no-cut philosophy and likely to remain so can meet the needs of the Red-eyed Vireo and its associates, freeing other landowners and managers to practice other bird-friendly forestry activities.

RESULTS AND DISCUSSION

Bird Friendly Best Management Practices Recommendations

In this program, the Prothonotary Warbler and Swainson's Warbler will serve as surrogate species for the several other birds which share similar structural habitat requirements. It is estimated that North and South Carolina support 22 percent of the global population of nesting Prothonotary Warblers and 12 percent of Swainson's Warblers (Partners in Flight Science Committee 2013), so intentional management for these species is particularly important. Because we have such a high percentage of their global populations, we have both great responsibility and great potential to help them.

Given the dual and equally important goals of optimizing both understory thickets for Swainson's Warbler and its allies, and mature interior forest habitat for Prothonotary Warbler and its allies, the prevailing criteria that we suggest for bird-friendly bottomland hardwood management will be staying above 60-70 percent canopy closure across large bottomland hardwood forest landscapes, and limiting the total area of forest which falls below 40 percent canopy closure to 10 percent of any given bottomland hardwood forest that is greater than 2,000 acres. Means for achieving these management suggestions are outlined below. Note that the below suggestions are adapted from, at least in part, the Lower Mississippi Valley Joint Venture's recommendations for forest types in that area (LMVJV Forest Resource Conservation Working Group 2007), as well as the available literature in the species review to follow.

Desired Habitat Condition Options: No Harvest

Landowners that desire to create and/or maintain old growth on part or all of their bottomland hardwood forest, and timber revenue is not a major concern, should certainly do so. In such cases, obviously, no harvest is needed. Many interior forest bird species, such as Prothonotary Warbler, Red-eyed Vireo and Yellow-throated Vireo, find their very best habitat in such undisturbed forest stands. These lands can function as the old-growth cores, around and adjacent to which other owners in the landscape can provide the other forest habitat types and successional stages.

Desired Habitat Condition Options: Modified Approach

When some revenue is desired, multiple clear-cuts of up to 10 acres in size, up to 10 percent of the forest stand, could be recommended to create regenerating, dense understory habitat (aka "thickets"). Thickets can be isolated or near one another. In the latter situation, two or more thickets might be connected by a single skid trail, to minimize the area of disturbance and fragmentation resulting from a larger single cut, and avoid multiple loading decks. The result would be a "string of pearls" harvest design (fig. 1a). An alternate design would be to locate the loading deck in the middle and cut patches like spokes of a wheel (fig. 1b). Foresters should also consider the surrounding forest landscape when deciding upon the location of clearcuts. If possible, avoid placing clearcuts adjacent to existing early-successional habitat, such as agricultural land, even if such land is on a different stand or belongs to a different landowner.

It is also a recommendation to "feather" the edges of any clearcuts to soften the edge effect (fig. 2). This will help prevent nest parasitism by the Brown-headed Cowbird. Brown-headed Cowbirds are brood parasites, meaning that they lays their eggs in nests of other species. The foster parents then unknowingly raise the young cowbirds, usually at the expense of their own offspring. Cowbird eggs require a shorter incubation period than most other songbirds and thus usually hatch first. Cowbird nestlings also grow large very quickly. These advantages allow them to command the most food from their foster parents, usually resulting in reduced nesting success of the host species.

Feathering edges—If clearcuts alone do not provide a sufficient economic opportunity to justify a harvest, landowners can thin bottomland hardwood forest stands using single tree selection, so long as they do not reduce the canopy closure from 90 percent (fig. 3a) to below 60 percent-70 percent (fig. 3b). Foresters can select trees for removal based on whatever silvicultural prescriptions or other goals they have, such as but not limited to improved species composition, release of residual trees, maximizing mast trees, or maximizing revenue. Using a variety of techniques, foresters can estimate the before-treatment canopy closure and the impact on canopy closure of the removal of each tree as it is being marked for harvest.
If understory thickets are to be created by multiple clearcuts and a stand-wide thinning is to take place as parts of the same harvest operation in the same stand, it is important to mark the thickets (clearcuts) first, to know how many acres and how much canopy opening will result from them before marking the thinning.

