A Regional Study of Coastal Migratory Stopover Habitat for Neotropical Migrant Songbirds: Land Management Implications

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Introduction

Widespread concern over declines in populations of neotropical migrant songbirds (e.g., Robbins et al. 1989, Terbough 1989) has sparked state (e.g., Maryland's Chesapeake Bay Critical Area Law; *see* Therres et al. 1988), national and international conservation initiatives (e.g., Partners in Flight Program). To date, most research and protection efforts have focused on breeding and wintering grounds. Migratory stopover areas, the connecting link between nesting and "wintering" habitats, have received relatively little attention yet represent a third and perhaps as critical a component in the conservation of neotropical migrants songbirds.

Migration is a period of extreme stress for neotropical migrants (Berthold 1975, Dawson et al. 1983). During stopovers, the need to replenish fat reserves, rest and find adequate cover from predators and adverse weather is essential. The availability of suitable stopover habitat can have a profound impact on population viability by influencing the ability of birds to complete migration and ultimately reproduce successfully. Unfortunately, little information is available on the location, extent or characteristics of critical stopover habitat for neotropical migrant songbirds.

The Cape May and Delmarva Peninsulas are among a number of locations in North America that traditionally have been viewed as important concentration areas for migrant passerines. This phenomenon is thought to be related to local and regional geography, the direction of prevailing winds and innate avian behavior (Dunne et al. 1989). The mid-Atlantic coastal region is, however, faced with unprecedented development pressures, especially on waterfront properties. Continued habitat loss and fragmentation on the two peninsulas may have serious consequences for neotropical migrant songbird populations.

To help develop a protection strategy for stopover habitat in this region, a four-state (Delaware, Maryland, New Jersey and Virginia), multi-agency study was implemented during 1991 along the coastal areas of the Cape May and Delmarva Peninsulas. Our goal was to examine landscape-scale patterns in "fall" migrant songbird distribution and abundance. Specifically, the study addressed five main questions in an attempt to characterize, in terms of geography and habitat, coastal areas that support the greatest abundance and species richness of neotropical migrant songbirds during fall migration. These questions were: (1) do migrants concentrate near the coast; (2) does migrant abundance differ among the bayside coast (Chesapeake and Delaware bays), Atlantic ocean coast, and peninsula interior; (3) do migrants concentrate near peninsula tips; (4) is migrant abundance greater on barrier islands than the adjacent coastal mainland; and (5) is migrant abundance related to habitat type?

In this paper we present a summary of our findings and discuss possible land-management implications. For additional information, refer to Mabey et al. (1993). Study funding was provided by the National Oceanographic and Atmospheric Administration's Office of Coastal Resource Management, The Nature Conservancy, National Fish and Wildlife Foundation and U. S. Fish and Wildlife Service. We also would like to extend our sincerest thanks to all of the members of the study team, including the hundreds of volunteers who graciously donated their time and birding expertise as field observers.

Methods

The study design and methodology are described in detail by Mabey et al. (1993). Briefly, migrant surveys were conducted during August through October 1991 at 487 sample points located randomly within the coastal region of the Cape May and Delmarva Peninsulas. The relative abundance of neotropical migrant songbirds was determined at each sample point using, simultaneously, a standardized audio-lure (tape recording of Carolina chickadee [*Parus carolinensis*] calls and human pishing and hand-squeaking noises) and a 10-minute long, fixed radius (82 feet [25 m]) point count. Point counts took place two days per week and each sample point was visited once per day. All counts occurred between two hours after sunrise and one hour before sunset to insure that birds had completed morning flight and already selected stopover habitat (Wiedner et al. 1992), and to avoid counting birds that had initiated nocturnal migration.

