ORNITOLOGIA NEOTROPICAL 20: 275–283, 2009

BREEDING AND WINTER SITE FIDELITY AMONG ELEVEN NEOTROPICAL AUSTRAL MIGRANT BIRD SPECIES

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Resumen. – Fidelidad al sitio reproductivo y no-reproductivo de once especies de migrantes australes del Neotrópico. – Existe muy poca información sobre los patrones de fidelidad al sitio de los migrantes australes del Neotrópico, que migran dentro de América del Sur. Anillamos aves migratorias en tres sitios de América del Sur, uno ubicado en el trópico y dos en latitudes templadas. Documentamos la fidelidad al sitio reproductivo de siete especies y la fidelidad al sitio no-reproductivo de cuatro especies. Conocer cuáles son los patrones de fidelidad al sitio de las aves migratorias en América del Sur es de suma importancia para comprender cuáles son los factores limitantes de sus poblaciones durante el ciclo anual y para generar planes de conservación.

Abstract. – Very little information currently exists on site fidelity patterns among Neotropical Austral migratory birds, which migrate wholly within South America. We banded migratory birds at three sites in South America, one located in the tropics and two at south temperate latitudes. We document breeding site fidelity among seven species and winter site fidelity among four species. Knowledge of patterns of site fidelity among migratory birds in South America is important for understanding the constraints affecting their populations throughout the annual cycle and ultimately for conservation planning. *Accepted 8 April 2009.*

Key words: Caparú, Cerrado, Chaco, El Bagual, Monte, Ñacuñán, philopatry.

INTRODUCTION

Breeding and winter site fidelity has been well-documented among migratory bird species in North America (e.g., Bobolink, *Dolichonyx oryzivorus*, Bollinger & Gavin 1989; Spotted Sandpiper, *Actitis macularia*, Reed & Oring 1993; Purple Finch, *Carpodacus purpureus*, Hilton 1994; Northern Shrike, *Lanius excubitor*, Rimmer & Darmstadt 1996; American Robin, *Turdus migratorius*, Haas 1998; White-eyed Vireo, *Vireo griseus*, Hopp *et al.* 1999). However, in spite of the influence of dispersal and site fidelity on immigration rates (Ward 2005), fecundity, and survival (Hoover 2003) and its potential for understanding population trends of migrant birds (Newton 2008), little information exists on how com-

mon site fidelity is among Neotropical Austral migrant bird species, which breed in the southern latitudes of South America and then migrate north towards or into Amazonia for the Austral winter (Chesser 1994, Jahn *et al.* 2004). Potential benefits to an individual of returning to the site where it fledged or spent a previous winter (reviewed by Newton 2008), include: 1) knowledge of the site, which may benefit it in competitive interactions, 2) local adaptation, and 3) for breeding site fidelity, a chance to re-mate with a previous partner with which it enjoys high breeding success. For a migrant bird that has been away from the breeding grounds for months and has only a few weeks to establish a territory and breed, these benefits may be the difference between a successful and a failed breeding season. Due to these potential benefits and because site fidelity is a common theme among North American passerines, it is reasonable to assume that site fidelity would also be common among Neotropical Austral migrant bird species.

The only records of site fidelity in the Neotropical Austral migrant system that we are aware of previous to the present study are those of McNeil (1982), who documented winter site fidelity in Small-billed Elaenia (*Elaenia parvirostris*) in Venezuela, of Rumboll *et al.* (2005), who reported breeding site fidelity in Southern Scrub-Flycatcher (*Sublegatus modestus brevirostris*), Euler´s Flycatcher (*Lathrotriccus euleri*), and White-tipped Plantcutter (*Phytotoma rutila rutila*) in Argentina, and of Brown *et al.* (2007), who found breeding site fidelity in White-crested Elaenia (*Elaenia albiceps*) in southern Chile.

Neotropical Austral migrants are generally members of one of two migratory subsystems: 1) South American Temperate-Tropical (SATT) species, which breed in South America's temperate latitudes and then migrate into the tropics to winter, and 2) South American Cool-Temperate (SACT) species, which breed and winter within the temperate zone of South America (Joseph 1997). Intratropical migration also exists within South America (e.g., White-throated Kingbird, *Tyrannus albogularis*, Chesser 1995).

With the goal of expanding our understanding of the prevalence of site fidelity among migrant birds in South America, we describe site fidelity patterns from among these migration sub-systems in South America from research at three study sites, two temperate ones and one tropical.