When determining the number and size of understory thickets to be created in a particular stand, the canopy openings generated from the combined harvest (clearcuts and thinning) must be included in the total canopy opening estimate. To reiterate, for the best possible bottomland hardwood bird habitat conservation outcome, clearcuts should occupy no more than 10 percent of a given stand and all accompanying thinning should not reduce canopy closure below 60-70 percent. We feel that these

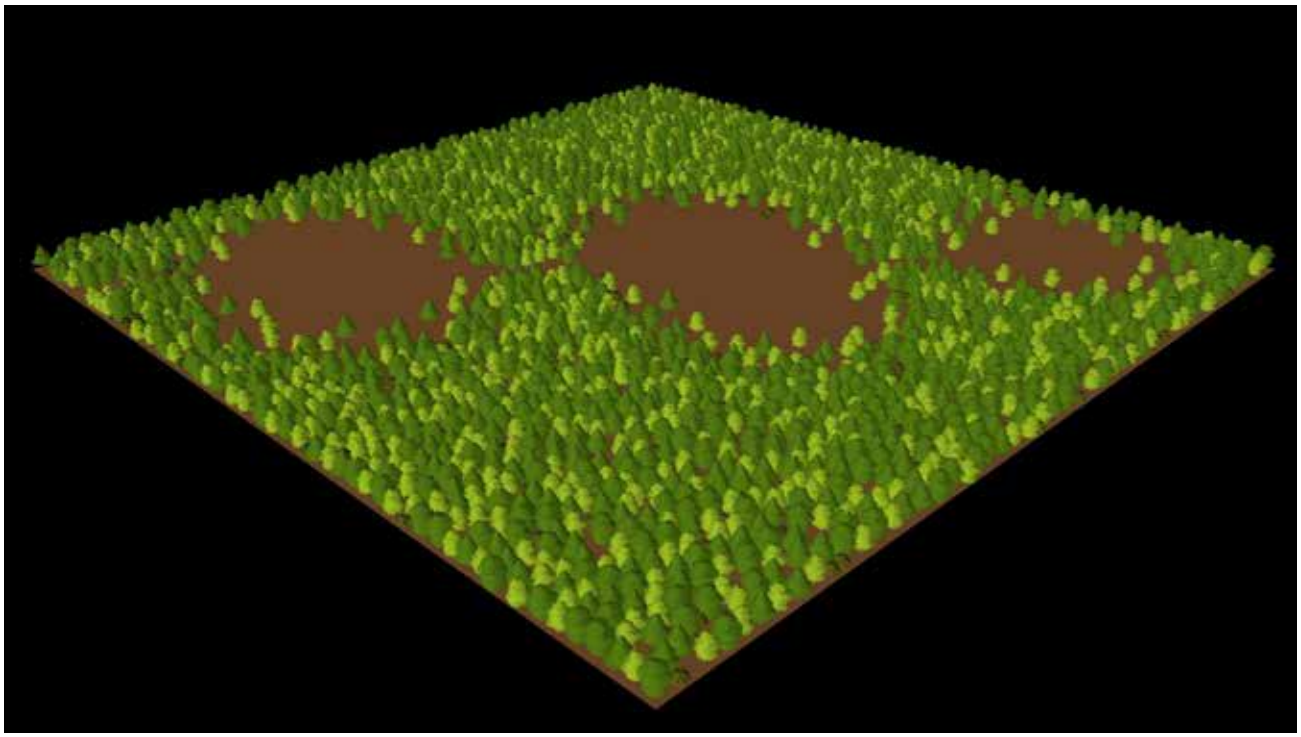

Figure 1a—String of Pearls.

