Transboundary Conservation: An Ecoregional Approach to Protect Neotropical Migratory Birds in South America

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ABSTRACT / Future conservation efforts will need to transcend geopolitical boundaries in efforts to protect entire landscapes and ecosystems. Neotropical migratory birds are as a group a useful conservation tool for linking diverse landscapes and people due to their dependence on multiple habitats, sensitivity to habitat changes, and universal public appeal. The conservation of neotropical migrants can therefore function as a powerful hemispheric umbrella for ecosystem protection. Efforts to protect neotropical migratory birds on their nonbreeding grounds have traditionally been focused on Mexico, Central America, and the Caribbean. To assess the importance of South America to neotropical migrants, an ecoregional classification system was used to determine species distributions in the Andean/Southern Cone Region (Bolivia, Colombia, Ecuador, Paraguay, Peru, and Venezuela). The occurrence of migrants in protected areas that are part of The Nature Conservancy's Parks in Peril program was also assessed. Of the 406 neotropical migrant species, nearly one third (132) occur as regular nonbreeding residents in the region and for almost half of these species (53), South America is their main nonbreeding ground. All Parks in Peril sites were found to harbor neotropical migrants. Forty-eight species (36%) have declining long-term North American Breeding Bird Survey population trends and/or high Partners in Flight concern scores and thus are of significant conservation concern. Most importantly, 29 species (22%) of conservation concern use South America as their primary nonbreeding ground, indicating a need for focused conservation action. The nature of the ecoregional approach used in this endeavor makes future prioritization of ecoregions and conservation strategies for neotropical migrants across national boundaries possible. The ability to link diverse landscapes using a common element such as migratory birds allows for unique transboundary partnerships and opportunities for habitat conservation, which support the goal of the Conservancy's new Migratory Bird Initiative.

The rise of conservation awareness in the last two decades has been centered around protecting particular sites resembling islands of nature. Society is learning quickly that these nature islands are the ultimate source of human well-being and that they are finite and susceptible to rapid degradation. An emerging approach to conservation includes a new relationship to nature in which people and nature coexist by having local communities included in protection and development plans. New terms entering popular speech, such as biosphere, ecosystem, biodiversity, and dozens of others, call for a new vision rooted in interconnections. The interconnectedness of preserves and ecosystems beyond political boundaries is definitely the next big conservation venture for society. A challenge ahead for conservationists is to identify the right set of natural phenomena and processes that are appealing and simple enough for the general public and governments to catalyze and consolidate this new vision.

Birds have traditionally captured peoples' imagination. Public interest in the conservation of birds is tremendous. Recent estimates suggest that there are tens of millions of birders in America (Kerlinger 1993). The environmental movement's beginnings can be traced in part to Rachel Carson's *Silent Spring*, which marshaled the American people to concerted action, based on their love of birds. Birds are a way to build the broad and diverse base of public support and the conservation ethic called for in this new vision where people and nature coexist with both minimum degradation of the environment and adequate living standards. Transboundary conservation issues involving migratory birds definitely require a new approach to work with sites, states, regions, and nations that are home to these international ambassadors.

KEY WORDS: Neotropical migratory birds; Transboundary conservation; Ecoregions; Protected areas; South America

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Why migratory birds? There are certain characteristics of birds, migratory birds in particular, that make them, as a group, an effective flagship for broader conservation endeavors based on ecoregions. Most neotropical migratory birds are dependent on a number of separate and distinct habitats scattered over more than two nations. Focusing conservation endeavors on these birds therefore directs resources beyond US borders to a wider range of geographic areas, including Latin America and the Caribbean. The ability to link diverse landscapes using a common element such as migratory birds allows for unique transboundary partnerships and opportunities for habitat conservation.

Another reason for focusing on neotropical migrants is the close relationship between landscape changes and the survival of migratory birds. The presence of neotropical migrants is strongly associated with numerous bird species endemic to and resident in South America. Preservation of migrants has been identified therefore as an important approach for protecting ecological integrity. During the past 200 years, humanity's impact on these avian travelers has been striking. On the North American continent and Hawaii, more than 33 species of birds have become extinct. Another 150 are in trouble. Long-term studies have clearly and tragically shown that many migratory bird populations have experienced declines (Robbins and others 1989). Every state in the nation has experienced these declines, with some having more than 75% of their species in decline.

The single most probable cause may be the loss and degradation of habitat in the neotropics. Although we have done much to alleviate the cause for the alarm sounded by Rachel Carson, this new peril threatens to silence many of these far-ranging fliers. A silent spring may yet come to pass.

> To preserve plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive.
>
> —The Nature Conservancy's Mission Statement

Because of the mobility of migratory birds, their conservation is best addressed on large geographic and ecological scales. The Nature Conservancy's (TNC) ability to work at scales that embrace landscape and ecosystem processes offers the best opportunity to understand and respond to these dramatic population declines. The dwindling numbers of these birds sounds a new global challenge for TNC. The Nature Conservancy's new Migratory Bird Initiative seeks to preserve imperiled populations by protecting their most critical habitats throughout the Americas. To help achieve this goal, TNC's Latin America and Caribbean Division initiated a series of studies of migratory birds. The first study was conducted for the Andean/Southern Cone (ASC) region and focused on the nations, ecoregions, and Parks in Peril (PiP) sites of Venezuela, Colombia, Ecuador, Bolivia, Peru, and Paraguay. The results presented in this paper are focused on the ecoregions and not the individual nations. A complete analysis can be found in Roca and others (1996).

Objectives

The widespread but erroneous belief that South America is not especially important for neotropical migratory birds motivated the ASC region study. A possible explanation for this misconception is that few ecoregion-based studies have been done on the neotropical migrants that occur in the ASC region. The project sought to fill this gap through two major objectives. The first objective of the project was to determine the distribution and conservation status of neotropical migrants in all ecoregions and nations of the ASC region. The approach here was to assess neotropical migrant occurrences over entire ecoregions as part of an attempt to develop regional and national conservation strategies in South America. The second objective was to encourage hemispheric partnerships through participation in TNC's Migratory Bird Initiative. With birds as an overarching conservation theme, the initiative's goal is a comprehensive program of information gathering and planning leading to a focused strategy of site protection and management. The success of protection efforts in North American breeding grounds is tied to conservation efforts in critical nonbreeding grounds in South America. The hope is that this study will enhance local initiatives, both in the United States and South America, by linking US and Latin American conservation efforts.

Some years ago, The Nature Conservancy, knowing that habitat protection is the heart of any solid conservation agenda, began implementing a program called PiP to enhance existing preservation efforts in Latin America and the Caribbean. The PiP program, funded by the US Agency for International Development, focuses on helping conservation efforts in a highly important set of protected areas that harbor many key habitats and species. It is within this rich landscape of PiP sites and other protected areas that this study analyzed the occurrence and status of neotropical migratory birds.

The ASC region study did not attempt to set priorities for conservation. Determining which regions or parks are most important for preservation will be possible only after up-to-date information on bird population numbers becomes available. The study was a

preliminary effort that is expected to serve as a springboard for future projects that will explore this question of abundance.

