Managing for Red-cockaded Woodpeckers and Neotropical Migrants—Is there a Conflict?

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Abstract Because managing pine habitats for red-cockaded woodpeckers (*Picoides borealis*) may result in reductions in habitat for certain neotropical migrant species, an apparent conflict exists between these species when managing stands of pine. However, other high priority species are likely to increase in areas managed for red-cockaded woodpeckers. The Partners in Flight prioritization scheme and research on bird-habitat relationships indicate that most high priority neotropical migrants in the East Gulf Coastal Plain are managed for best in bottomland hardwoods. In contrast, most high priority temperate migrant and resident bird species prosper in mature open pine habitat. Management conflict disappears when managing for red-cockaded woodpeckers and other pine associated species on a landscape scale. This process has ramifications for developing strategies to effectively conserve biodiversity in managed areas.

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Wildlife management efforts in the past have been aimed largely at individual or groups of species (e.g., game, endangered, or management indicator species), rather than ecosystems. Potential conflicts may arise as more holistic concepts based on ecosystem approaches, now being adopted by many agencies, are introduced into areas where public focus tends to be on one resource issue at a time. One potential conflict in the southeastern United States is the management of public lands for mature pine-dominated habitats for recovery of endangered red-cockaded woodpeckers (e.g., U.S. Dep. Agric., Forest Service 1993).

Existing legislative requirements to manage for the specific habitat needs of some endangered species, such as red-cockaded woodpeckers, seem contradictory to providing a variety of habitat features at the scale of a forest stand

typically promoted for many game and nongame species. Management for red-cockaded woodpeckers typically requires removal of hardwoods in mature pine-dominated stands (U.S. Fish and Wildl. Serv. 1985), which can reduce habitat for many nongame species, including neotropical migratory land birds (Johnston and Odum 1956, Meyers and Johnson 1978). This apparent management conflict leads to the perception that one species may benefit at the expense of many other species, and may require resource managers to consider tradeoffs.

Reversing population declines of neotropical migratory land birds, many of which favor hardwood-dominated habitats in the southeast, is the focus of Partners In Flight, an international conservation initiative (Finch and Stangel 1993). The purpose of the present paper is to show how the Partners in Flight prioritization scheme, in concert with a knowledge of bird-habitat relationships, can be used to determine regional habitat management goals for nongame and endangered species. We select one southeastern physiographic area and develop a scenario involving both red-cockaded woodpecker recovery and conservation of neotropical migrants.

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Methods

Description of Focus Area

The East Gulf Coastal Plain (EGCP) Physiographic Area covers southeastern Louisiana, the Florida panhandle, much of western Tennessee and southwestern Kentucky, all of Mississippi outside the alluvial plain, and all of Alabama below the fall line. The lower coastal section of the EGCP historically supported expansive pine savanna, flatwood, and sandhill ecosystems, with bottomland hardwoods broadly bordering rivers. Upper coastal plain forests consisted primarily of oak-hickory and pine forests in the uplands, with narrower forested riparian zones than found in the lower coastal plain. All these forest types are greatly reduced compared with historical distributions (Martin et al. 1993*a, b*). This reduction is due in large part to expansion of commercial forestry, agriculture, and development, as well as suppression of natural disturbances such as flooding and growing (warm) season fires.

Setting Priorities

The prioritization scheme used by Partners in Flight identifies those birds likely in need of conservation attention (Hunter et al. 1993*a*). Seven ranking criteria, each scored from 1 to 5 points, were used to establish priorities based upon characteristics of species that make them vulnerable: (1) global abundance; (2) global extent of breeding and (3) non-breeding distributions; (4) threats during breeding and (5) non-breeding periods; (6) population trend; and

(7) importance of the area under consideration for conservation of the species. The Southeast Management Working Group of Partners In Flight (SEPIF) identified species scoring 24 or more out of a possible 35 points as requiring the most conservation attention (Table 1). To move toward ecosystem-based management, these high priority species were grouped into assemblages representing high priority habitats (Hunter et al. 1993*b*).

Identifying Habitat Relationships

Hamel (1992*a*) provided a qualitative assessment of bird-habitat relationships by identifying the suitability of broadly defined seral stages (i.e., grass/forb, shrub/seedling, sapling/poletimber, and sawtimber) for land birds found in each forest type. Each habitat is considered optimal, suitable, or marginal for each bird species. Although qualitative in nature, these hypotheses can guide managers on defining desired future conditions necessary to support species of highest concern.