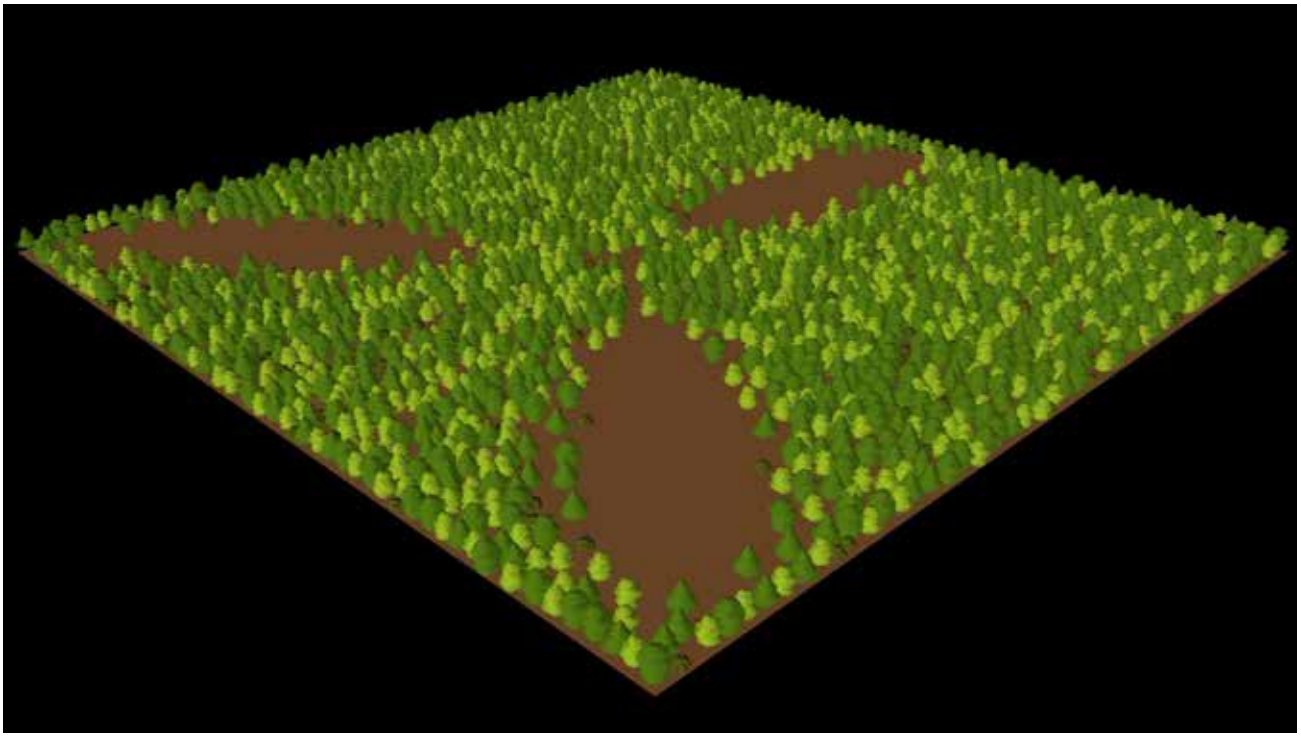

Figure 1b— Spokes of Wheel.

Figure 2—Feathered Edges of Clearcut.

Figure 3a—95 percent canopy closure, looking up from within stand.

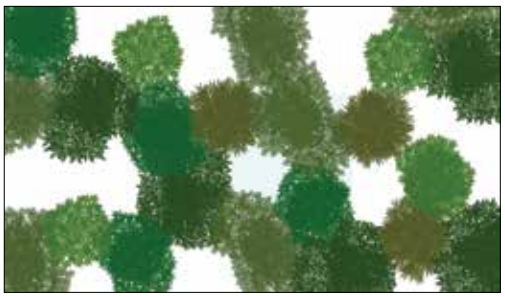

Figure 3b—65 percent canopy closure.

recommendations do the best possible job of benefiting both birds and landowners in this forest type.