Most sample points were located within a continuous 1.9-mile (3 km) wide "coast" band that paralleled both the bay (Delaware and Chesapeake bays) and ocean coastline. This band was further divided into a "near-coast" zone (0–0.9 miles [0–1.5 km] from mean high tide line]mhtl]) and an "inland" zone (0.9–1.9 miles]1.5–3 km] from mhtl). We also established a 1.9-mile (3 km) wide band in the mainland "interior" (6.2–14.3 miles]10–23 km] from mhtl) in Delaware, Maryland and New Jersey. Sample points were randomly located within each band at a density of approximately 1 per 1.9 $miles^2$ (2.7 km^2). Although the small size of most barrier islands precluded the delineation of 1.9-mile (3 km) wide bands, sample point density was similar to that on the mainland. All points occurred in forest or scrub habitat patches that were > 2.5 acres (1 ha) in size,

≥ 492 feet (150 m) wide, and dominated by woody vegetation ≥ 1.7 feet (0.5 m) tall. To avoid sampling edges, points were placed in the interior of the habitat patch or ≥ 164 feet (50 m) from the habitat edge. Based on a standard vegetation assessment, the habitat surrounding each point was categorized as either coniferous forest, deciduous forest, mixed forest or scrub-shrub.

Bird abundance was defined as the mean number of birds observed per point count. Species richness was the mean cumulative (during August through October 1991) number of species observed per sample point. All statistical comparisons presented in this paper are based on analyses of variance and Tukey's standardized student range tests to separate means.

Findings

A total of 11,583 point counts were conducted, during which 37,301 neotropical migrant songbirds comprising 79 species were observed. We refer collectively to these species as songbirds even though several non-passerine species are included (black-billed cuckoo [*Coccyzus erythropthalmus*], yellow-billed cuckoo, ruby-throated hummingbird, and yellow-bellied sapsucker; all other scientific names are provided in Table 1).

A primary question was whether or not migrants concentrate near the coast. Although the mid-Atlantic coast long has been considered an important concentration area for migrant passerines, this premise had not been investigated quantitatively prior to this study. Our data indicate that such a concentration does occur based on comparisons between the near-coast and inland zones; migrant abundance ($P < 0.0001$, Figure 1a) and species richness ($P = 0.006$, Figure 2a) both were significantly greater near the coast. In fact, on a regional scale, migrant abundance averaged 17 percent greater in the near-coast zone than in the inland zone.

A clearer picture of this "coastal effect" emerges in comparisons among the bay and ocean coasts (0–1.9 miles [0–3 km] from the mhtl), and mainland interior areas. These analyses revealed that bird counts were significantly ($P < 0.0001$) higher along the Chesapeake and Delaware Bay coasts than either the ocean coast or mainland interior and there was no difference between the latter two areas (Figure 1b). Species richness showed a similar pattern ($P < 0.0001$, Figure 2b). Although bird counts were higher ($P < 0.0001$) in the near-coast zone on both the bay and ocean sides of the peninsulas, species richness (Figure 2c) and migrant abundance (Figure 1c) were particularly high in the bayside near-coast zone. The same trends were evident when comparisons between geographic areas (i.e., near-coast versus inland zone, bay coast versus ocean coast) were controlled for habitat type (coniferous forest, deciduous forest, mixed forest and scrub).

The tendency of migrants to concentrate near the coast, especially on the bayside coast, probably is due to a combination of factors: (1) a west to northwest reorientation by birds drifted offshore and the subsequent return of these birds to the mainland coast during the early morning hours (Baird and Nisbet 1960, Drury 1960, Drury and Keith 1962, Drury and Nisbet 1964, Murray 1976, Able 1977); (2) fat-depleted birds migrating over the mainland may "drop out" along the coast rather than continue offshore under increasingly difficult flight conditions during daylight hours (Kerlinger and Moore 1989); and (3) morning flight behavior, resulting in large numbers of birds dispersing westward around the peninsula tips and then northward up the bay coast, and birds moving inland from both the bay and ocean coasts (Alerstam 1978, Gauthreaux 1978, Wiedner et al. 1992).