STUDY SITES AND METHODS

Study sites. The southernmost temperate study site was at the Biosphere Reserve of Ñacuñán (BRÑ), Department of Santa Rosa, Mendoza Province, Argentina (34°03'S, 67°54'W, 540 m a.s.l.), located in the central Monte desert. The landscape of the Reserve is mainly open woodland intersected by variably-sized tracts of shrubland. The open woodland is a matrix of non-thorny tall shrubs dominated by *Larrea divaricata*, with thorny trees (*Prosopis flexuosa* and *Geoffroea decorticans*), and thorny tall shrubs (*Capparis atamisquea* and *Condalia microphylla*; Marone 1991, Milesi *et al.* 2002).

The northernmost temperate study site was Reserva El Bagual (REB), Department of Laishi, Formosa Province, Argentina (26º10'S, 58º56'W, 70 m a.s.l.). This is a private, protected grassland in the Humid Chaco (eastern Chaco), throughout which are found patches of forests, shrublands, woodlands, and wetlands (Di Giacomo & Krapovickas 2005).

The tropical study site was at Caparú Biological Station (CBS), Department of Santa Cruz, Bolivia (14°48'S, 61°10'W, 170 m a.s.l.). The main habitat types at CBS are: seasonally inundated humid forest, *terra firme* humid forest, and cerrado, a wooded savannah with a

tree layer composed primarily of *Curatella americana*.

Bird sampling. From November 2004 to December 2008 VRC, MCS, and JLdeC banded migratory birds at BRÑ with numbered aluminum bands and color bands. Birds were captured using nylon mist-nets (12 m x 3 m, 38 mm mesh size) located on a permanent 10 ha study plot which was divided into sampling blocks, 25 m on a side. In the plot were installed 30 mist-nets (10 nets in three parallel lines), 50 m apart. Sampling was conducted during the breeding season (October–March) and non-breeding season (April–September). On each sampling occasion nets were opened for 6 days. After net sampling, color-banded birds were searched for at least 10 days or until no new banded individuals were observed after searching for at least 10 person-hours. Distances between locations of captures and the first recapture or re-observation of color-banded individuals between consecutive seasons were calculated by plotting these on a map for each individual and measuring the distance in a straight line between locations.

At BRÑ we captured two species that deserve further critical taxonomic studies. One corresponds to an undescribed species of *Serpophaga* tyrannulet that Straneck (1993) considered to be *Serpophaga griseiceps* (reviewed by Herzog & Mazar Barnett 2004). Recently, Straneck (2007) has formally renamed this species as *Serpophaga griseicapilla*. Since Straneck (2007) did not suggest a common name for this new species, we use Gray-crowned Tyrannulet. The other species is Rufous-collared Sparrow (*Zonotrichia capensis*). This species is a complex of at least 22 subspecies (Chapman 1940). We found that two of them, *Z. c. hypoleuca* and *Z. c. australis*, are common at BRÑ. Individuals of the latter subspecies can be easily recognized by the lack of black bands in the grey head. *Z. c. hypoleuca* is a resident at our study area and *Z. c. australis* is a migrant, present at the site during autumn and winter. In the rest of the paper we use the common name Rufous-collared Sparrow to refer to the subspecies *Z. c. australis*.

From August 2004 until May 2008, ADG banded migratory birds using numbered aluminum bands and color bands at REB. Adult individuals were captured with nylon mist-nets (9, 12, and 18 m x 2.6 and 3 m, 36, and 38 mm mesh size) set up in lines of 3–5 nets per line at five sampling sites, and sampling for two days per site. Nestlings which were about to fledge were also banded. Captures were registered during the breeding season (September–March) as well as during the non-breeding season (April–August). Sites where birds were captured and re-captured, and sightings of color-banded birds were geo-referenced using a GPS receiver.

From October 2004 to July 2007 AEJ, AMM, and JQV banded migratory birds with numbered aluminum bands and color bands at CBS, using nylon and polyester mist-nets (12 m and 18 m x 2.6 m, with 36 mm and 38 mm mesh size). The study site was divided into 23 sampling plots of approximately 100–500 m on a side. Censuses were conducted for color-banded birds through area searches on each plot and during opportunistic observations (i.e., while conducting other research, such as behavioral observations). Most plots were visited at least once/month from October 2004 to July 2007 during most of both the breeding season (October–February) and non-breeding season (March–September), although we did not census during most of the non-breeding season of 2005, when we were absent June–September. We also censused birds at the site for two weeks in June 2008. Although we did not measure the distance between the original capture site and sites where individuals were re-observed at CBS, all captures and censusing were

conducted within an area of approximately 5 km².