Methodology

Bird migration in South America has three components. The first is the North American segment, the neotropical migrants. These birds visit South America from October to April during the northern winter. The second component is the austral, or southern, migrants. These are the birds that fly north, staying within South America, from March to October during the southern winter. Most of the austral migrants move from temperate to tropical latitudes. The final segment is the group of local migrants that move up and down the slopes of the Andes at varying times of the year. The focus of the project was restricted to the first group: the neotropical migrants that breed in the United States and Canada and are regular nonbreeding residents in the ASC region. Various species that occur only marginally or casually were excluded from the analyses.

The ASC migratory bird project was an immense task, requiring the compilation, organization, and manipulation of a tremendous amount of data, as well as extensive communication with numerous Latin American partner organizations and experts. To put the results in context, it will help to describe the steps undertaken for this ambitious study. Before looking at the study's methodology, however, it will help to define the term ecoregion and explore its significance to conservation. A number of scientists have proposed the classification of geographical areas into ecoregions (e.g., Bailey 1996). Most agree that ecosystems occur in an orderly hierarchy culminating in ecoregions at the broadest geographical scales. These large-scale ecoregions are appropriate for addressing the conservation of migrants because of the birds' mobility and for other reasons explored below.

The Ecoregions

The staff of the World Bank's (WB) Environment Unit for Latin America and the Caribbean and the World Wildlife Fund's (WWF) Conservation Science Program developed the ecoregion system used in the study. The WB and WWF proposed the system to address the absence of a widely accepted land classification scheme (Dinerstein and others 1995). Their ecoregion scheme represents a powerful land classification system that can be applied to Latin America and the Caribbean. The WB-WWF system emphasizes the consideration of ecological processes in addition to an area's visible biological and physical elements. Specifically, to paraphrase somewhat, an ecoregion is defined as a geographically distinct assemblage of natural communities that historically share a large majority of their species, exhibit similar ecological dynamics and environmental conditions, and depend for their long-term persistence on critical ecological interactions (Dinerstein and others 1995).

An ecoregion may contain a variety of habitat types and be used differentially by bird species but still be considered a single unit. Ecoregions can vary widely in size. Moreover, individual instances of a given type of ecoregion need not be contiguous. Because of differences in climate, soils, historical processes, or landforms, such as mountain ranges, large rivers, or other waterbodies, variant kinds of ecosystems can be interspersed within a given ecoregion.

Ecoregions are appropriate units for conservation because they are based on relationships and processes that include biotic and abiotic components of habitats. Conservation planning that takes into account an ecoregional perspective is more likely to preserve these ecological processes and associated components of the landscape. In doing so, the long-run adaptability and sustainability of conserved areas are better maintained, as are functions of the land area that are important to local residents. Ecoregions are thus superior to units based on artificial or crude demarcations, such as political boundaries or simple landforms (e.g., a river).

The WB-WWF ecoregion system was developed in such a way that the units reflect the minimum level of resolution required for achieving regional representation and effective conservation planning. That is, each ecoregion boundary is intended to identify an area for which a single conservation strategy can be applied effectively. At the same time, ecoregions can be broken down into smaller portions for focused conservation efforts. Our assessment of neotropical migratory birds in the ASC region is the first time that the WB-WWF ecoregion scheme has been integrated into a conservation endeavor for a specific group of species.

Migratory Species in Nations and Their Conservation Status

The first step in the methodology employed in the study was to identify neotropical migratory birds that frequent the ASC region. Neotropical migrants were defined as those avian species that breed in the United States and Canada and have been recorded during the nonbreeding season in habitats located in South America, Central America, Mexico, and the Caribbean. We generated initial bird lists for each of the six relevant nations (Bolivia, Colombia, Ecuador, Paraguay, Peru, and Venezuela) using TNC's Biological and Conserva-

tion Data System. This vast and comprehensive data base is used to manage information related to the ecology, conservation status, management, protection, occurrence, and monitoring of animal and plant species of the Western Hemisphere. Based on a review of the literature and the advice of consultants, we expanded the initial lists for each nation into a master list of neotropical migrants. This list encompasses all the birds that migrate from North America and occur as regular nonbreeders in the ASC region during the northern winter. It should be noted that some of the migratory species included on the list also have breeding populations in South America. The master list does not include species that occur purely as accidentals or vagrants, that is, species that occur irregularly and in very small numbers. Ecoregions were used next as a sort of map to plot bird occurrences in the PiP sites in each country. Thus, the study's ecoregional approach involved compiling layers of information.

After we developed the national and ecoregion lists, we gathered information on the status of the migratory populations. For this project, we identified two main sources for evaluating conservation status. The first is the North American Breeding Bird Survey (BBS), which has been coordinated and maintained since 1966 by the US Fish and Wildlife Service and the Canadian Wildlife Service. The purpose of the survey is to improve understanding of breeding bird abundances and distributions. For the present study, we relied on US long-term population trends for 1966 to 1991, presented as percent decline per year (it should be noted that survey trends do not exist for all migrants to the ASC region). The number of declining species recorded by the BBS has been subject to recent debate and analysis. Notwithstanding the survey's limitations, we believe that for conservation purposes it is the best available long-term quantitative indicator of bird population trends.

The second main source for determining conservation status is based on figures developed by Partners in Flight (PIF) for its system of conservation prioritization. Partners in Flight is a coalition of agencies, organizations, and individuals interested in migratory birds and their habitats. The coalition was set up by the National Fish and Wildlife Foundation in 1990. Partners in Flight encourages national and international partnerships that protect neotropical migratory birds before they become endangered or threatened. Efforts by the groups that make up PIF include the development of a prioritization scheme that "identifies those birds at any locality on several geographic scales most in need of conservation action" (Hunter and others 1993). The scheme is based on scores that reflect a species' potential to be extirpated. Scores range from 7 to 30, and species with scores higher than 18 are considered to be of high conservation concern (Hunter and Pashley 1995). Unlike the BBS data, which are limited to population trends in North America, the PIF scores take into account factors from both breeding and nonbreeding grounds.

Migrants with a South American Affinity

To assess the status of neotropical migrants, it is necessary to understand the importance of South American destinations to these species. In other words, for which migrants is a habitat in South America the most important destination as opposed to somewhere in Mexico, Central America, or the Caribbean? Answering this question was critical to setting conservation priorities for the group of migrants that have this South American affinity. They are the species that truly need South American habitats in order to survive. A major outcome of this project is a comprehensive list, built on existing work by Hunter (1995), of neotropical migratory birds with a specific South American affinity.

Migratory Species in Parks in Peril Sites

The study described in this document also called for determining species occurrences in more refined geographic areas, specifically ecoregions and PiP sites. The PiP program was designed by TNC, together with TNC's Latin American and Caribbean partner organizations, as an emergency effort to safeguard the most important and imperiled natural areas in the hemisphere. The purpose is to ensure an initial level of critical management for each of the targeted protected areas.

The PiP program is based on building a collaborative partnership among national, international, public, and private organizations. Currently, the program includes a total of 61 sites encompassing more than 300,000 km^2. Thirty-nine organizations participate in PiP activities in 18 countries. The US Agency for International Development played a major role in launching and supporting this successful program.

For the present study, the occurrence of species for ecoregions and PiP sites was determined in a systematic and integrated fashion. Occurrence in each ecoregion was based on habitat descriptions from the literature, species range maps, and additional information provided by consultants. For the PiP sites, we developed and sent preliminary species lists to TNC's partners and ornithological experts, who confirmed or negated records of birds in the various sites. If a bird species was recorded as occurring within a PiP site, we assumed that the species was present in the ecoregion or ecoregions that overlap the park's boundaries. Ultimately we gener-

ated two types of species lists, one indicating recorded occurrences and the other estimated occurrences.