Estimating Spatial Requirement Targets

Understanding the spatial requirements needed to support populations of the most area-sensitive high priority species is necessary for planning effective conservation for entire assemblages of high priority species. Unfortunately, data bases do not exist for estimating species' spatial requirements in most areas (however, see Robbins et al. 1989). Although species' specific spatial requirements mostly remain unknown, the existence of such requirements (even if undefined) is not an issue.

Although Soulé (1987) cautioned that population size should be calculated separately for each species, he guessed that a population of several thousand should be adequate for vertebrates. Similarly, Thomas (1990) recommended population sizes from several thousand to 10,000. The SEPIF strategy is to provide a good number and distribution of "source" (sensu Pulliam 1988) populations for the most area-sensitive high priority breeding species based on opportunities provided through cooperating public and private land managers. SEPIF assumes that in most cases these populations will exist in actively managed forests with various silvicultural and other land use objectives, in contrast to passively managed set-asides or wilderness areas. SEPIF further assumes there will be relatively free interchange among breeding populations, potentially raising the effective population size within a physiographic area into the tens of thousands with an adequate number of source populations.

Our best estimate is that at least 1,000 breeding individuals (i.e., 500 pairs) are required in a single habitat patch to constitute a source population. Breeding density estimates (e.g., Hamel 1992*a*) are multiplied by the number of pairs desired (i.e., 500) to support a source population. Other literature is examined for empirical determinations of habitat patch size for certain species (e.g., Hamel 1992*b*). A final step in this process is to determine the number and distribution of source populations desired within and among physiographic areas. Fac-

Table 1. Concern scores and broad forest habitat preferences for high priority land birds of the East Gulf Coastal Plain. For details on how concern scores were derived, see Hunter et al. (1993*a*). O = Optimal, S = Suitable, adopted with modifications from (Hamel 1992*a*).

Residency group/ Species	Concern score[a]	Forest types[b]					
		PSAV	SHLL	LLSL	LBSH	OGCY	MPHW
Neotropical Migrants							
American swallow-tailed kite (*Elanoides forficatus*)	25					O	
Yellow-billed cuckoo (*Coccyzus americanus*)	25					O	S
Chuck-will's widow (*Caprimulgus carolinensis*)	24				O		O
Great crested flycatcher (*Myiarchus crinitus*)	24		S	S	S	O	O
Wood thrush (*Hylocichla mustelina*)	25				S	O	S
Bachman's warbler[c] (*Vermivora bachmanii*)	35					O	
Prairie warbler (*Dendroica discolor*)	24		S	S	S		O
Cerulean warbler (*Dendroica cerulea*)	25					S	
Prothonotary warbler (*Protonotaria citrea*)	28					O	
Swainson's warbler (*Limnothlypis swainsonii*)	29					O	
Orchard oriole (*Icterus spurius*)	24						
Temperate Migrants[d]							
Southeastern American kestrel (*Falco sparverius paulus*)	25/25	S					
Eastern Bewick's wren (*Thryomanes bewickii bewickii*)	28/30						
Loggerhead shrike (*Lanius ludovicianus*)	24/26	S					
Bachman's sparrow (*Aimophila aestivalis*)	35/27	O	S	O	O		S
Field sparrow (*Spizella pusilla*)	24/26		S	S	O		O
Henslow's sparrow (*Ammodramus henslowii*)	–/29	O		O			
Residents							
Northern bobwhite[c] (*Colinus virginianus*)	22	O	S	S	O		O
Mississippi sandhill crane (*Grus canadensis pulla*)	35	O					
Red-cockaded woodpecker (*Picoides borealis*)	33	S	O	O	O		
Ivory-billed woodpecker[c] (*Campephilus principalis*)	35					O	
Brown-headed nuthatch (*Sitta pusilla*)	26	S	O	O	O		

Table 1. *(continued)*

[a]Specific scores on file with senior author.
[b]PSVA = pine savanna, SHLL = longleaf sandhills, LLSL = longleaf/slash flatwoods, LBSH = loblolly/shortleaf, OGCY = oak-gum-cypress, MPHW = pine-hardwood mix.
[c]These species are not considered further as no populations are presently known in area.
[d]Breeding and wintering populations are scored separately for area importance and total score.
[e]Northern bobwhite is of considerable management interest and is included here, even though it is not among the highest scoring species.

tors to consider in accomplishing this last step include habitat availability and potential, size of the planning area, and the location of the area relative to the center of a species breeding range. We encourage additional research to improve upon the estimates we list here, but these estimates are starting points for managers interested in proactive bird conservation that can be modified as more information is generated.