RESULTS AND DISCUSSION

We registered breeding site fidelity in two SATT and in three SACT migrant species at BRÑ (Table 1). We also documented breeding site fidelity in one SATT migrant species at REB (Tropical Kingbird, *Tyrannus m. melancholicus*) and in an intra-tropical migrant at CBS (White-throated Kingbird, *Tyrannus albogularis*; Table 2). Winter site fidelity was recorded in three SACT migrant species at BRÑ (Table 3) and in one SATT migrant species at CBS (Vermilion Flycatcher, *Pyrocephalus r. rubinus*).

Central-western Argentina, where BRÑ is located, lies within the breeding range of Crowned Slaty-Flycatcher (*Griseotyrannus a. aurantioatrocristatus*), Southern Scrub-Flycatcher, Hudson's Black-Tyrant (*Knipolegus hudsoni*) (Fitzpatrick 2004), Gray-crowned Tyrannulet (Straneck 1993), and White-tipped Plantcutter (Snow 2004). Crowned Slaty-Flycatcher and Southern Scrub-Flycatcher winter primarily in western Amazonia, occurring there mainly from late March to September (Fitzpatrick 2004). At BRÑ we banded 26 Crowned Slaty-Flycatchers and 43 Southern Scrub-Flycatchers, and documented breeding site fidelity for one and three individuals, respectively (Table 1). Other study species migrate shorter distances to winter: Hudson's Black-Tyrant arrives in Paraguay, Bolivia, and southern Brazil in August–September and is recorded as far north as Mato Grosso, Brazil (Fitzpatrick 2004). During the non-breeding season, Gray-crowned Tyrannulet migrates to north-eastern Argentina, Paraguay, southern Brazil, and Uruguay (Straneck 1993, Bencke *et al.* 2002), and White-tipped Plantcutter to eastern Argentina and Uruguay (Snow 2004). At BRÑ, we banded 18 Hudson's Black-Tyrants, 34 White-tipped Plantcutters, and 65 Gray-crowned Tyrannulets, and documented breeding site fidelity for one, one, and three individuals, respectively (Table 1).

Northern Argentina, where REB is located, lies in the breeding range of Tropical Kingbird, a SATT migrant which winters within or closer to Amazonia (Chesser 1995). At REB, a pair of nesting Tropical Kingbirds was captured in nets placed near the nest. The pair was banded with band numbers D-001084, and D-001085 on 19 December 2005. Both adults nested at the site during four consecutive breeding seasons and in each season the nest was built on the same branch. Dates of the first re-sighting in the following seasons were 27 October 2006, 31 October 2007, and 2 November 2008. The nestlings from the first two seasons were banded (N=5), but none were re-observed subsequently. These data also suggest the existence of mate fidelity between seasons in this species.

White-throated Kingbird breeds in northern and southern Amazonia, with a non-breeding range in central Amazonia (Chesser 1995). CBS is located in the southern Amazonian breeding range of this species. The earliest breeding season date recorded for this species at CBS was September 18, and the latest was April 5. We banded 34 White-throated Kingbirds and documented breeding site fidelity for 10 of these individuals. This includes one record of natal philopatry, involving a bird which was banded immediately after leaving the nest and returned the next season (band number CA02105; Table 2). Chesser (1995) reported that this species is present on its southern Amazonian breeding grounds from August to February. Our data suggest some individuals may stay slightly further into the post-breeding season (i.e., early April).

Central-western Argentina lies within the wintering range of Scale-throated Earthcreeper (*Upucerthia dumetaria dumetaria*),

TABLE 1. Breeding site fidelity records (through captures, re-captures, and observations of color-banded birds) of Neotropical Austral migrant species at the Biosphere Reserve of Ñacuñán, Argentina. SATT: South American Temperate-Tropical and SACT: South American Cool-Temperate. Abbreviations: CSF = Crowned Slaty-Flycatcher, SSF = Southern Scrub-Flycatcher, HBT = Hudson's Black-Tyrant, GCT = Gray-crowned Tyrannulet, WTP = White-tipped Plantcutter. Indices: [1]Breeding season lasts from October to March of the following year; [2]banding date; [3]re-capture date; [4]date of observation of the color-banded individual.

Species	Band no.	Migratory sub-system	Breeding season dates[1] recorded				
			2004–05	2005–06	2006–07	2007–08	2008–09
CSF	C000519	SATT		1 Dec 05[2]	11 Feb 07[3]	-	-
SSF	CA0006	SATT	25 Nov 04[2]	29 Nov 05[3]	29 Oct 06[3]; 21 Jan 07[4]	-	-
SSF	CA0009	SATT	25 Nov 04[2]	29 Nov 05[3]	-	20 Nov 07[3]	-
SSF	A04701	SATT				23 Nov 07[2]	08 Dec 08[3]
HBT	B004504	SACT			30 Nov 06[2]	14 Feb 08[3]	-
GCT	CA0037	SACT	29 Nov 04[2]	19 Dec 05[4]	17 Nov 06[4]; 4 Dec 06[3]	-	-
GCT	A04095	SACT		1 Dec 05[2]	29 Nov 06[3]	-	-
GCT	A04689	SACT				21 Nov 07[2]	07 Dec 08[3]
WTP	D000561	SACT			3 Dec 06[2]	21 Nov 07[3]	-