Information Management

The information was generated from a number of computerized and manual sources and was subsequently recombined in spreadsheets for tabular data analysis and in a geographic information system for mapping purposes. The Nature Conservancy's new Migratory Bird Information System (MBIS) was used to manage the data. This comprehensive and versatile Microsoft Access data base allows for specific data queries involving all of the geographic, occurrence, and status information. For our geographic information system, we took advantage of leading-edge PC ARC/INFO and PC ARC/VIEW software, which was invaluable to the spatial analysis and presentation of the study's results. The analyses performed with the data aim to provide a descriptive, first-cut quantitative assessment of the species richness, distribution, and general conservation status of neotropical migratory bird species in the ASC region. We believe that this study can serve as the foundation for further projects and for the development of priorities and strategies for migratory bird conservation in other regions.

Results and Discussion

The marvels and mysteries of South America's rich biological diversity have long captured the interest of scientists. The exuberance of life found in the continent's forests and coasts captivates conservation groups and the public as well. The birdlife by itself is enough to account for the increased attention that has occurred in recent decades. Tropical and subtropical ecosystems of South America harbor almost a third (approximately 3100 species) of all known species of birds on earth (Ridgely and Tudor 1989).

South America alone contains the highest diversity of endemic birds in the Western Hemisphere. Endemic birds—native species that occur only in one area of the world—coexist with numerous other resident birds and hundreds of migrants from North America, southern South America, and the Caribbean, as well as a few transoceanic migrants from the Old World. South America's vast territory and amazing wealth of habitats are partly responsible for this proliferation of species. Other contributing factors are the continent's multiple geographic barriers: the Andes and large rivers such as the Amazon and the Orinoco. The fact that the uplifting of the Andes is relatively recent as a geological event also has accelerated the process. As a result, the multiplying of fauna in South America is the most spectacular speciation process that has occurred in the Americas.

Approximately six billion birds migrate between the neotropics and North America every year (Greenberg 1989). Of the 650 species reported as nesting in the United States, the study's research reveals that 62% (406 species) have been recorded in Latin America and the Caribbean as nonbreeders. Of these neotropical migrants, nearly a third (132 species) occur regularly in the ASC region during the nonbreeding season. Represented in these 132 species are 19 taxonomic families that include landbirds, waterfowl, seabirds, and shorebirds. Also represented are regular transients that pass through the ASC region on their way to other nonbreeding grounds in South America. A list of these species and their conservation status is presented in Table 1.

Despite emerging information on avian diversity in South America, most efforts to protect the nonbreeding grounds of neotropical migrants focus on Mexico, Central America, and selected Caribbean islands. Part of the reason may be the notion that South America is less critical to the survival of these birds than are areas in the rest of Latin America and the Caribbean. It is true that more species of neotropical migrants winter in those areas. Yet, for many species, habitats in South America are the most important destination. Those species are "programmed" to go to specific geographic destinations—habitats in the 77 ecoregions of the ASC region. Among the habitats these species use, either as transients or nonbreeding residents, are tropical moist forests, dry forests, yungas, paramo, chaco, and coastal and mangrove habitats.

Why do some birds migrate between North and South America? The answer provides a perspective that may enhance the conservation of migratory birds. Scientists have proposed a number of theories on the evolution of bird migration, but a recent hypothesis suggested by Rappole (1995) combines some elements of previous ideas and seems to best explain the migration of most neotropical migrants. Rappole proposes that most of these species were originally neotropical residents that were forced away from their birthplace by competition with members of their own species. They retreated to the northern temperate zone but were pushed back to the neotropics by deteriorating weather as the northern winter approached.

Migratory species spend only one third to one half of their lives on their breeding grounds in North America. This suggests that the traditional North American view of neotropical migrants as "our" birds that are temporary "guests" in the neotropics where they "winter" should be adjusted. To modify this North American bias, certain changes in semantics are needed. For

Table 1. Conservation status of Andean/Southern Cone region neotropical migrants

Family	Scientific name	Common name	S. Amer. affinity[a]	Concern[b]	PIF >18[c]	Decline[d]	Level of signif.[e]
Hydrobatidae (storm petrels)	*Oceanodroma leucorhoa*	Leach's storm petrel				nt	
	Oceanodroma melania	black storm petrel		X	22	nt	
	Oceanodroma microsoma	least storm petrel		X	24	nt	
Ardeidae (bitterns and herons)	*Ixobrychus exilis*[f]	least bittern					
	Ardea herodias	great blue heron					
	Casmerodius albus[f]	great egret					
	Egretta thula[f]	snowy egret					
	Egretta caerulea[f]	little blue heron				−1.2	
	Bubulcus ibis[f]	cattle egret					
	Butorides virescens[f]	green heron				nt	
Anatidae (ducks)	*Anas acuta*	northern pintail				−32.9	
	Anas discors	blue-winged teal				−3.5	
	Anas cyanoptera	cinnamon teal					
	Anas clypeata	northern shoveler				−0.6	
	Anas americana	American wigeon					
	Aythya affinis	lesser scaup					
Cathartidae (vultures)	*Cathartes aura*	turkey vulture					
Accipitridae (kites, hawks and ospreys)	*Pandion haliaetus*	osprey			nt		
	Elanoides forficatus[f]	American swallow-tailed kite	X	X	24		
	Ictinia mississippiensis	Mississippi kite	X	X	19		
	Buteo platypterus	broad-winged hawk	X				
	Buteo swainsoni	Swainson's hawk	X				
Falconidae (falcons)	*Falco columbarius*	merlin				−0.1	
	Falco peregrinus[f]	peregrine falcon					
Rallidae (rails)	*Porzana carolina*	sora				−9.9	
Charadriidae (plovers)	*Pluvialis squatarola*	black-bellied plover				nt	
	Pluvialis dominica	American golden-plover	X			nt	
	Charadrius wilsonia	Wilson's plover		X	20		
	Charadrius semipalmatus	semipalmated plover				nt	
	Charadrius vociferus	killdeer					
Scolopacidae (sandpipers, phalaropes and allies)	*Tringa melanoleuca*	greater yellowlegs	X			nt	
	Tringa flavipes	lesser yellowlegs				−1.7	
	Tringa solitaria	solitary sandpiper				nt	
	Catoptrophorus semipalmatus	willet					
	Heteroscelus incanus	wandering tattler				nt	
	Actitis macularia	spotted sandpiper				−0.4	
	Bartramia longicauda	upland sandpiper	X				
	Numenius phaeopus	whimbrel				nt	
	Limosa haemastica	Hudsonian godwit	X	X	22	nt	
	Arenaria interpres	ruddy turnstone				nt	
	Aphriza virgata	surfbird		X	19	nt	
	Calidris canutus	red knot		X	22	nt	
	Calidris alba	sanderling				nt	
	Calidris pusilla	semipalmated sandpiper				nt	
	Calidris mauri	western sandpiper				nt	
	Calidris minutilla	least sandpiper				nt	
	Calidris fuscicollis	white-rumped sandpiper	X	X	21	nt	
	Calidris bairdii	Baird's sandpiper	X			nt	
	Calidris melanotos	pectoral sandpiper	X			nt	
	Calidris himantopus	stilt sandpiper	X	X	20	nt	
	Tryngites subruficollis	buff-breasted sandpiper	X	X	22	nt	
	Limnodromus griseus	short-billed dowitcher				nt	
	Gallinago gallinago[f]	common snipe					
	Steganopus tricolor	Wilson's phalarope	X			−0.8	
	Phalaropus lobatus	red-necked phalarope				nt	
	Phalaropus fulicaria	red phalarope	X			nt	