Birds migrating in a southerly direction would be expected to concentrate at barriers to southerly flight. Observations at two well-known bird research stations (Cape May Bird Observatory, Cape May, New Jersey, and Kiptopeake Bird Banding Station, Kiptopeake, Virginia) suggest that as birds move southward and eastward toward the coast they concentrate near the southern tips of the Cape May and Delmarva peninsulas (Virginia Heritage Program 1988, U. S. Fish and Wildlife Service 1984). Such concentrations have been documented for diurnal migrants (e.g., raptors, Kerlinger 1989) but only speculated for nocturnal passerine migrants. Our data show no evidence ($P > 0.05$) of this

Table 1. Stopover habitat associations of neotropical migrant songbirds during fall migration in the coastal region of the Cape May and Delmarva Peninsulas. Associations are based on comparisons of migrant abundance[a] among four major habitat types: coniferous forest; deciduous forest; mixed forest and scrub-shrub habitat.

Common name[b]	Scientific name	Stopover habitat[c]
Yellow-billed cuckoo*	*Coccyzus americanus*	$Forest_{d,m}$
Ruby-throated hummingbird	*Archilochus colubris*	$Forest_c$
Yellow-bellied sapsucker	*Sphyrapicus varius*	$Forest_g$
Eastern wood-pewee	*Contopus virens*	$Forest_g$
Eastern phoebe	*Sayornis phoebe*	Scrub
Eastern kingbird	*Tyrannus tyrannus*	Scrub
Great-crested flycatcher	*Myiarchus crinitus*	$Forest_c$
House wren	*Troglodytes aedon*	Scrub
Ruby-crowned kinglet	*Regulus calendula*	$Forest_c$
Blue-gray gnatcatcher	*Polioptila caerulea*	$Forest_c$
Veery*	*Catharus minimus*	$Forest_g$
Hermit thrush	*C. guttatus*	
Wood thrush*	*Hylocichla mustelina*	$Forest_g$
Gray catbird*	*Dunetella carolinensis*	Scrub
White-eyed vireo*	*Vireo griseus*	Scrub
Solitary vireo	*V. solitarius*	
Red-eyed vireo	*V. olivaceus*	$Forest_d$
Northern parula*	*Parula americana*	
Chestnut-sided warbler*	*D. pensylvanica*	
Magnolia warbler	*D. magnolia*	
Cape May warbler	*D. tigrina*	
Black-throated blue warbler	*D. caerulescens*	
Yellow-rumped warbler	*D. coronata*	Scrub
Black-throated green warbler*	*D. virens*	$Forest_g$
Pine warbler	*D. pinus*	$Forest_c$
Prairie warbler	*D. discolor*	$Forest_c$
Black-and-white warbler	*Mnioltilta varia*	$Forest_g$
American redstart	*Setophaga ruticilla*	$Forest_g$
Ovenbird*	*Seirus aurocapillus*	$Forest_g$
Common yellowthroat*	*Geothlypis trichas*	Scrub
Scarlet tanager*	*Piranca olivaceus*	
Northern oriole*	*Icterus galbula*	$Forest_d$

[a]Mean number of birds per point count. Habitat associations based on analysis of variance and Tukey's studentized range test for mean separation.
[b]Asterisks indicate species with significant ($P < 0.05$) population declines, based on 1978–87 Breeding Bird Survey data (Robbins et al. 1989).
[c]Forest subscripts: c-coniferous, d-deciduous, m-mixed, g-forests in general (i.e., abundance greater in forest than scrub habitat but not significantly associated with a particular forest type).