Defining Future Desired Condition

Specific microhabitat requirements differ among species found in the same general forest type, suggesting that management must provide the full diversity of habitat conditions necessary to support all high priority species as well as their spatial requirements. Therefore, preliminary descriptions of future desired condition, and some of the techniques leading to these condition, are provided to cover the habitat needs of all high priority species within each forest type. Again, additional research is necessary to improve upon the preliminary desired future conditions described here.

Results and Discussion

High priority species within the EGCP include temperate migrants, residents, and neotropical migrants (Table 1). Mature hardwood and pine forest types collectively support all but two of the high priority breeding species (i.e., eastern Bewick's wren [*Thryomanes bewickii bewickii*] and orchard oriole [*Icterus spurius*]). While certain forest types are undoubtedly important locally for breeding species (e.g., remnant oak-hickory, southern mixed mesic) or for wintering and migrating populations (especially coastal woodlands) and should not be ignored, most EGCP managers work in more widespread forest types. Thus, the following strategies and descriptions of desired future conditions for mature pine, oak-gum-cypress, and pine-hardwood mix forest types should assist in establishing management priorities for the majority of species of concern in the EGCP.

Mature Pine Forests

Recovery of red-cockaded woodpecker populations will be accomplished only where large patches include mature and overmature pine forests managed for the special foraging and nesting habits of this species (U.S. Fish and Wildl. Serv. 1985). Public lands provide the greatest opportunity for the species' recov-

ery, especially in managed areas exceeding 50,000 ha (U.S. Dep. Agric., For. Serv. 1993; also see Reed et al. 1988). This habitat patch size assures enough appropriately managed pine habitat will be available at all times to support a recovered population. In keeping with a landscape view, a patch size of 50,000 ha or more was established assuming non-pine sites (e.g., bottomland and upland hardwood sites), pine regeneration sites, and other landscape features also will be present and unavailable to woodpeckers within any given patch. In addition, pine-dominated ecosystems within areas less than 50,000 ha under public or cooperating private land management support important woodpecker populations. These smaller populations need to be maintained as the species is recovered (U.S. Dep. Agric., For. Serv. 1993). Regardless of patch size, appropriately managed pine-dominated ecosystems also provide habitat for other high priority species (Table 1).

In the EGCP, the pine savanna forest type provides the primary habitat for several species of high concern (Table 1, 2). Resident Mississippi sandhill cranes (*Grus canadensis pulla*) are endangered and restricted to sparsely stocked pine savanna in the EGCP (U.S. Fish and Wildl. Serv. 1991). Temperate migrant loggerhead shrikes (*Lanius ludovicianus*) occur primarily in pine savanna among available forest types, even though this species is more widespread in non-forested habitats in the EGCP (Hamel 1992*a*). Other species optimally using sparsely-stocked pine savanna include resident northern bobwhites (*Colinus virginianus*) and temperate migrant Bachman's sparrows (*Aimophila aestivalis*) and Henslow's sparrows (*Ammodramus henslowii;* winter only). Southeastern American kestrels (*Falco sparverius paulus*), red-cockaded woodpeckers, and brown-headed nuthatches (*Sitta pusilla*) may be found if longleaf (*Pinus palustris*) or slash (*P. elliottii*) pines are old enough for cavities.

Forests managed for red-cockaded woodpecker recovery exceed spatial requirements for all other high priority species optimally using longleaf/slash pine flatwoods, longleaf sandhills, and loblolly (*P. taeda*)/shortleaf (*P. echinata*) forest types (Table 2). Support of source populations for other pine species such as northern bobwhite, brown-headed nuthatch, and Bachman's sparrows also may require attention to spatial requirements (Table 2). All of these pine specialists, in addition to wintering Henslow's sparrow populations, are especially common in longleaf pine habitats where reduction of hardwoods through frequent warm season fires is essential for maintaining a healthy and functioning ecosystem (Abrahamson and Hartnett 1990, Myers 1990). Careful management of other southern pine forest types, including a combination of cool and warm season burning and mechanical removal of hardwoods, can also provide optimal habitat for many of these same species (Table 2).