Additional Species to Consider

Swallow-tailed Kites represent another priority species of southeastern bottomland forests (listed as High Priority on the SAMBI plan). These kites forage over bottomland hardwood forests and cattle pastures proximal to them, and nest in super-emergent trees such as bald cypress in floodplains and loblolly pines in or near swamps or on swamp islands. Simple steps such as retaining very tall cypresses or other trees in swamp Streamside Management Zones and elsewhere in and near bottomlands can create and sustain habitat for this elegant, charismatic bird. Similarly, electing to retain very tall swamp loblolly pines wherever they exist can also provide this important nesting habitat. Yellow-throated Warbler, which has an affinity for bald cypress in bottomland forests, may also be benefitted by retaining tall cypresses (Graber 1983, Hall 1996, Gabbe 2002).

Chimney Swift nest in hollow trees, in addition to the chimneys from which they derived their name. Retaining large, hollow trees of any species in bottomland hardwood stands can help support this remarkable insect eating bird. In the case of cypress, the needs of both Swallow-tailed Kite and Chimney Swift might be met with the same conservation action.

CONCLUSIONS

Audubon has demonstrated bird friendly forest management practices at their 3,250 acre Silver Bluff Audubon Center and Sanctuary to improve diversity of habitat in bottomland hardwood forests by adjusting the management. Staff logged three small clearcuts totaling 9 acres within a 90 acre even-aged bottomland hardwood stand and thinned an additional 70 acres, keeping the overall canopy closure to >60 percent. (fig. 4). An additional 10 acres within the stand were left undisturbed as a buffer along the Savannah River. The management followed the recommended thresholds that can be tolerated by most interior species, while allowing for new openings to develop into early successional habitat to support additional species such as Swanson's Warblers. Given that the 90 acre stand is embedded in an expansive landscape >7,000 acres of undisturbed bottomland hardwoods, the silvacultural activities address all the suites of species. The demonstration site has been a focal point at multiple outreach workshops for foresters and landowners. It has been one year since the clearcuts were completed. In May 2015, Swainson's warblers were sighted and heard in the recent clearcuts, and the majority of the disturbance tolerant species have also returned to the portions of this forest stand that were thinned. The canopy that was thinned to 60 percent has been restored to almost 90 percent. When the canopy closure of the clear cuts reaches 95 percent,