Table 1. (Continued) Conservation status of Andean/Southern Cone region neotropical migrants

Family	Scientific name	Common name	S. Amer. affinity[a]	Concern[b]	PIF >18[c]	Decline[d]	Level of signif.[e]
Laridae (gulls and terns)	*Stercorarius pomarinus*	pomarine jaeger				nt	
	Stercorarius parasiticus	parasitic jaeger				nt	
	Stercorarius longicaudus	long-tailed jaeger	X			nt	
	Larus atricilla	laughing gull					
	Larus pipixcan	Franklin's gull	X	X	23	−19.3	***
	Xema sabini	Sabine's gull	X			nt	
	Sterna nilotica	gull-billed tern				−0.9	
	Sterna maxima	royal tern				−2.0	
	Sterna elegans	elegant tern	X	X	19	nt	
	Sterna sandvicensis	sandwich tern					
	Sterna dougallii	roseate tern				nt	
	Sterna hirundo	common tern		X		−8.4	***
	Sterna paradisaea	Arctic tern				nt	
	Sterna antillarum	least tern	X	X	19	−2.8	
	Chlidonias niger	black tern	X	X		−5.6	***
Cuculidae (cuckoos)	*Coccyzus erythropthalmus*	black-billed cuckoo	X	X	20	−0.1	
	Coccyzus americanus	yellow-billed cuckoo	X	X	21	−1.3	***
Caprimulgidae (nighthawks)	*Chordeiles acutipennis*[f]	lesser nighthawk					
	Chordeiles minor	common nighthawk	X			−0.1	
	Caprimulgus carolinensis	chuck-will's-widow				−0.9	
Apodidae (swifts)	*Cypseloides niger*	black swift		X	24	−3.5	
	Chaetura pelagica	chimney swift	X			−0.7	
Alcedinidae (kingfishers)	*Megaceryle alcyon*	belted kingfisher				−0.7	
Tyrannidae (tyrant flycatchers)	*Contopus borealis*	olive-sided flycatcher	X	X	20	−3.7	***
	Contopus sordidulus	western wood-pewee	X	X	19	−1.7	***
	Contopus virens	eastern wood-pewee	X	X		−1.5	***
	Empidonax virescens	Acadian flycatcher		X	19		
	Empidonax alnorum[g]	alder flycatcher	X			nt	
	Empidonax traillii[g]	willow flycatcher			nt	nt	
	Myiarchus crinitus	great crested flycatcher					
	Myiodynastes luteiventris	sulphur-bellied flycatcher	X	X	20		
	Tyrannus tyrannus	eastern kingbird	X			−0.3	
	Tyrannus dominicensis	gray kingbird	X	X	19	−2.6	***
Hirundinidae (swallows)	*Progne subis*	purple martin	X				
	Riparia riparia	bank swallow	X			−0.1	
	Hirundo pyrrhonota	cliff swallow	X				
	Hirundo rustica	barn swallow	X				
Muscicapidae (thrushes)	*Catharus fuscescens*	veery	X	X	19	−1.0	**
	Catharus minimus	gray-cheeked thrush	X	X		−1.7	**
	Catharus ustulatus	Swainson's thrush	X			−0.9	
Vireonidae (vireos)	*Vireo flavifrons*	yellow-throated vireo	X	X	19		
	Vireo olivaceus	red-eyed vireo	X				
	Vireo altiloquus	black-whiskered vireo	X	X	19		
	Vireo flavoviridis	yellow-green vireo	X			nt	
Emberizidae (songbirds and allies)	*Vermivora chrysoptera*	golden-winged warbler		X	25	−2.6	***
	Vermivora peregrina	Tennessee warbler					
	Dendroica petechia	yellow warbler					
	Dendroica pensylvanica	chestnut-sided warbler		X	22	−0.4	
	Dendroica magnolia	magnolia warbler					
	Dendroica tigrina	Cape May warbler		X	19		
	Dendroica caerulescens	black-throated blue warbler		X	21		
	Dendroica coronata	yellow-rumped warbler					
	Dendroica virens	black-throated green warbler					
	Dendroica fusca	Blackburnian warbler	X	X	21		
	Dendroica castanea	bay-breasted warbler	X	X	19	−1.3	
	Dendroica striata	blackpoll warbler	X			−8.9	

Table 1. (Continued) Conservation status of Andean/Southern Cone region neotropical migrants

Family	Scientific name	Common name	S. Amer. affinity[a]	Concern[b]	PIF >18[c]	Decline[d]	Level of signif.[e]
	Dendroica cerulea	cerulean warbler	X	X	25	−2.9	***
	Mniotilta varia	black-and-white warbler		X		−1.1	**
	Setophaga ruticilla	American redstart		X		−1.1	*
	Protonotaria citrea	prothonotary warbler		X	22	−0.2	
	Seiurus aurocapillus	ovenbird					
	Seiurus noveboracensis	northern waterthrush					
	Seiurus motacilla	Louisiana waterthrush		X	21		
	Oporornis formosus	Kentucky warbler				−0.7	
	Oporornis agilis	Connecticut warbler	X	X	21		
	Oporornis philadelphia	mourning warbler	X	X	19		
	Geothlypis trichas	common yellowthroat				−0.2	
	Wilsonia citrina	hooded warbler		X	20		
	Wilsonia canadensis	Canada warbler	X	X	20		
	Piranga rubra	summer tanager				−0.2	
	Piranga olivacea	scarlet tanager	X	X	19		
	Pheucticus ludovicianus	rose-breasted grosbeak	X				
	Spiza americana	dickcissel	X	X	21	−1.7	***
	Dolichonyx oryzivorus	bobolink	X	X		−1.9	***
	Icterus spurius	orchard oriole		X	20	−1.4	**
	Icterus galbula	northern oriole					
		Totals:	53	48	43	45	17

[a]Neotropical migratory bird with a South American affinity.

[b]Species of conservation concern: species with PIF concern scores that are >18 and/or statistically significant negative BBS population trends.

[c]Partners in Flight concern score is greater than 18. nt = no trend available.

[d]Breeding Bird Survey US trend (1966–1991). Declines are presented. nt = no trend available. Statistical significance in next column.

[e]Level of significance for population trends (*$P < 0.10$; **$P < 0.05$; ***$P < 0.01$).

[f]Difficulty in distinguishing between ranges of South American residents vs North American migrants or subspecies.

[g]Difficulty in distinguishing between two species of flycatchers.

example, the term nonbreeding grounds should replace wintering grounds, and nonbreeding resident should substitute for winter resident. Such adjustments might help galvanize conservationists in North America to unite with partners in Latin America to do what is necessary to conserve these birds.