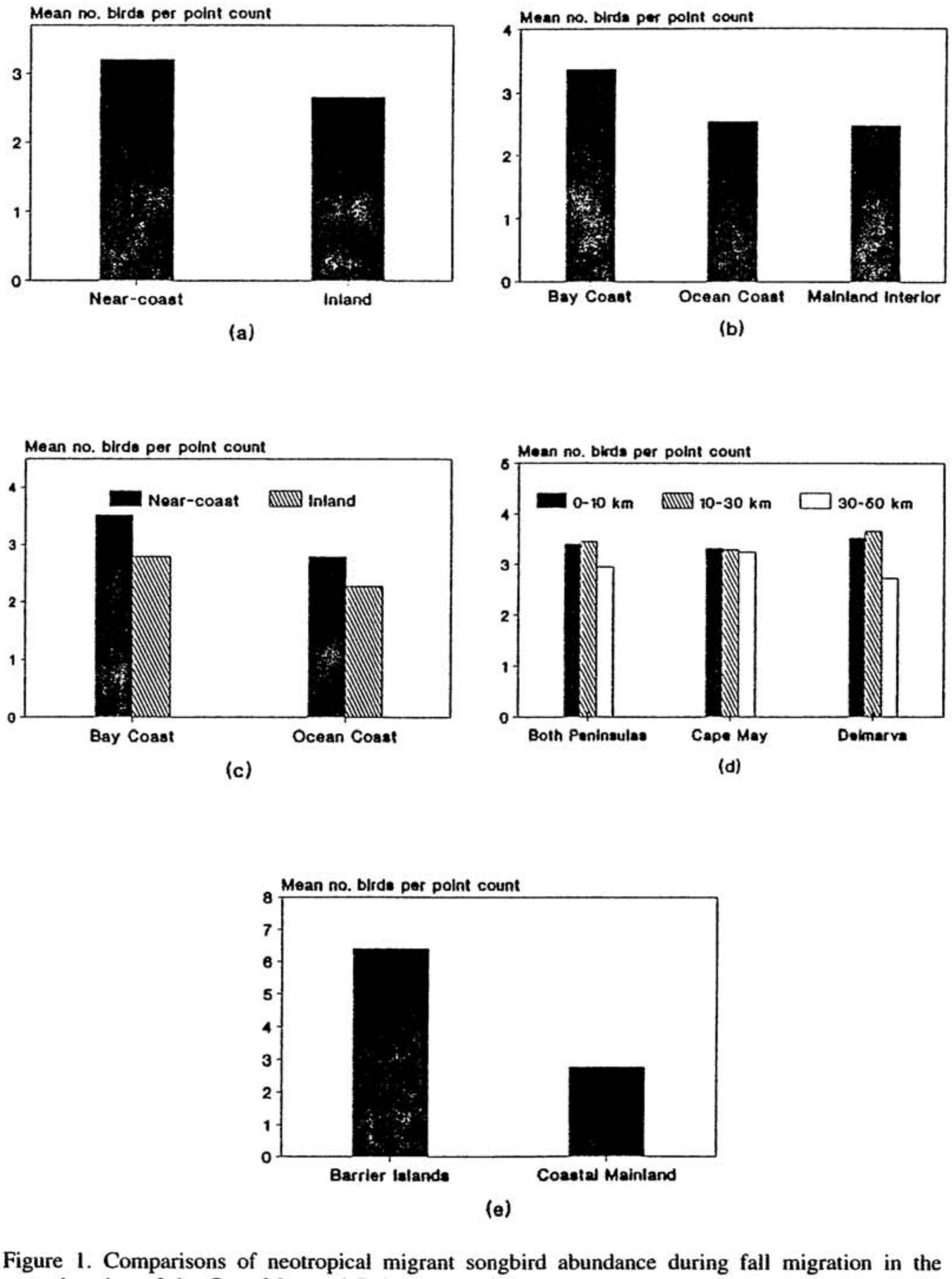

Figure 1. Comparisons of neotropical migrant songbird abundance during fall migration in the coastal region of the Cape May and Delmarva Peninsulas: (a) near-coast zone versus inland zone, (b) bay coast versus ocean coast versus mainland interior, (c) 'a' by bay coast and ocean coast, (d) comparison between coastal areas at different distances from the southern tips of peninsulas, and (e) barrier islands versus adjacent coastal mainland.

