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OPPORTUNITIES THROUGH PARTNERSHIPS FOR CONSERVATION AND RESEARCH OF AUSTRAL MIGRANTS

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Abstract. Many migrant birds that breed in North and South America overwinter in the tropics of South America. Yet their exact distribution, micro-habitat use, and threats to survival on their wintering grounds are still poorly understood. Although many use secondary habitats, others require habitats such as native grasslands that are under intense threat of human development. Given that a large portion of these open habitats are located on private landholdings, there is great potential for conserving them and their migratory birds through partnerships with local property owners. To illustrate this, we present a review of the biogeography, habitat occupancy, and conservation and research priorities for migratory species found in South America, along with two examples of partnerships with private landowners.

Key Words: austral, collaboration, Nearctic, Neotropical, private landholders, wintering.

OPORTUNIDADES MEDIANTE COLABORACIONES PARA LA CONSERVACIÓN E INVESTIGACIÓN DE LAS AVES MIGRATORIAS AUSTRALES

Resumen. Muchas especies de aves migratorias que se reproducen en Norteamérica y Sudamérica residen durante la temporada no reproductiva en el trópico de Sudamérica. Sin embargo, su distribución exacta, su uso de micro-hábitat y los riesgos para su supervivencia en esas latitudes son poco conocidos. Aunque muchas de estas especies ocupan hábitats secundarios, otros requieren de hábitats como pastizales nativos, cuales se encuentran críticamente amenazados por las actividades humanas. Dado que una gran proporción de estos hábitats abiertos se encuentran en propiedades privadas, existe un gran potencial para la conservación de estos hábitats y las especies de aves migratorias que los ocupan mediante mecanismos de cooperación con propietarios de estas tierras. Para ilustrar este punto, presentamos una revisión de la biogeografía de las especies migratorias en Sudamérica, su uso de hábitat, y sus prioridades de conservación e investigación. Aportamos finalmente dos ejemplos de cooperación con propietarios, en base a nuestra experiencia.

INTRODUCTION

South America is home to two major bird migration systems: the Nearctic-Neotropical and the Neotropical austral. Nearctic-Neotropical migrants over winter in the tropics, while Neotropical austral migrants (hereafter "austral migrants") breed in the south temperate latitudes of South America, then migrate north towards, and sometimes into, tropical latitudes, staying wholly within South America (see reviews for the latter by Chesser 1994, Joseph 1997, Jahn et al. 2004). In terms of distance traveled, the Neotropical austral system is the most extensive migratory system in the Southern Hemisphere (Chesser 1994). Although other types of migration, such as altitudinal and intra-tropical also occur on the continent, most well-defined, long-distance bird movements in South America occur as part of these two systems.

Very little information exists on the ecology and distribution of many species in these systems during the non-breeding season (Stotz et al. 1996). What is the non-breeding season micro-habitat use? What are the principal sources of mortality during this period? What is the population connectivity between breeding and non-breeding seasons? What seasonal carryover effects exist between seasons? Such questions basically remain unanswered for species over-wintering in the South American tropics (but see Jones et al. 2008).

Nearctic-Neotropical migrants that overwinter within the tropics of South America (i.e.,

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north of the Tropic of Capricorn) have generally broad habitat tolerances (Stotz et al. 1996). Similarly, austral migrants largely use scrubby and open habitats on both the breeding and non-breeding grounds (Chesser 1994). Due to this predominant use of secondary habitats, as well as the relatively large ranges of most species, it has been assumed that migrants in both systems are not highly threatened by anthropogenic changes in their wintering habitat (Stotz et al. 1996). This view is changing, however. Recent work on Nearctic-Neotropical migrants suggests that winter habitat is limiting and may affect reproductive success for at least some species (e.g., Marra et al. 1998, Studds and Marra 2005). Additionally, migratory birds may be especially vulnerable to habitat loss because they require much larger areas of habitat—areas for breeding, for wintering, and for stopover during migration. Indeed, numerous studies have documented steep and widespread declines in North American migratory species (Sauer et al. 2005, Valiela and Martinetto 2007), presumably due in part to habitat loss. Whether a similar process is unfolding in South America is simply unknown. There is a strong consensus of a critical need for studies that link populations at breeding sites to those same populations at particular wintering sites (Webster et al. 2002). These studies are rare for Nearctic-Neotropical migrants and essentially nonexistent for austral migrants.