Distributions in Ecoregions

Given the tremendous variety of ecosystems in the ASC region, the determination of species distributions of neotropical migrants was a complex undertaking. The task involved establishing the number of species of neotropical migrants that occur in each of the 77 ecoregions found in the six nations of the ASC region. Comparison of species richness across ecoregions and nations must be done with great caution. Major variations in habitat within a given ecoregion are caused by differences in soils, elevation, human disturbance, and hydrographic features, and these variations affect the distribution of birds. The occurrence and abundance of a given neotropical migrant species is therefore not uniform across an ecoregion. The ecoregions and PiP sites of the ASC region are illustrated in Figure 1.

The fact that one ecoregion has more migratory bird species (i.e., a higher species richness) than another does not mean that it is more important for migratory birds. Factors such as the abundance of each species and the status of the birds need to be known before solid conservation priorities can be set. Identification of the ecoregion distribution of the 132 species in the ASC region during the nonbreeding season reveals that the greatest number of species occurs along the coastline. The ecoregions determined to have the highest species richness are, in descending order, the Cordillera de la Costa forests in Venezuela; the Chocó/Darién moist forests in Colombia, Panama, and Ecuador; the Ecuadorian dry forests; the Guajira/Barranquilla xeric scrub of Colombia and Venezuela; and the La Costa xeric shrublands of Venezuela. Each of these ecoregions hosts between 58 and 65 species. The ecoregional distribution and conservation status of all migrants and those with a South American affinity are presented in Table 2.

The Sinú Valley dry forests in Colombia and the interior Napo moist forests, which extend from Peru through Ecuador and Colombia and a small portion of Venezuela, also are particularly rich in neotropical migratory bird species, hosting 57 species each. Overall, we found a total of 30 ecoregions in the ASC region that

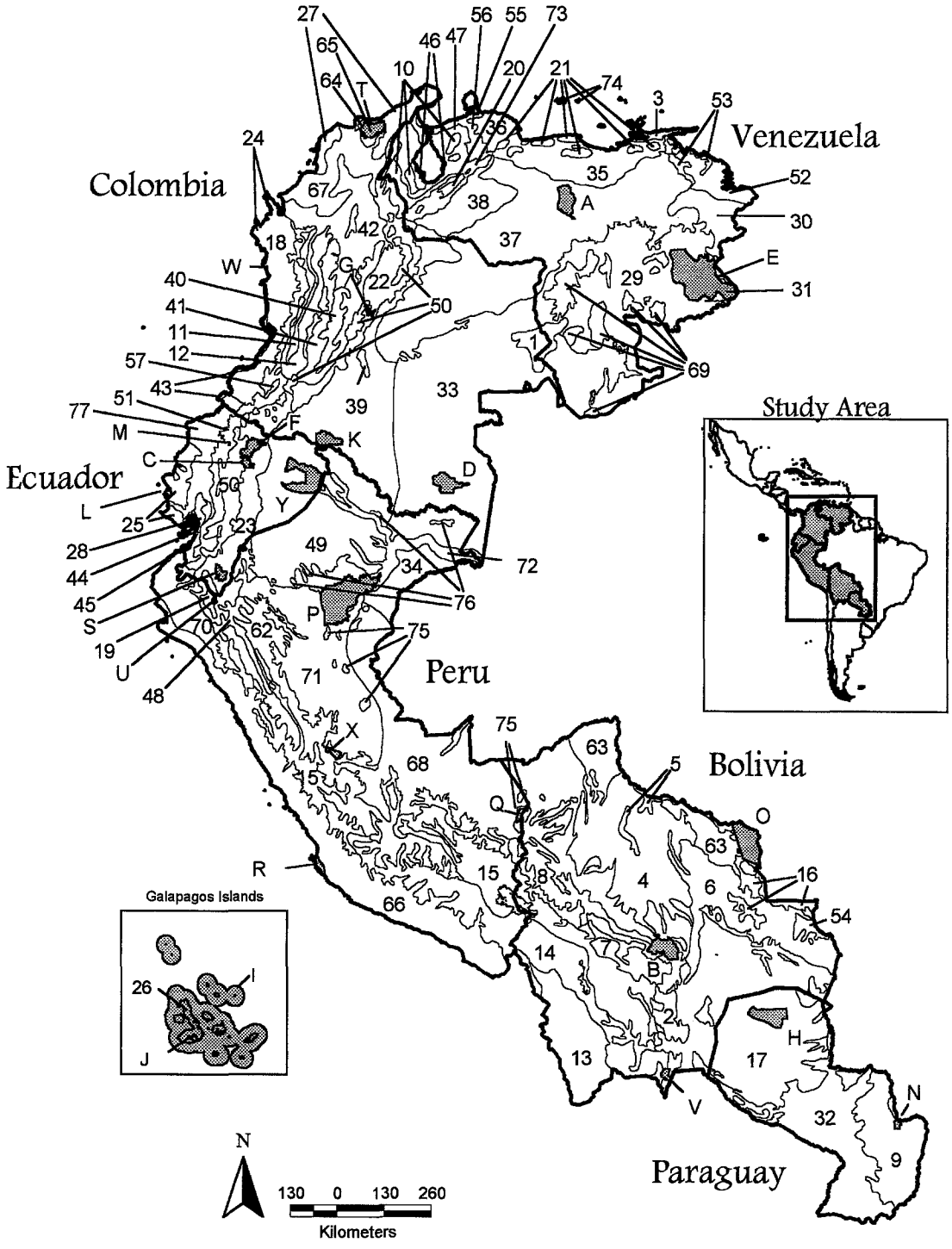

Figure 1. The Andean/Southern Cone region and Parks in Peril sites.

each harbor more than 30 neotropical migratory bird species.

The fact that relatively high numbers of migratory species occur in the coastal ecoregions is not surprising, because shorebirds and seabirds constitute more than one third of the 132 migrant species that occur in the ASC region. The high number of migratory species determined to live along the Ecuadorian and Peruvian coasts may be explained by an important natural phenomenon, the Humboldt Current, that affects these coasts. The Humboldt Current is a shallow, cold-water current flowing northwards along the western coast of

Table 2. Distribution and conservation status of migrants in Andean/Southern Cone ecoregions