Among high priority neotropical migrants only prairie warblers (*Dendroica discolor*) unequivocally benefit from management favoring red-cockaded woodpeckers. Both species were most closely associated historically with fire-maintained pine ecosystems (Nolan 1978). Prairie warblers throughout most of their distribution today are associated most closely with early-successional habi-

Table 2. Preliminary description of future desired condition and management prescription for sawtimber pine-dominated forest types in the East Gulf Coastal Plain. Details are based on best information for supporting populations of high priority land birds (e.g., Hamel 1992*a*).

Mature pine

1. Average stocking
   a. *Pine savanna:* open canopy/low stocking (2.3–4.6m²/ha).
   b. *Sandhills, flatwoods, loblolly/shortleaf:* open canopy/moderate density (13.8–22.9m²/ha).
2. Predominance of older age classes.
3. Overmature trees for cavity nesting red-cockaded woodpeckers, brown-headed nuthatches and other species as noted below.
   a. *Pine savanna:* southeastern American kestrel.
   b. *Sandhills, flatwoods, loblolly/shortleaf:* great crested flycatcher.
4. Midstory and understory control with emphasis on grassy/herbaceous ground cover with sparse retention of shrub-scrub for northern bobwhites, red-cockaded woodpecker, prairie warblers, Bachman's and field sparrows, and other species as noted below.
   a. *Pine savanna:* regular warm-season prescribed burns, for Mississippi sandhill cranes, southeastern American kestrels, Henslow's sparrows, and loggerhead shrikes.
   b. *Sandhills and flatwoods:* regular warm-season prescribed burns, for Henslow's sparrows (flatwoods only).
   c. *Loblolly/shortleaf:* mechanical reduction of hardwood or pine in midstory, at least around red-cockaded woodpecker cavity cluster sites, wider reductions recommended for early seral species, regular use of cool and warm season prescribed burns.
5. Large contiguous blocks of managed habitat.
   a. *Pine savanna:*
      Mississippi sandhill cranes: 9,000 ha or more for subpopulations.
   b. *Sandhills, flatwoods, loblolly/shortleaf:*
      Brown-headed nuthatches: 1,825 ha or more (mean 11 pairs/40 ha).
      Northern bobwhites: 3,000 ha or more (mean 7 pairs/40 ha).
      Bachman's sparrows: 3,500 ha or more (mean 6 pairs/40 ha).
      Red-cockaded woodpeckers: 50,000 ha or more.
6. In all pine types regeneration in >10 ha patches, if not in confict with woodpecker management guidelines, for northern bobwhites, Bachman's sparrows and other species as noted below.
   a. *Pine savanna:* includes slash pine conversion for southeastern American kestrels (maintain cavity trees), Mississippi sandhill cranes, loggerhead shrikes, and Henslow's sparrows.
   b. *Sandhills and flatwoods:* for prairie warblers, field, and Henslow's (flatwoods only) sparrows.
   c. *Loblolly/shortleaf:* for field sparrows and prairie warblers.

tat such as the seedling-sapling seral stage produced under even-aged silviculture and by retarding succession in old-fields. However, prairie warblers and other early-successional specialists have undergone long-term and steep regional population declines during the last 25 years (Hunter et al. 1993*b*). These declines are apparently continuing despite the proliferation of short-rotation pine plantations resulting in an abundance of early-successional habitat in the southeast during the last 30 years (Meyers and Johnson 1978, Hunter et al. 1993*b*).

Restoring fire or other means to reduce hardwoods in pine-dominated stands may reduce habitat for many hardwood-dependent neotropical migrants. However, opening mature pine stands should better secure source populations

for prairie warblers. In addition, most high priority temperate migrant and resident species now depend on this management.

Oak-gum-cypress

In contrast to mature pine, neotropical migrants are the only high priority species for which mature oak-gum-cypress provides optimal habitat (Table 1). Among the most area-sensitve neotropical migrants, the American swallow-tailed kite (*Elanoides forficatus*) now regularly breeds only in the southern third of the physiographic area in Florida, Alabama, Mississippi, and Louisiana, We know of no published information on spatial requirements for the kite in the EGCP. However, Cely and Sorrow (1990) studied an area of approximately 39,800 ha supporting a population of 80–85 kite pairs in South Carolina. Specifically within the EGCP, there appears to be a stable population along the lower Pearl River, forming the Mississippi-Louisiana border, on 40,500 ha of managed mature oak-gum-cypress forest. Thus, even expansive managed forests within the EGCP may now provide only partial security for this species, if South Carolina data is reflective of typical coastal plain kite populations. This information also suggests that supporting 500 pairs of kites should be a southeast regional goal to be accomplished with subpopulations along as many forested lower coastal plain rivers as possible stretching from South Carolina to Louisiana.