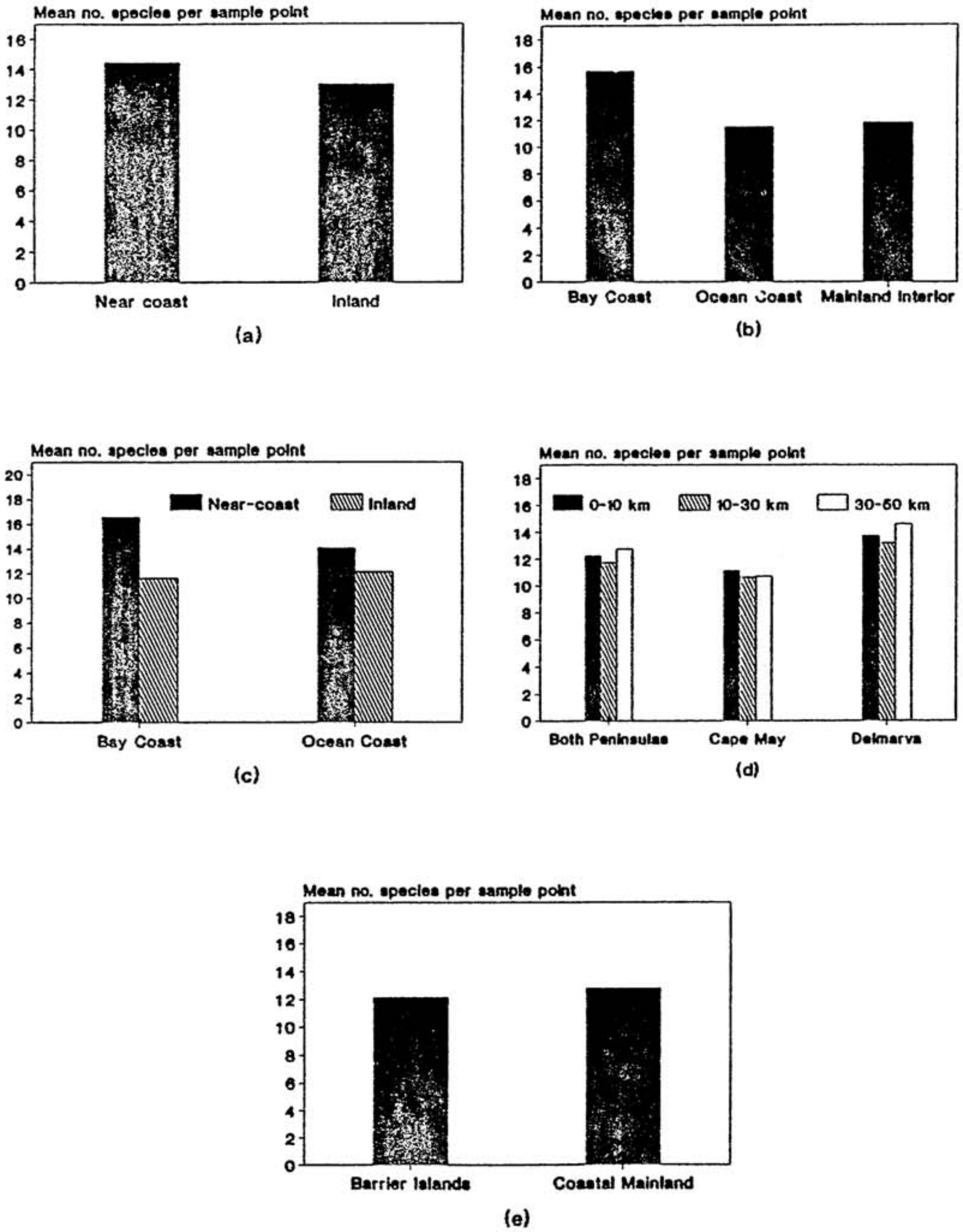

Figure 2. Comparisons of neotropical migrant songbird species richness during fall migration in the coastal region of the Cape May and Delmarva Peninsulas: (a) near-coast zone versus inland zone, (b) bay coast versus ocean coast versus mainland interior, (c) 'a' by bay coast and ocean coast, (d) comparison between coastal areas at different distances from the southern tips of peninsulas, and (e) barrier islands versus adjacent coastal mainland.