Ecoregion[a]	Area (km²)	All neotropical migrants						Migrants with a South American affinity					
		Species	Cons. concern[b]		PIF[c]	BBS trends[d]		Species	Cons. concern[b]		PIF[c]	BBS trends[d]	
			N	%	>18	N	Dec.		N	%	>18	N	Dec.
Cordillera La Costa forests—Venezuela	13,481	65	28	43	22	54	13	26	17	65	14	21	8
Chocó/Darién moist forests—Colombia, Ecuador	69,001	63	25	40	21	52	11	28	17	60	15	23	8
Ecuadorian dry forests—Ecuador	22,271	63	17	27	14	37	7	25	11	44	10	15	5
Guajira/Barranquilla xeric scrub—Colombia, Venezuela	32,402	62	14	23	12	42	6	15	7	46	6	9	4
Venezuelan Islands[c]—Venezuela	na	60	24	40	18	53	12	26	15	57	12	25	9
La Costa xeric shrublands—Venezuela	64,379	58	17	29	11	45	8	18	10	55	7	14	5
Napo moist forests—Peru, Ecuador, Colombia, Venezuela	369,847	57	24	42	18	44	11	39	20	51	16	30	8
Siú Valley dry forests—Colombia	55,473	57	16	28	14	45	8	16	9	56	8	14	5
Sechura desert—Peru	188,492	54	14	26	10	26	5	23	9	39	7	13	3
Cordillera Oriental montane forests—Colombia, Venezuela	66,712	53	18	34	14	51	9	23	11	47	8	22	6
Eastern Cordillera Real montane forest—Ecuador, Colombia, Peru	84,442	52	20	38	15	44	10	33	17	51	14	27	7
Northwestern Andean montane forests—Colombia, Ecuador	52,937	49	19	39	16	43	8	24	13	54	12	21	5
Catatumbo moist forests—Venezuela, Colombia	21,813	48	22	46	19	43	10	25	14	56	12	22	7
Galapagos Islands xeric scrub—Ecuador	9,122	46	8	17	6	24	3	16	5	31	4	10	2
Llanos—Venezuela, Colombia	355,112	46	11	24	8	35	7	20	8	40	6	15	5
Western Ecuador moist forests—Ecuador, Colombia	40,218	45	14	31	11	33	6	16	9	56	8	14	4
Magdalena/Urabá moist forests—Colombia	73,660	43	19	44	16	40	7	21	12	57	11	19	4
Southwestern Amazonia moist forests—Peru, Bolivia	327,601	41	15	37	13	30	6	31	14	45	13	23	5
Venezuelan Andes montane forests—Venezuela, Colombia	16,638	39	16	41	13	38	7	20	11	55	9	20	5
Cauca Valley montane forests—Colombia	32,412	38	18	47	15	36	7	19	11	57	10	17	4
Mangroves[e]—Venezuela	4,595	38	7	18	5	26	3	10	4	40	3	7	2
Santa MarXta montane forests—Colombia	4,707	38	21	55	17	38	10	15	11	73	9	15	6
Magdalena Valley montane forests—Colombia	49,322	37	16	43	12	36	8	19	11	57	9	18	5
Lara/Falcón dry forests—Venezuela	16,178	36	8	22	7	26	4	8	3	37	3	7	2
Paraguaná xeric scrub—Venezuela	15,313	36	10	28	9	26	4	7	4	57	4	7	2
Mangroves[e]—Ecuador	2,811	34	7	21	4	20	4	7	4	57	3	3	2
Mangroves[e]—Colombia	5,265	33	7	21	5	20	3	6	4	66	1	0	0
Guianan highlands moist forests—Venezuela, Colombia	203,977	32	13	41	11	30	6	22	11	50	10	20	4
Japura/Negro moist forests—Colombia, Venezuela, Peru	384,906	32	14	44	11	30	7	21	12	57	10	19	6
Bolivian Yungas—Bolivia, Peru	72,517	31	10	32	8	24	6	23	10	43	8	18	6
Peruvian Yungas—Peru	188,735	31	13	42	9	28	8	19	11	57	9	17	6
Varzea forests—Colombia, Ecuador, Peru	58,917	30	5	17	4	21	1	17	5	29	4	12	1
chaco savannas—Bolivia, Paraguay	281,378	29	8	28	7	18	2	23	8	34	7	13	2
Guayaquil flooded grasslands—Ecuador	3,617	29	5	17	3	18	2	6	3	50	2	4	1
Orinoco Delta swamp forests—Venezuela, Guyana	28,469	29	7	24	5	21	4	10	6	60	5	8	3
Araya and Paría xeric scrub—Venezuela	5,424	28	8	29	4	21	6	5	4	80	3	4	3
Humid Chaco—Paraguay, Brazil, Bolivia	152,968	28	8	29	7	18	2	22	8	36	7	13	2
Rondônia/Mato Grosso moist forests—Brazil, Bolivia	70,562	28	9	32	8	21	5	20	9	45	8	15	5

Table 2. (Continued) Distribution and conservation status of migrants in Andean/Southern Cone ecoregions

		All neotropical migrants							Migrants with a South American affinity					
			Cons. concern[b]		PIF[c]	BBS trends[d]			Cons. concern[b]		PIF[c]	BBS trends[d]	
Ecoregion[a]	Area (km²)	Species	N	%	>18	N	Dec.	Species	N	%	>18	N	Dec.
Western Amazon flooded grasslands—Peru, Bolivia	10,111	28	5	18	4	21	2	19	5	26	4	13	2
Cauca Valley dry forests—Colombia	5,130	27	7	26	5	23	4	8	3	37	2	6	2
Magdalena Valley dry forests—Colombia	13,837	27	8	30	5	25	6	9	5	55	3	8	4
Ucayali moist forests—Brazil, Peru	173,527	27	12	44	10	23	6	21	11	52	10	17	5
Maracaibo dry forests—Venezuela, Colombia	31,471	26	10	38	9	22	5	11	6	54	6	8	3
Tumbes/Piura dry forests—Ecuador, Peru	46,341	26	6	23	4	16	4	7	3	42	3	7	2
Beni savannas—Bolivia	165,403	25	6	24	5	18	3	18	6	33	5	13	3
Western Amazon swamp forests—Colombia, Peru	8,315	25	6	24	5	19	3	17	6	35	5	12	3
Brazilian Interior Atlantic forests—Paraguay	80,299	24	7	29	6	17	2	19	7	36	6	14	2
Pantanal—Bolivia, Paraguay	15,114	24	6	25	5	16	2	19	6	31	5	12	2
Cerrado—Paraguay, Bolivia	28,387	23	6	26	5	18	3	17	6	35	5	13	3
Beni swamp and gallery forests—Bolivia	15,369	22	5	23	4	15	2	16	5	31	4	10	2
Central Andean wet puna—Peru, Bolivia	184,067	21	5	24	4	12	2	11	4	36	3	6	2
Northern Andean paramo—Colombia, Ecuador, Venezuela	58,806	21	3	14	3	15	2	12	3	25	3	8	2
Mangroves[e]—Peru	701	20	2	10	1	10	1	2	1	50	3	3	2
Eastern Panamanian montane forests—Colombia	789	19	9	47	7	19	4	7	4	57	4	7	1
Bolivian lowland dry forests—Bolivia	102,362	17	6	35	5	14	3	12	6	50	5	10	3
Central Andean dry puna—Peru	78,051	17	2	12	1	11	1	9	2	22	1	5	1
Cordillera de Mérida paramo—Venezuela	3,518	17	3	18	3	12	1	11	3	27	3	7	1
Andean Yungas—Bolivia	21,858	16	3	19	2	13	2	10	3	30	2	8	2
Central Andean puna—Bolivia, Peru	140,960	16	2	13	2	10	0	9	2	22	2	5	0
Pelagic[e]—Ecuador	na	16	7	44	5	5	3	7	4	57	3	3	2
Bolivian montane dry forests—Bolivia	39,368	14	3	21	2	11	2	8	3	37	2	6	2
Guianan savannas—Venezuela	13,160	14	4	29	3	11	2	11	4	36	3	9	2
Jurúa moist forests—Peru	36,157	14	5	36	4	12	3	11	5	45	4	10	3
Orinoco wetlands—Venezuela	6,403	14	3	21	2	11	1	4	3	75	2	3	1
Pelagic[e]—Colombia	na	14	5	36	4	4	2	6	3	50	2	3	2
Pelagic[e]—Peru	na	13	6	46	4	5	3	6	4	66	3	3	2
Tepuis—Venezuela	46,180	13	6	46	5	13	2	10	5	50	5	10	1
Patia dry forests—Colombia	1,291	12	4	33	2	11	3	5	3	60	2	4	2
Santa Marta paramo—Colombia	1,329	12	4	33	4	11	3	7	4	57	4	7	3
Cordillera Central paramo—Peru, Ecuador	14,128	11	2	18	2	8	2	8	2	25	2	5	2
Llanos dry forests—Venezuela	44,177	11	6	55	5	10	4	5	4	80	4	5	2
Macarena montane forests—Colombia	2,366	11	8	73	7	11	3	10	7	70	6	10	3
Paraguaná restingas—Venezuela	88	9	2	22	2	4	1	1	1	100	1	1	1
Amazonian savannas—Colombia, Venezuela	18,011	7	2	29	2	5	0	7	2	28	2	5	0
Pelagic[e]—Venezuela	na	7	3	43	1	3	2	2	2	100	1	2	1
Guianan moist forests—Venezuela	31,931	4	2	50	1	4	1	4	2	50	1	4	1
Marañón dry forests—Peru	14,921	4	3	75	1	4	2	2	2	100	1	2	1