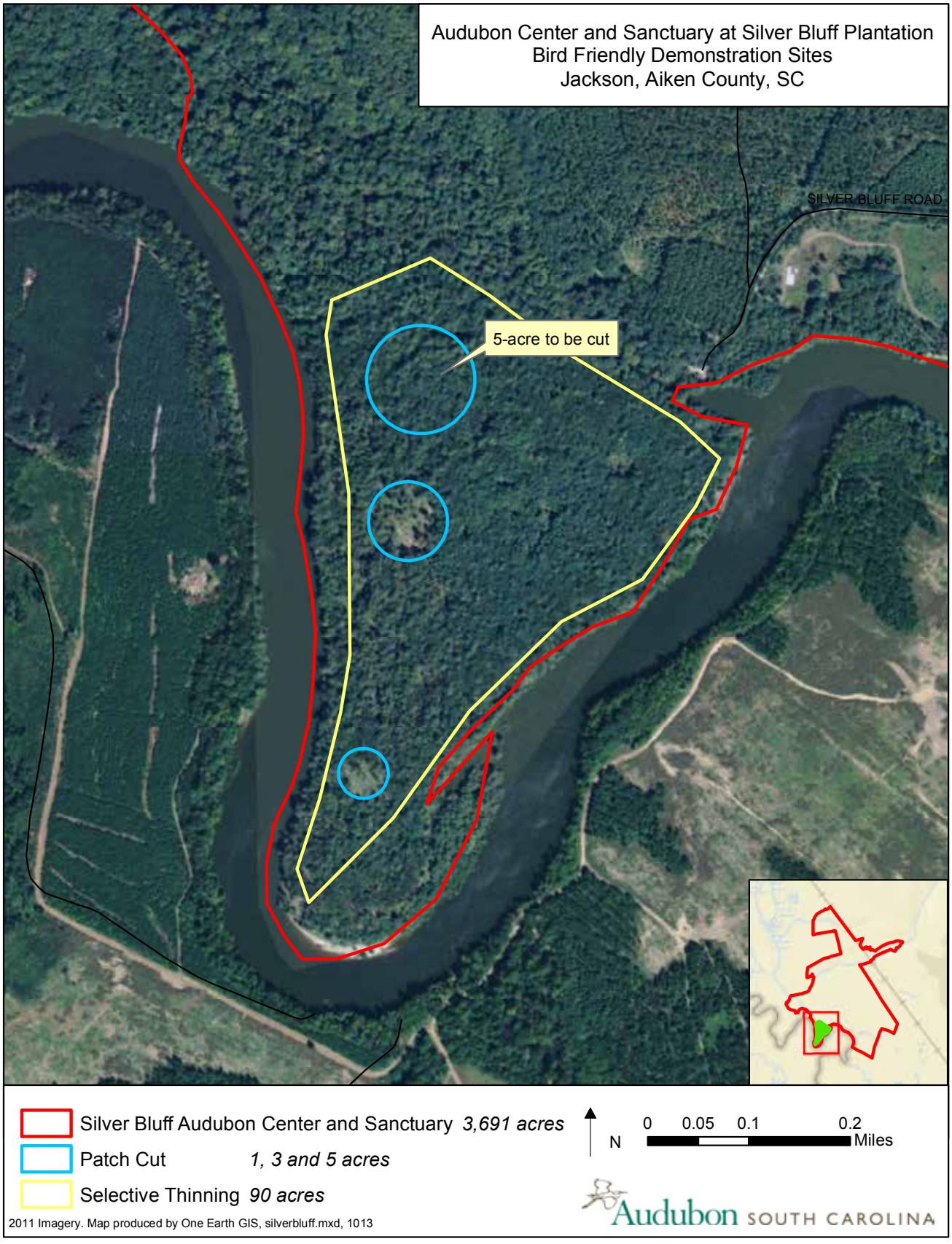

Figure 4—Thinning and Clearcut at Silver Bluff 90 acre Island.

expected in 5-7 years, Audubon will identify and cut an additional 10percent of the mature forest. Forty-five acres along the east side of the stand will not be disturbed and instead, allowed to revert to old growth bottomland forest. Thinning, as needed to continue to create new habitat, will be allowed in this part of the stand. Following the successful implementation at the Silver Bluff demonstration site, Audubon South Carolina is seeking to replicate their success at a similar demonstration site on the 17,000 acre Audubon Center and Sanctuary at Francis Beidler Forest in Dorchester County, SC.

ACKNOWLEDGMENTS

Audubon South Carolina appreciates the efforts and guidance of its partners, including American Forest Management, Audubon North Carolina, Audubon Vermont, and Lowcountry Open Land Trust. In addition, Audubon appreciates Together Green, an Audubon program funded by Toyota, for providing the startup funds for this project, and Sustainable Forestry Initiatives, Inc. for continuing to fund the research and outreach efforts.

LITERATURE CITED

Abernethy, Y. A. 1987. U.S. forested wetlands:status and changes 1940-1980. Biosciences. 37: 721-727.

Bowen, L. C. 2007. Seasonal bird use of canopy gaps in bottomland forest. Wilson Journal of Ornithology. 119: 77-88.

Gabbe, A. P. 2002. Tree-species preferences of foraging insectivorous birds: implications for floodplain forest restoration. Conservation Biology. 16: 462-470.

Gosselink, J. A. 1989. Cumulative impact assessment in bottomland hardwood forests. Wetlands. 9: 89-174.

Graber, J. R. 1983. Illinois birds: wood warblers. Champaign, IL: State of Illinois, Department of Energy and Natural Resources, Natural History Survey Division. Biological Notes. 118: 144 p.

Graves, G. 2001. Factors governing the distribution of Swainson's Warbler along a hydrological gradient in the Great Dismal Swamp. Auk. 118(3): 650-664.