A case in point is that of migrant ecology in the cerrado grassland of central Brazil, of which only 2% is legally protected (Klink and Machado 2005). According to Mantovani and Pereira (1998), by 1993 only approximately 35% of the cerrado was left undisturbed. Extensive mechanized agriculture is the main threat (Stotz et al. 1996). According to Alho and Martins (1995) nearly one-quarter of all grain produced in Brazil comes from the cerrado region. Yet, most research on bird migration in cerrado is recent—we are still in the stage of identifying which species are migratory and determining their migratory routes (Cavalcanti 1990).

Given the current state of knowledge of migrant bird ecology in South America, the study of austral bird migration is timely for several reasons. First, austral migration provides an independent test of theory developed mainly in north temperate latitudes (Jahn et al. 2004). By testing hypotheses in South America, researchers can assess the generality of theory, thereby developing a better theoretical foothold on the "how's and why's" of bird migration from a global perspective.

Second, migratory birds are internationally important disease vectors. For example, various strains of avian influenza are found in wild birds on all continents and are transported between continents by migration (Gilchrist 2005, Spackman et al. 2006). Migratory birds are also hosts to Equine Encephalitis, Newcastle, and West Nile viruses; the latter has caused human deaths and alarming population declines in North American birds (LaDeau et al. 2007) and has recently been discovered in Argentina (Morales et al. 2006). To predict the spread of avian transmitted diseases, it is imperative for epidemiologists to understand the very basic ecology of migratory birds. Which species migrate? When do they migrate? And, what habitats do they use? Because this information is already known in North America, public health officials in 2006 were able to focus their monitoring efforts for the H5N1 strain of avian influenza in North America on a small set of species predicted to transport the virus. The scientific community is unprepared to make such predictions with species that migrate within South America or between North and South America.

Third, migratory birds are a proven barometer of global climate change. Numerous studies from the Northern Hemisphere have reported that migratory birds have advanced the timing of spring migration in response to recent climate change (Root et al 2003, Jonzén et al. 2006, Zalakevicius et al. 2006). These shifts have resulted in population declines of some migrants (Both et al. 2006). Similar data simply do not exist in South America. A long-term database on the phenology of austral migration across most of southern South America could provide an independent (Southern Hemisphere) barometer of global warming already observed in the Northern Hemisphere.

We have two objectives: 1) to review the biogeography, habitat use, and conservation and research status of migratory bird species in South America, with a focus on austral migrants and 2) to illustrate the value of developing international partnerships among researchers in South America, as well as between researchers and private landholders for the study and conservation of migratory birds.

METHODS AND RESULTS

We use data from Parker et al. (1996) to quantify the proportion of migrants in South America as a whole, as well as per country. We also use these data to describe habitat occupancy of austral migrants and to evaluate current conservation and research priorities for austral migrants.

We divided the number of Nearctic-Neotropical migrant species found in each South American country by the total number of species found in that migratory system (416