[a]Species of conservation concern: Species with PIF concern scores that are >18 and/or statistically significant negative US Breeding Bird Survey (BBS) population trends.

[b]Partners in Flight (PIF) concern scores that are greater than 18.

[c]Breeding Bird Survey US trend, 1966–1991. Columns indicate number of birds with trends and declines that differ significantly from zero ($P < 0.10$).

[d]Ecoregions derived from the WB/WWF Conservation Assessment (Dinerstein and others 1995). Areas are given for ecoregion coverage in the Andean/Southern Cone Region only.

[e]This ecoregion designation was created for this study and does not conform to WB/WWF dataset.

South America. It causes an upwelling of nutrient-rich waters (Morrison and Ross 1989). The high nutrient levels in turn increase fish and plankton populations, providing migrant birds with a rich oceanic feast. Upwelling is generally most intense along the coast of Peru (United States Naval Hydrographic Office 1968).

Shorebirds and seabirds have entirely different habitat requirements from landbirds and waterfowl. Exclusion of these species could be expected to affect our study's ecoregional analysis. To determine the impact, we examined the ecoregional occurrence of the subset of neotropical migratory birds comprising landbirds and waterfowl only, excluding from consideration the storm petrels, plovers, sandpipers, turnstones, surfbirds, phalaropes, gulls, and terns.

We found that among the ecoregions with the highest number of species, several that border the coast are still in the top 10. Included are the Chocó/Darién moist forests, Cordillera de la Costa forests, and Magdalena/Urabá moist forests. However, a few landlocked ecoregions now show some of the highest numbers of species. Among these are ecoregions situated near the upper Andean region, interior Napo moist forests ecoregion, and the Sinú Valley dry forests. The number of species of landbird and waterfowl neotropical migratory birds in the 10 top-ranking ecoregions ranges from 39 to 48.

Neotropical migrants use numerous protected areas in South America as stopover sites or nonbreeding grounds. An important aspect of our analysis was to determine to what extent these species occur in the PiP sites in the ASC region. The region has 22 of these sites at present and three protected areas that may be designated as PiP sites. Altogether, the 25 sites total nearly 170,000 km^2. The PiP sites preserve original habitat for 36 ecoregions and, as a group, provide refuge for at least 101 of the 132 species of migrants to the ASC region. An additional 28 species are estimated to frequent one or more of these sites but have not yet been recorded. Only the black storm petrel, Wilson's plover, and the black swift are not listed (i.e., neither recorded nor estimated) for any PiP site in the ASC region. The total number of migrants at each site (including recorded and estimated) ranges from 23 to 93 species. A complete list of neotropical migrant occurrence in the ASC region PiP sites is presented in Table 3.

Migrants with a South American Affinity

Of the 132 species in the ASC region during the nonbreeding season, our results show that South America is the main or core wintering ground for 53 species. These 53 species, representing 40% of the migratory species that occur in the ASC region, are thus neotropical migratory birds with a South American affinity (Table 1). These birds are "perpetual summer-seekers" who presumably benefit from their long-distance migration by maximizing reproduction during the lush northern summer and minimizing mortality during the harsh northern winter. The fact that the majority of the populations of each of these 53 species spends the nonbreeding season in South America indicates that ASC region habitats and PiP sites are critical to the protection of these birds. Our geographical analysis also indicated that the highest numbers of neotropical migrants with a South American affinity occur in two major areas in the interior of the ASC region (Table 2). One area includes the Napo moist forests (39 species) and the eastern Cordillera Real montane forests of Ecuador, Colombia, and Peru (33 species). The second area comprises the southwestern Amazonian moist forests (31 species).

High distribution of species with a South American affinity also is apparent in coastal ecoregions, including the Chocó/Darién moist forests, Cordillera de la Costa forests, Ecuadorian dry forests, and Catatumbo moist forests of Venezuela and Colombia, each of which hosts from 25 to 28 species. A recent study by Robinson and others (1995) confirms this pattern of species richness. Additional ecoregions with high numbers of migrants with a South American affinity are the Bolivian yungas and Chaco savannas of Paraguay and Bolivia. As with the neotropical migrants in general, we did another evaluation of distribution by excluding shorebirds and seabirds. When this subset was excluded, we found that many of the ecoregions with the greatest species richness overall are also richest in the 53 species with a South American affinity. These ecoregions are the Napo moist forests, eastern Cordillera Real montane forests, Chocó/Darién, and the southwestern Amazonian moist forests. Some interior ecoregions, such as the Cordillera Oriental montane forests and Magdalena/Urabá moist forests, also are among the top 10 ecoregions with respect to species richness of landbirds and waterfowl with a South American affinity.

Species of Conservation Concern

Which migrant species are most at risk? For the purposes of this study, we singled out a group of migratory species of "conservation concern," based on PIF scores and BBS population trends. Included in this group are all species that exhibit one or both of the following: high PIF scores (greater than 18) and statistically significant long-term BBS trends (Table 1).

Table 3. Distribution and conservation status of migrants in nations and parks in peril sites