Graves, G. 2002. Habitat characteristics in the core breeding range of the Swainson's Warbler. Wilson Bulletin. 114(2): 210-220.

Hall, G. 1996. Yellow-throated warbler (*Dendrocia dominica*). In: A. Poole and F. Gill (eds.), The Birds of North America, No. 223. Philadelphia, PA: Academy of Natural Sciences, and The American Ornithologists' Union, Washington, D.C. Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/223 doi:10.2173/bna.223. [Date accessed unknown].

Hunter, W. D. 2001. Conservation of disturbance-dependent birds in eastern North America. Wildlife Society Bulletin. 29: 440-455.

Meanley, B. 1969. Pre-nesting and nesting behavior of the Swainson's Warbler. Wilson Bulletin. 81(1): 246-257.

Moorman, C. E.; Guynn, D.C. 2001. Effects of group-selection opening size on breeding bird habitat use in a bottomland forest. Ecological Applications. 11: 1680-1691.

Norris, J. M.; Chamberlain, M.J.; Twedt, D.J. 2009. Effects of wildlife forestry on abundance of breeding birds in bottomland hardwood forests of Louisiana. Journal of Wildlife Management. 73(8): 1368-1379.

Partners in Flight Science Committee. 2013. Population Estimates Database, version 2013. http://rmbo.org/pifpopestimates. [Date accessed: December 11, 2014].

Pashley, D.N.; Barrow, W.C. 1993. Effects of land use practices on neotropical migratory birds in bottomland hardwood forests. In: Finch, D; Stangel, P., eds. Status and management of neotropical migratory birds. Gen. Tech. Rep. RMRS-229. Fort Collins, CO: U.S. Department of Agriculture Forest Service, Rocky Mountain Research Station: 315-320.

Peters, K. 1999. Swainson's Warbler (*Limnothlypis swainsonii*) habitat selection in a managed bottomland hardwood forest in South Carolina. Raleigh, NC: North Carolina State University. 91 p. M.S. thesis.

Savage, A. L.; Moorman, C.E.; Gerwin, J.A.; Sorenson, C. 2010. Prey selection by Swainson's warblers on the breeding grounds. The Condor. 112: 605-614.

Somershoe, S.G.; Hudman, S.P.; Chandler, C.R. 2003. Habitat use by Swainson's Warblers in a managed bottomland forest. Wilson Bulletin. 115(2): 148-154.

Thomas, B. W. 1996. Habitat selection and breeding status of Swainson's Warblers in southern Missouri. Journal Wildlife Management. 60(3): 611-616.

Thompson, J. 2005. Breeding biology of Swainson's Warblers in a managed South Carolina bottomland forest. Raleigh, NC: North Carolina State University. 177 p. Ph.D. dissertation.

Twedt, D.J., Wilson, R.R.; Henne-Kerr, J.L.; Hamilton, R.B. 1999. Impact of forest type and management strategy on avian densities in the Mississippi Alluvial Valley, USA. Forest Ecology and Management. 123(2-3): 261-274.

Twedt, D.J.; Loesch, C.R. 1999. Forest areas and distribution in the Mississippi Alluvial Valley: implications for breeding bird conservation. Journal of Biogeography. 26: 1215-1224.

Wilson, R.; Ribbeck, K.; King, S.; Twedt. eds. 2007. LMVJV forest resource conservation working group. Restoration, management, and monitoring of forest resources in the Mississippi Alluvial Valley: recommendations for enhancing wildlife habitat. Vicksburg, MS: Lower Mississippi Valley Joint Venture Office. 137 p.

Wright, E.A. 2002. Breeding population density and habitat use of Swainson's Warbler in a Georgia floodplain forest. Athens, GA: The University of Georgia. 99 p. M.S. thesis.

Zimmerman, J.A. 2010. Habitat relationships of breeding birds in bottomland hardwood forests of the Altamaha River, Georgia. Statesboro, GA: Georgia Southern University. 73 p. M.S. thesis.