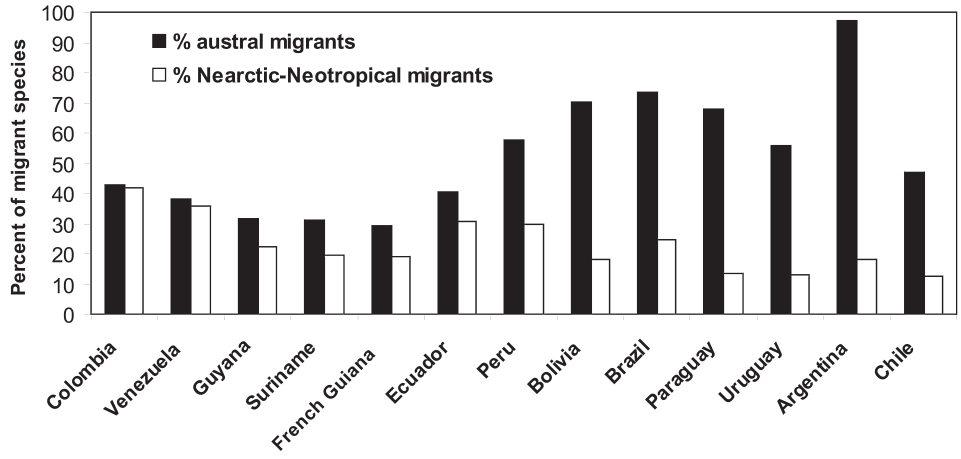

FIGURE 1. Percent of Nearctic-Neotropical and Neotropical austral migrants in each South American country, organized north to south, from left to right. Data from Parker et al. (1996).

Nearctic-Neotropical migrant species). We then performed the same analysis for the austral system (a total of 232 austral migrant species). All data were taken from Parker et al. (1996).

In particular, the percent of austral migrants increases towards the south, with French Guiana holding the lowest percent (29.3%) and Argentina holding the highest (97.0%)(Fig. 1). Conversely, the percent of Nearctic-Neotropical migrant species per country does not change dramatically from country to country, although the highest proportions are in the north, in Colombia (41.8%) and Venezuela (35.8%) (Fig. 1).

Habitat Occupancy

We evaluated habitat occupancy of austral migrants by summing the number of species listed by Parker et al. (1996) occupying each habitat. Habitat occupancy of austral migrants is concentrated in generally open and edge-dominated habitats, with secondary forest, freshwater marshes and second growth scrub being the most common habitats occupied (Fig. 2).

Our analysis combines breeding and nonbreeding habitat occupancy, as there is no distinction between these in the Parker et al. (1996) database. However, the winter habitat occupancy from this database is summarized by Stotz et al. (1996) who concluded that the most commonly used winter habitats occupied by austral migrants are grasslands, lowland evergreen forests and freshwater marshes. According to Chesser (1994), the breeding habitats of most austral migrant passerine species are generally open or scrubby while the least used is forest.

Conservation Priorities

For each species, Parker et al. (1996) list a "conservation priority" on a scale of 1 to 4 (1 = urgent, 2 = high, 3 = medium, 4 = low), subjectively based on population status and vulnerability, habitat, range size, and other variables. They also list a "research priority" for each species on a scale of 1 to 3 (1 = high, 2 = medium, 3 = low), based on the life history, distribution and taxonomy of species. The average conservation priority of austral migrants is 3.8 (median = 4.0) and the average research priority is 2.6 (median = 3.0).

Stotz et al. (1996), in the same book in which the databases of Parker et al. (1996) are presented, state that migrant species are generally a lower conservation concern than non-migratory species because of the former's generally large wintering ranges and low habitat specificity. However, they single out one group of conservation concern: species occupying native grasslands and marshes at the center of the continent, mainly Emberizids of the genus *Sporophila*. In a review of the movements made by this genus, Silva (1999) found that the cerrado grasslands of Brazil are likely the most important wintering habitat for long-distance migrants in this genus.

DISCUSSION

Given that most austral migrants in South America are found in the south of the continent, the most "bang for the buck" increases southward, in terms of research and conservation of the highest number of austral migrant species. Likewise, prioritizing the conservation of open