relationship on either peninsula (Figures 1d and 2d), based on regression analyses, comparisons of migrant abundance among three discrete distance categories (0–6.2, 6.2–18.6 and 18.6–31.1 miles [0–10, 10–30 and 30–50 km, respectively] north of the southern tips of the peninsulas), and analyses that accounted for variation from other geographic features (i.e., proximity to coastline, bay versus ocean coast) and habitat types. We believe that while large numbers of birds do occur near the peninsula tips during early morning hours, most are engaged in morning flight and relatively few stopover due to a lack of suitable resting and feeding habitat (Wiedner et al. 1992, Niles and Kerlinger unpublished data; Watts and Mabey unpublished data). It also is possible that our study design was only appropriate for investigating peninsular concentrations at a regional level and was simply ineffective (e.g., by random chance, few sample points were located directly at the peninsula tips) at detecting patterns that may be operating at a much more local level. For example, limited ancillary data from Virginia (Mabey unpublished data) suggest that birds do concentrate near the Delmarva Peninsula tip but only within the distal 1.9 miles (3 km). These and other explanations (e.g., migrant abundance is related, in part, to landscape-level habitat distributions) are currently being investigated further on both peninsulas (Watts and Mabey unpublished data; Kerlinger and Niles unpublished data).

Barrier islands supported a remarkably high abundance of migrants that was over two times greater ($P < 0.0001$) than on the adjacent mainland (Figure 1e). Although 54 percent (26 percent on the adjacent mainland) of the migrants recorded on barrier islands were yellow-rumped warblers, analyses without this species still showed higher ($P = 0.024$) bird counts on barrier islands; there was, however, less disparity. We also found greater abundance on barrier islands, with and without yellow-rumped warbler data, in comparisons by habitat type. Although there was no difference in species richness (Figure 2e), both areas supported a nearly complete assemblage of migrant songbird species that were observed during the study (76 of a possible 79 species occurred on both barrier islands and the adjacent coastal mainland).

Barrier islands apparently are an important stopover area for migrants. Similar observations, although not quantitatively compared to a nearby mainland, have been made on other islands near ocean coasts (Baird and Nisbet 1960, Able 1977, Moore et al. 1990). To a large degree, these concentrations can be attributed to the geographic position of barrier islands. As the most seaward stretch of land along the mid-Atlantic coast, they represent the last possible stopover area for birds that are engaged in nocturnal migratory flights and departing from the mainland, and the first potential landfall for birds offshore and attempting to regain land. Habitat conditions also may have influenced migrant abundance since most sample points on barrier islands were located in extensive, relatively undisturbed interdune scrub and woodland habitat. The dense cover and abundant food in these plant communities may provide ideal stopover habitat for a variety of migrant songbird species.

Finally, is migrant abundance related to habitat type? We found that, on the average, bird abundance was highest ($P < 0.0001$) in scrub-shrub habitat, but there were no differences between the three forest types. Species richness showed a different pattern; values were highest ($P < 0.0001$) in coniferous forest, followed by deciduous and mixed forests, and scrub-shrub habitat had the lowest species richness. A tally by habitat type of the total number of species present revealed that species numbers were lowest in coniferous forests (61 species), highest in deciduous and mixed forests (73 and 75 species, respectively), and intermediate in scrub-shrub habitat (68 species). In an attempt to examine habitat associations more closely, data for 32 species with adequate sample sizes ($n > 100$ birds observed) were analyzed individually. Twenty-three of these 32 species showed significant ($P < 0.1$) habitat associations (Table 1). Generally, species preferred either forest (16 species) or scrub-shrub habitat (7 species). However, of those species preferring forested areas, six were most commonly associated with coniferous forests, two were strongly associated with deciduous forest, and one seemed to prefer either deciduous or mixed forest; the other eight species tended to be equally abundant in all three forest habitat types. Although our data did not permit fine-scale analyses of habitat use, it is significant to note that species requiring forests during the breeding season also are strongly associated with forest habitats during migration. Likewise, species that nest in early successional forest and scrub-shrub vegetation used similar habitat during stopovers.