Cerulean warblers (*Dendroica cerulea*) now breed only within the northern third of the EGCP in Alabama, Mississippi, Tennessee, and Kentucky. Hamel (1992*b;* also see Robbins et al. 1992) recommended 4,000-ha tracts of mature oak-gum-cypress to maintain a source population of cerulean warblers based on his work in the EGCP of Tennessee. An investigation of habitat patches exceeding this hypothesized minimum could provide an estimate of the number of cerulean warbler source populations now occurring within this physiographic area. If insufficient numbers of source populations are apparent, new populations then could be established through improved habitat management or reforestation.

Of the species occurring throughout the EGCP, Swainson's warblers (*Limnothlypis swainsonii*) and prothonotary warblers (*Protonotaria citrea*) are the most highly ranked. A source population of Swainson's warblers requires at least 2,250 ha of mature oak-gum-cypress forest, with prothonotary warblers requiring at least 1,350 ha (Table 3). Spatial requirements for source populations of American swallow-tailed kites, cerulean warblers, Swainson's warblers, and prothonotary warblers should be adequate to support source populations of less area-sensitive associates in mature oak-gum-cypress. Habitat patches too small for a source population of prothonotary warblers may still benefit other less area-sensitive species.

The above spatial requirements are based on the assumption that all habitat patches would be managed to support important diversity components such as variation in understory density (from cane thickets to open), diverse age struc-

Table 3. Preliminary description of future desired condition for forested wetland forest types within the East Gulf Coastal Plain. The details are based on best information for supporting populations of high priority land birds (e.g., Hamel 1992*a*).

Mature oak-gum-cypress
1. A variety of tree species, substrates, and flooding regimes.
2. Large blocks of contiguous, managed habitat:
a. Prothonotary warblers: 1,350 ha or more (mean 15 pairs/40 ha).
b. Swainson's warblers: 2,250 ha or more (mean 9 pairs/40 ha).
c. Cerulean warblers: 4,000 ha or more.
d. American swallow-tailed kites: 40,000 ha or more for subpopulations.
3. Stands with tall trees, moderately closed canopy, little understory (west. Ky., Tenn., north. Miss., north. Ala.) for cerulean warblers.
4. Tall trees (bald cypress and loblolly pine) along major forested floodplains (south. Ala., south. Miss., La., Fla.) in proximity to open habitats for nesting American swallow-tailed kites (often feed over open areas).
5. Snags 15 cm dbh or greater for prothonotary warblers and 30 cm dbh or greater for great crested flycatchers.
6. Moderately open canopy, drier sites, well-developed midstory and understory layers for Swainson's warblers, wood thrushes, yellow-billed cuckoos, and many other species.

ture (seedlings to mature), and multiple vegetative layers. This microhabitat diversity is important as high priority species dependent upon mature oak-gum-cypress forests do vary in microhabitat requirements (Table 3). Thus, with increasing area under management comes increasing flexibility so a manger can apply a variety of silvicultural practices to achieve more traditional management objectives and still provide optimal habitat for many high priority bird species.

A possible exception to this generalization may be cerulean warblers, which require the largest stands of hardwoods in mature or overmature condition (Hamel 1992*b*, Robbins et al. 1992). However, cerulean warblers persist on commercial forests in which harvests mimic tree fall gaps (Hamel 1992*b*). If timber volume targets are exceedingly high this type of uneven-aged management may result in excessive fragmentation when roads and surrounding landscape are considered. In this case, larger regeneration cuts (e.g., 8–16 ha) along with long rotations (e.g., 150–200 years) may be acceptable for maintaining large mature hardwood stands.