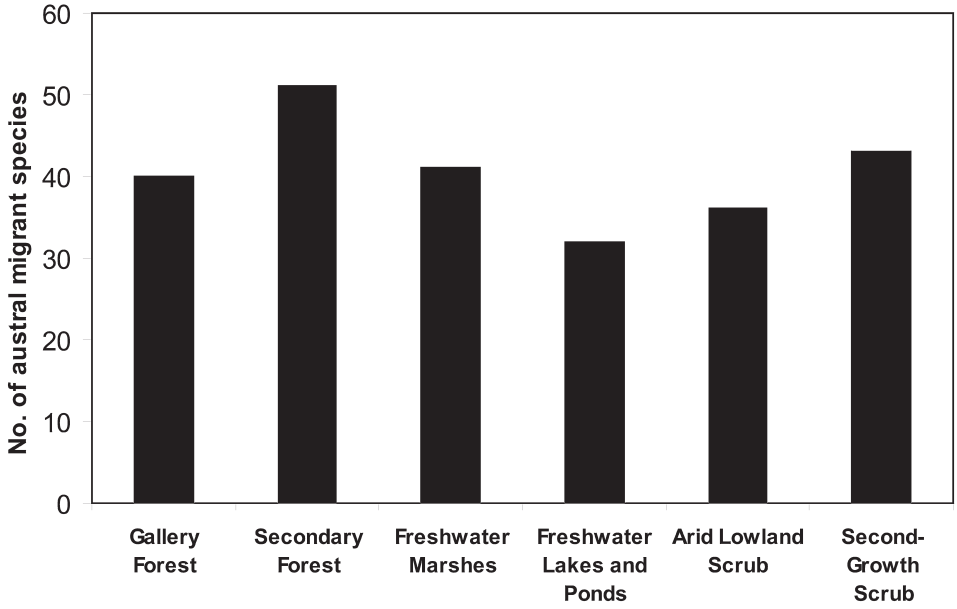

FIGURE 2. Habitats most occupied by austral migrants, according to Parker et al. (1996). We present the two habitats most commonly used by austral migrants for each of the three habitat categories used by Parker et al. (1996): forested (i.e., Gallery forest and Secondary forest), aquatic (i.e., Freshwater marshes and Freshwater lakes and ponds), and non-forested (i.e., Arid lowland scrub and Second-growth scrub) habitats.

habitats such as native grasslands would help protect a larger number of austral migrants than a focus on more closed habitats such as humid forest. Nevertheless, as information such as population trends and habitat needs of individual austral migrant species or groups of species becomes available, research and conservation schemes will do best to tailor their priorities accordingly in terms of where to work and in what habitats to concentrate on.

We suggest that Parker et al.'s relatively low priority score for research on austral migrants is largely driven by lack of basic information about the year-round habitat needs of those species—if many species "disappear" when they leave their breeding grounds and predictably return, it's difficult to conclude that they are in trouble and largely impossible to project any impacts of habitat loss on their wintering grounds. For this reason, Stotz et al. (1996) emphasize that research is "urgently needed" on winter distributions and habitat use of austral migrants. A second reason that Parker et al.'s average priority score for austral migrants is low is that austral migrants were scored alongside all species in the Neotropics, such as local endemics and habitat specialists, for many of which there are intensive studies and for which the current outlook is certainly dire. In comparison, little available information exists on the population status and distribution of most austral migrant species.

We propose that both applied and theoretical research on austral migration should be high priorities due to the lack of information on the population status, distribution and ecology of these species. Additionally, recent findings from other migration systems that migrants can be habitat-limited while overwintering (e.g., Studds and Marra 2005), that migratory birds may be negatively affected by climate change (Both et al. 2006) and that there may exist population-specific patterns between population decline and connectivity (Jones et al. 2008) argues for more basic research on this migratory system. As mentioned earlier, we know little of how diseases are transported by migratory birds in South America, or of the usefulness of austral migrants as monitors of climate change, such that knowledge of migration routes, population connectivity and timing of migration should be priorities for research in South America.

As new distributional information becomes available, the conservation concern for a species could quickly change if it is found to inhabit ecosystems under threat of anthropogenic change (Stotz et al. 1996). For example, although austral migrants readily occupy secondary and disturbed habitats, these habitats could represent an ecological trap (i.e., a habitat in which the

bird does poorly, despite an apparent preference for the habitat; e.g., Robertson and Hutto 2006). Another potential threat to both Nearctic-Neotropical and austral migrants in South America that is relatively understudied is the use of pesticides and herbicides that are now banned in many developed countries but used in Latin America (e.g., Lacher and Goldstein 1997).

In order for researchers and conservationists to be successful in this endeavor, strong partnerships with local government agencies and private organizations to promote the study and protection of at least target species is fundamental. This has already begun for a few Nearctic-Neotropical migratory species, such as the Cerulean Warbler (*Dendroica cerulea*), through the Cerulean Warbler Technical Group, which includes government and private organizations from the U.S. and in several South American countries.