Nation		Parks in peril site[a]	All neotropical migrants						Migrants with a South American affinity					
				Cons. concern[b]		PIF[c]	BBS trends[d]			Cons. concern[b]		PIF[c]	BBS trends[d]	
			Species	N	%	>18	N	Dec.	Species	N	%	>18	N	Dec.
Bolivia			43	16	37	14	31	8	33	16	48	14	24	8
	B	Amboró National Park	41	15	36	13	30	7	31	15	48	13	23	7
	O	Noel Kempff Mercado National Park	33	11	33	10	24	5	25	11	44	10	18	5
	V	Tariquia	23	4	17	3	16	2	16	4	25	3	10	2
Colombia			131	47	35	41	94	16	53	29	54	25	39	12
	T	Sierra Nevada de Santa Marta National Park	93	34	36	29	72	14	34	20	58	17	28	10
	G	Chingaza National Park	65	20	30	16	58	10	30	13	43	10	26	7
	W	Utria National Park[e]	63	25	39	21	52	11	28	17	60	15	23	8
	K	La Paya National Park	56	23	41	18	43	10	39	20	51	16	30	8
	D	Cahuinari National Park	32	14	43	11	30	7	21	12	57	10	19	6
Ecuador			97	32	33	25	61	12	47	23	48	19	33	9
	L	Machalilla National Park	62	17	27	14	36	7	25	11	44	10	15	5
	C	Antisana Ecological Reserve	54	18	33	13	45	9	34	16	47	13	28	7
	F	Cayambe-Coca Ecological Reserve	54	18	33	13	45	9	34	16	47	13	28	7
	Y	Yasuni National Park	52	20	38	14	39	9	36	17	47	13	27	7
	S	Podocarpus National Park	49	18	36	13	42	9	32	16	50	13	26	7
	I	Galapagos Marine Reserve	46	8	17	6	24	3	16	5	31	4	10	2
	J	Galapagos National Park	46	8	17	6	24	3	16	5	31	4	10	2
	M	Maquipucuna	43	15	34	12	37	7	23	12	52	11	21	5
Paraguay			28	9	32	8	19	2	22	9	40	8	14	2
	H	Defensores del Chaco National Park[e]	27	8	29	7	18	2	21	8	38	7	13	2
	N	Mbaracayu Nature Reserve	24	7	29	6	18	2	19	7	36	6	14	2
Peru			84	29	35	22	51	12	46	23	50	19	32	9
	R	Paracas National Reserve[e]	54	14	25	10	26	5	23	9	39	7	13	3
	P	Pacaya-Samiria National Reserve	51	17	33	14	38	7	36	16	44	14	27	6
	U	Tabaconas Namballe National Sanctuary	46	17	36	12	38	9	31	15	48	12	25	7
	Q	Pampas del Health National Sanctuary	45	15	33	13	33	6	32	14	43	13	23	5
	X	Yanachaga-Chemillén National Park	39	16	41	11	34	9	27	14	51	11	23	7
Venezuela			111	40	36	33	84	16	45	25	55	21	35	11
	E	Canaima National Park	62	23	37	19	52	13	34	19	55	16	29	10
	A	Aguaro/Guariquito	46	11	23	8	36	7	20	8	40	6	15	5

[a]Letter codes correspond to labels on Figure 1.

[b]Species of conservation concern: Species with PIF concern scores >18 and/or statistically significant negative US Breeding Bird Survey (BBS) population trends.

[c]Partners in Flight (PIF) concern scores >18.

[d]Breeding Bird Survey US trend (1966–1991). Columns indicate number of birds with trends and declines that differ significantly from zero ($P < 0.01$).

[e]Potential Parks in Peril site.

The results of our evaluation of conservation status are summarized below:

	Total species	Conservation concern
US neotropical migrants	406	156
Migrants to ASC region	132	48
South American affinity	53	29

By these criteria, an alarming 29 species (55%) of the migrants with a South American affinity are of conservation concern. Additional migratory species would join this group if we consider information from other studies (Rappole 1995). The additional species are the broad-winged hawk, Swainson's hawk, upland sandpiper, barn swallow, American golden plover, and yellow-green vireo. The addition of these six species makes a

grand total of 35 migratory species with a South American affinity that are of conservation concern. This conclusion suggests that two thirds of the 53 species with a South American affinity have a tenuous future unless their status can be improved.

Which ecoregions are utilized by the greatest number of neotropical migratory birds of conservation concern? A tally of species for each ecoregion points to, in descending order, the Cordillera de la Costa forests (28 species), Chocó/Darién moist forests, Napo moist forests, and Catatumbo moist forests (22 species) (Table 2). Of these species of conservation concern, the group with a South American affinity is of particular interest to this study because the future of these birds depends heavily on the fate of their nonbreeding grounds in the ASC region. For this group, the same ecoregions are in the top five with respect to species richness except for the Catatumbo moist forests, which are replaced by the eastern Cordillera Real montane forests. The number of species per ecoregion in this analysis ranged from 20 (Napo moist forests) to 15 (Venezuelan islands) (Table 2).

Conclusions

The study highlights the fact that the ASC region is the main destination for 53 species with a South American affinity. Two thirds of these species have a tenuous future unless their status can be improved. More than one third have life histories that make them especially vulnerable to habitat degradation in South America (Roca and others 1996). Unfortunately, of 68 terrestrial ecoregions in the ASC region, only 15 are considered "relatively stable" or better (Dinerstein and others 1995).

The futures of the Franklin's gull, Mississippi kite, yellow-billed cuckoo, cerulean warbler, scarlet tanager, Canada warbler, olive-sided flycatcher, eastern wood pewee, veery, and dickcissel—to mention a few examples—are uncertain. Protection programs for migratory birds are unlikely to be successful if we wait until only a few, isolated populations of a species remain.

The ecoregional approach used in the study resulted in preliminary bird occurrence lists for each PiP site. We look forward to confirming occurrences in these parks based on future input from TNC's partners. Perhaps other protected areas will benefit as well from this concerted effort. On-the-ground refinement of bird occurrences in ecoregions and PiP sites is needed in particular for the Tariquia site in Bolivia, Defensores del Chaco in Paraguay, and all PiP sites in Colombia, excluding Sierra Nevada de Santa Marta.

Continued integration of information on endemic and resident birds is another need, as is integration of data on other animals and communities. Analysis and prioritization of flyway use, concentration areas, and stopover sites will help in the development of linkages between sites on breeding and nonbreeding grounds. This information is crucial to identifying key areas for conservation. Projects need to be initiated to determine bird abundances in sites and ecoregions.

Expansion and consolidation of partnerships in South America is needed to facilitate sharing of vital information on migratory birds. Communication is essential also on funding opportunities, projects, surveys, and the results of monitoring and management activities. Training workshops are needed as well.

Additional activities are necessary in the ASC region and beyond, and TNC would like to undertake these activities in the longer term. They include expansion of this ecoregional methodology to the entire Western Hemisphere, including breeding grounds in North America and additional nonbreeding regions of Latin America. Crucial to future conservation planning for migratory birds will be analysis of the results from desperately needed field research directed at characterizing the relative suitability of various human-altered landscapes in Latin America for each migrant species. Only with this information can we evaluate "how much is enough" in terms of conservation of the habitat types that are currently limiting the populations of these species. Another highly important endeavor will be support of partnerships to promote education on land-use practices beneficial to migratory and resident birds. For example, farmers and coffee consumers alike need to be educated on the benefits of shade-grown coffee.

A Global Outlook

For many species of neotropical migratory birds, long-term survival depends on the quality of their habitats in several countries. Any successful conservation plan for these species will require habitat-based conservation actions that cross national boundaries. In the past, efforts to develop conservation priorities for nonbreeding habitats of neotropical migrants have been fragmented and unsystematic. Preservation efforts have lacked a globally oriented approach that takes into account conservation needs of a range of species across an entire region. The ecoregional approach used in the ASC region study is a first step toward developing this international perspective.

For neotropical migrants, the great challenge is to develop and implement solid conservation plans based on good science and partnerships among all nations that provide homes for migratory birds. The Nature

Conservancy is meeting this challenge through its new Migratory Bird Initiative. A globally oriented viewpoint is imperative if these migratory fliers are to continue to make their incredible journeys. An ecoregional methodology can do the job, however, only if it leads to conservation action.

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