Pine-Hardwood Mixes

There is strong interest among wildlife and forest managers for maintaining a substantial amount of pine-hardwood mix within a managed landscape (e.g., Waldrop 1989), even in situations where a pure pine stand would be more appropriate. Although overall bird species diversity may be high within the pine-hardwood forest type itself (Meyers and Johnson 1978), enthusiasm for the proliferation of hardwoods may not be justified for at least some high priority land birds. Potential conflicts occur when a manager encourages hardwood proliferation within a mature pine-dominated stand, reducing habitat value for an entire

species assemblage requiring a more open habitat. How high priority nongame birds fare in pine stands with high hardwood density is the question we attempt to answer here. The pine-hardwood mix forest type itself serves as a surrogate for predicting responses by high priority land birds to pine-dominated stands allowed to develop substantial hardwood in midstory and understory vegetative layers (e.g., longleaf pine-scrub oak forest type).

Stands of pine-hardwood mix in the EGCP constitute optimal habitat only for chuck-will's-widows (*Caprimulgus carolinensis*) and great crested flycatchers (*Myiarchus crinitus*) among high priority migrants (Table 1). Other high priority land birds only find pine-hardwood mixes suitable or optimal at grass/forb and shrug/seedling stages produced through even-aged silviculture (Table 4). Thus, removal of hardwoods would not appreciably harm high priority neotropical migrants and would benefit red-cockaded woodpecker and other high priority residents and temperate migrants in pine-dominated stands managed for sawtimber.

In contrast to sawtimber, management of pine for pulp/paper production would not provide optimal habitat for many high priority temperate migrants or resident land birds. A manager could provide suitable habitat for some neotropical migrants by retaining a dense hardwood understory and midstory (Table 4). However, benefits to many high priority neotropical migrants in a pine-hardwood mix would be less valuable than restoration and appropriate management of optimal mature bottomland hardwoods.

Conclusions

We provide an analysis of existing information to assist managers in making decisions. This information is subject to change with better understanding of bird-habitat relationships and spatial requirements. Nevertheless, this type of information is essential if ecosystem-based landscape-oriented management is ever to become a mainstream approach to conservation. For example, informa-

Table 4. Preliminary description of future desired condition for pine-hardwood mix forest type within the East Gulf Coastal Plain. The details are based on best information for supporting populations of high priority land birds (e.g., Hamel 1992*a*).

Mixed pine-hardwood sawtimber, pine poletimber
1. Moderate pine density (16.1–20.7 m^2/ha for sawtimber, 13.8–16.1 m^2/ha for poletimber), moderate canopy closure.
2. Encourage midstory and understory development for chuck-will's-widows, wood thrushes, and lower priority species using these layers.
3. Snags 30 cm dbh for great crested flycatchers.
4. If even-aged regeneration used, patches (with appropriate erosion controls) of 20–40 ha, with new regeneration adjacent to previous regeneration as much as possible for northern bobwhites, Bachman's and field sparrows, and prairie warblers.
5. Appropriate management of red-cockaded woodpecker cavity cluster sites and foraging area where they now exist, in accordance with standards and guidelines; also good for great crested flycatchers and brown-headed nuthatches.

tion suggesting natural resource managers need to think in terms of thousands or tens of thousands of hectares for managing species assemblages is superior to managing forested habitats stand-by-stand in areas often less than 40 hectares.

This EGCP example is specific to the Southeast, but the process used here to provide management guidance may serve as a model for implementing landscape-level management throughout North America. Managers should have accurate accounting of their resources before applying this approach locally, including the spatial distribution of habitats present and a general understanding of the abundance and habitat relationships for each species of species assemblage of concern. Managers also should gain an understanding of what role they can play relative to other cooperators within the larger landscape. Through cooperative management, even small ownerships can make important contributions toward managing for habitats that are in short supply regionally. Finally, monitoring the response of target and non-target species will be essential for reformulating management plans to correct problems and achieve greater success.

We show that apparent conflicts at the stand level dissolve as larger scale relationships and priorities are understood, perhaps resulting in greater efficiency of management for consumptive and non-consumptive resources. The apparent conflict between management for high priority pine species and neotropical migrants is resolved through examination of landscape priorities. General conclusions are (1) open pine forests provide optimal habitat for high priority temperate migrants and residents, (2) bottomland hardwood forests provide optimal habitat for high priority neotropical migrants, and (3) mixed pine-hardwood forests do not provide key habitat for either of these assemblages. Thus, in developing regionally encompassing conservation strategies, a manager should avoid mixing habitat needs in a manner that reduces the security of each high priority species assemblage.

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