Management Implications

Although the data provide evidence of several important landscape patterns in migrant abundance, the study also points to the complexity of developing an effective protection strategy for stopover habitat for neotropical migrant songbirds. Clearly, no single landscape feature or habitat type will provide suitable stopover areas for all migrants or all species. Effective conservation requires a mosaic of different natural habitat patches distributed across an entire region, as suggested by Sprunt (1975). Findings by Winker et al. (1992) suggest a similar strategy. However, certain coastal landscape features, such as barrier islands and bay coastal areas, are particularly important to migrants and should receive priority protection measures. Many barrier islands in our study area are currently under private, state or federal protection and, with proper management, will likely continue to provide suitable stopover areas for neotropical migrants. However, for most other barrier islands, little natural upland vegetation remains due to human development. Similar situations exist along parts of the coastal mainland. Management recommendations for these and other coastal areas are outlined below.

Ideally, conservation efforts should focus on large forest blocks. Large forests tend to contain a greater diversity of habitat types than smaller forest blocks (Buckley 1982, Forman and Godron 1986) and therefore will support not only a greater absolute number of migrants, but greater species diversity. Also, species such as veery, wood thrush and black-throated green warbler (all of which are experiencing population declines, *see* Robbins et al. 1989) prefer forest habitat during migration and scrub-shrub vegetation may not contain adequate stopover habitat. For some migrants, especially species like white-eyed vireo, gray catbird and common yellowthroat, adequate stopover habitat may exist in small woodlots, coastal scrub (i.e., dominated by bayberry [*Myrica* sp.] and high tide bush [*Iva frutescens*]), hedgerows, and filter strips. It is worth noting that although some species apparently prefer certain habitat types during migration, none of the 32 species listed in Table 1 were entirely absent from any of the four habitat categories.

Ultimately, the protection of stopover habitat (i.e., native forest and scrub habitat) must be addressed through environmental policies and conservation programs. On the Cape May Peninsula, songbird stopover areas currently receive some protection through the New Jersey Freshwater Wetlands Act and Coastal Areas Facility Review Act. Our findings should strengthen and focus the habitat protection recommendations made under these laws. Critical stopover habitat also should be introduced as significant coastal areas in state Coastal Zone Management (CZM) Program plans. In Maryland, for example, the

Chesapeake Bay Critical Area Law provides considerable protection for forests along the Chesapeake Bay coast (within 1,000 feet [301 m] of mhtl) and specifically addresses the need to conserve breeding habitat for forest interior dwelling bird species (*see* Therres et al. 1988), the majority of which are neotropical migrant songbirds. Through the cooperation of local Critical Area Programs, the conservation of migratory stopover habitat also could be addressed in these areas.

A number of non-regulatory options (e.g., open space easements and state Natural Areas Registry Programs) also are available for protecting coastal stopover habitat. In addition, state and federal incentive programs, such as the Conservation Reserve Program (CRP), Acreage Conservation Reserve Program (ACR) and Forest Stewardship Programs, offer many opportunities for educating and encouraging private landowners to consider the stopover needs (and breeding habitat requirements) of neotropical migrants. In many coastal areas, the only available stopover sites consist of landscaped vegetation in suburban and urban environments. The best opportunity for providing resting and feeding habitat in these situations may be through landscaping recommendations to developers, land planners and private homeowners (e.g., in some areas, local ordinances already exist that provide specific guidelines for retaining native vegetation and replanting: *see* Sutton 1989). However, by themselves, these piecemeal attempts to provide stopover habitat must be incorporated into a regional, proactive land-management plan that protects a mosaic of natural habitats.

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