Surprisingly, no such international collaborative networks exist for research on austral migrant species. Ornithologists are studying Neotropical austral migrants in South America but are mostly doing it without standardized, coordinated data collection among countries. Thus, elucidating continental patterns, such as migratory timing and population trends, remains out of reach. As is often the case in South America, strong research skills and commitments are present, but are limited by funding and logistical constraints. We believe one way to address this problem is through creation of strong partnerships at different levels. We focus on two types of partnerships for promoting a better understanding of austral migration: 1) International partnerships among researchers and 2) Local partnerships among researchers, conservationists and private landholders.

International Research Partnerships

There are obstacles to partnership creation at large scales. South America is comprised of 13 countries which speak 6 official languages (Dutch in Suriname, French in French Guiana, English in Guyana, Portuguese in Brazil, Guaraní and Spanish in Paraguay, and Spanish in all remaining countries). There is a general lack of funding in most South American countries for ornithological research relative to most North American and European countries. Combined with the large distances and access problems, the logistic challenges to the establishment of an international network of researchers in South America are formidable.

According to Karlsson et al. (2007), the "knowledge divide" that generally exists between north temperate countries and those in the sub-tropics and tropics can be at least partially ameliorated through such actions as increasing the transfer of financial resources for research, increasing collaboration among researchers in southern countries as well as between northern and southern countries, and making research originating in southern countries more accessible to the scientific community by strengthening southern scientists' publication records. Thus, creating a research initiative among South American migratory bird researchers will likely be most successful through a strategy that incorporates increased funding for research, especially interdisciplinary research that incorporates north temperate and South American researchers on an equal footing, and promoting first-authorship among South American researchers.

Given the challenges and opportunities, we offer the following list of recommendations for an international network of collaborators for the study of bird migration within South America.

1) Set specific and prioritized research objectives. These will define the structure of the research design and will help keep partners focused on common objectives throughout the research process. Prioritizing research needs is an important step in defining these objectives. Given that little natural history information is available for most austral migrants, compiling a natural history database on austral migrants would logically be one of the first steps. Other priorities include documenting when and where austral migrants migrate, as well as the mechanistic underpinnings driving their migratory behavior (Jahn et al. 2006).

2) Establish a network that incorporates a variety of institutions (e.g., government, private, academic). Partners in Flight or Alliance for the Grasslands (which operates in southern South America) may be good models to follow initially, with possible modifications later. Students, who are the future of science on the continent, as well as established professionals, should be involved.

3) Foster good communication, which is essential. In the case of research partnerships among countries in South America, overcoming language barriers (e.g., Portuguese vs. Spanish) and cultural differences will be a challenge. Regular meetings, regular communications, and jointly managed websites are essential tools to ensuring fluid contact among participants.

4) Training and capacity-building is imperative. Since comparisons across study sites cannot be made unless the same protocols are used, training network partners in the use of common methods should be a high priority. This will be a challenge for any international initiative on

bird migration across South America, as data collection protocols (e.g., census and banding methods) vary among workers both within and among countries. The training can be delivered in the form of training workshops organized by the network itself, or by sponsoring the attendance of partners to already existing training venues such as courses held by the Organization for Tropical Studies. Once protocols are agreed upon and followed, ensuring that methods remain standardized across observers through time (e.g., by holding regular workshops), will be equally important. Although training in data collection techniques is the focus here, a successful collaborative network could also act as a link to sponsor the attendance of partners at institutions of higher education (e.g., graduate school) through grants and academic advising. These people could then return to their countries of origin to establish research labs and teach at local institutions.

5) Data sharing is essential for such an initiative to produce meaningful results. However, a researcher's proprietary rights to data should be respected. Fortunately, web-based tools are now in place (e.g., Landbird Monitoring Network of the Americas, Avian Knowledge Network, Movebank) to permit data sharing along with filters each participant can use to establish how much of their database is viewable by others.

6) Because science cannot be accomplished without money, fundraising may be the biggest initial challenge to establishing such a network. Government funding within South America has been historically low for ecological studies. Government funding from overseas is at times possible but often has restrictions (e.g., Neotropical Migratory Bird Conservation Act). Possible funding sources include private foreign institutions, conservation groups, and international foundations (e.g., British Petroleum Conservation Leadership Programme, World Health Organization).

Partnerships with Landholders

Working on the ground in South America presents logistical challenges not easily overcome in many areas. For this reason, strong partnerships with local government agencies and private or public institutions are imperative. Public protected areas, such as national parks, exist across much of South America. Research documenting biodiversity and basic natural history is necessary to implement sound management within their boundaries, as well as to demonstrate to the public the value of such areas.

Another partnership often pursued by researchers and conservationists in South America's tropics is with private landholders. Costs and benefits of working on private vs. public lands vary by situation, and may be influenced by availability of proper infrastructure (e.g., lodging), permits required to work on different types of land (e.g., there is often more paperwork involved when working in protected areas), and accessibility (e.g., roads open in all seasons to study sites).

Partnering with private landholders can educate them about the importance of properly managing their land for plants and wildlife and in the long-run potentially encourage development of a conservation ethic in them and others in the community. We use two privately-owned facilities in South America's tropics as examples:

Caparú Ranch.—This is a 15 000 ha property in northeastern Bolivia, primarily comprised of seasonally inundated savannas and *terra firme* humid forest. The primary economic activity is low-intensity cattle ranching. However, the owners expressed interest in developing a biological research station on the property, such that dependence on cattle could be reduced through fees charged to visiting scientists.

We have been working at Caparú Ranch since 2004 to create better infrastructure for visiting researchers. As a result, Bolivian students, foreign students and professional biologists have begun research projects or attended bird banding workshops at the ranch. A primary benefit of working on the property is its year-round accessibility. By contrast, much of the nearby Noel Kempff Mercado National Park is difficult to access during the rainy season.

Working on a private property has facilitated our contact with other property holders and we now have the option to work on other ranches in the region. Additionally, through avian influenza sampling of the local chicken population, we have expanded research into a nearby village, thereby exposing local people to scientific activities.

Hato El Frío.—This second site is an extensive cattle ranch located in the flooded savannahs (Llanos) of the Orinoco river basin of Venezuela. Spanning 63 000 ha, conservation on the property has been a cornerstone since 1929, when hunting or trading with wildlife was completely banned. It also forms part of the Caño Guaritico Wildlife Refuge, Fishing Reserve and Protective Zone, created in 1989 with the main purpose of preserving 9300 ha of habitat for conservation and reintroduction programs for the globally endangered Orinoco Crocodile (*Crocodylus intermedius*).

The savannahs, dry forests and riparian habitats of the ranch are home to at least 80 mammal, 50 reptile, 20 amphibian and 225 fish

species. El Frío is considered an Important Bird Area (IBA) by Birdlife International, hosting a total of 319 species, including the globally threatened Orinoco Goose (*Neochen jubata*) and Yellow-knobbed Curassow (*Crax daubentoni*) and 10 species restricted to the Orinocan Llanos.

In 1974, El Frío Biological Station was established to promote conservation and research in this important ecosystem. To date, over 120 research projects from national and international institutions have been conducted at the ranch, providing invaluable knowledge of this dynamic ecosystem and its sustainable use.

These are only two cases of partnerships with landowners that can greatly expand both research and education about migratory birds on their tropical wintering grounds. We believe such models not only make a lot of sense in terms of overcoming logistical obstacles to research, but also offer an opportunity for landholders to become active stakeholders in the conservation of wintering migratory birds locally.

Migratory species hold great potential for promoting research and conservation of other species in the ecosystems they inhabit. From a layperson's perspective, they are visitors from distant lands, such that even short distance, intracontinental migrants, can serve as a rallying point for promoting conservation and research on other species of fauna and flora on private lands in tropical South America. Interest in migrants can carry over into initiatives for resident species, with conservation funding for migratory species helping to conserve the same habitats used by residents.

Because migratory birds have different requirements and face different challenges in different seasons, more multi-faceted questions about migratory birds can be answered through research across the entire annual cycle, including the wintering period. Given that migrants do not recognize international borders, international networks of researchers are essential for conducting this type of research and indeed, they are becoming a more common model for migratory bird research. An international network of researchers across South America, along with local partnerships, both public and private, will be fundamental to pursuing questions about austral migratory species and gaining a better understanding of the complex lives of migratory birds at those latitudes.

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