Patagonian Mockingbird (*Mimus patagonicus*), and Rufous-collared Sparrow. These species breed mainly in Patagonia and move to northern Argentina from April to September (Remsen 2003, Cody 2005, Canevari *et al.* 1991). At BRÑ, we banded seven Scale-throated Earthcreepers, 19 Patagonian Mockingbirds, and 262 Rufous-collared Sparrows and documented winter site fidelity for two, one, and four individuals, respectively (Table 3).

Eastern Bolivia lies within the wintering range of Vermilion Flycatcher, where it is present from March to October, although a permanent population may exist in central and southern Bolivia (Chesser 1995). The earliest post-breeding date we recorded this species at CBS was 2 April and the latest date was 26 October. We banded seven Vermilion Flycatchers (three females, three males, and one of unknown sex) at CBS. We documented winter site fidelity in one male Vermilion Flycatcher, which was originally banded on 6 May 2005 and was re-captured the following winter (19 May 2006). We then recorded it by observing its color bands on two separate occasions in a third winter (4 June and 13 July 2007), and again in a fourth winter, on 15 June 2008.

At BRÑ, we documented a lower average distance among captures and re-captures or observations of color-banded migratory individuals between consecutive breeding seasons (i.e., breeding site fidelity) than between consecutive winter seasons (i.e., winter site fidelity) (Table 4). This pattern has been reported in passerine migrant species and could be related to non-territorial behavior during the winter (Newton 2008). However, because this is an interspecific comparison, the pattern could be simply due to differences between species' ecology rather than to differences between breeding and winter season ecology *per se*, and thus merits further research. Re-captures of Swamp Sparrow (*Melospiza*

TABLE 2. Breeding season site fidelity records (through captures, re-captures and observations of color-banded birds) of White-throated Kingbird at Caparú Biological Station, Bolivia. Indices: [1]Breeding season lasts from October to March of the following year; [2]banding date; [3]re-capture date; [4]date of observation of the color-banded individual.

Band no.	Breeding season dates[1] recorded		
	2004–05	2005–06	2006–07
CA00793	9 Oct 04[2]	25 Oct 05[4]	-
CA02059	4 Mar 05[2]	20 Jan 06[3]	11 Aug 06[4]
CA02062	5 Mar 05[2]	28 Sep 05[4]; 20 Oct 05[4]	-
CA02068	15 Mar 05[2]	20 Jan 06[3]	-
CA02105	26 Nov 04[2]	14 Jan 06[4]; 20 Jan 06[3]; 6 Feb 06[4]	-
CA02120	4 Dec 04[2]	25 Oct 05[3]	1 Aug 06[4]
CA02150	13 Dec 04[2]; 3 Feb 05[3]; 10 Mar 05[4]	22 Oct 05[3]	-
CA02199	16 Feb 05[2]	-	18 Jan 07[4]
CA02882		10 Oct 05[2]; 13 Jan 06[4]	17 Nov 06[4]
CA02975		20 Jan 06[2]; 9 Mar 06[4]	29 Dec 06[3]

TABLE 3. Winter site fidelity records (through captures and re-captures) of Neotropical Austral migrant species of the South American Cool-Temperate migratory sub-system at the Biosphere Reserve of Ñacuñán, Argentina. Indices: [1]Non-breeding season lasts from April to September of the following year; [2]banding date; [3]re-capture date.

Species	Band no.	Winter season dates[1] recorded		
		2006	2007	2008
Scale-throated Earthcreeper	D000545	10 Aug 06[2]	13 May 07[3]; 21 Jul 07[3]	12 May 08[3]
Scale-throated Earthcreeper	C000547	11 Aug 06[2]	22 Jul 07[3]	13 Aug 08[3]
Patagonian Mockingbird	D000551	13 Aug 06[2]	23 Jul 07[3]	-
Rufous-collared Sparrow	B004257	13 May 06[2]	16 May 07[3]	-
Rufous-collared Sparrow	B004393	8 Aug 06[2]	23 Jul 07[3]	-
Rufous-collared Sparrow	B004422	9 Aug 06[2]	16 May 07[3]	-
Rufous-collared Sparrow	B004454	11 Aug 06[2]	15 May 07[3]	-

georgiana) on wintering grounds in Florida, USA have occurred within as little as 50 m of the location of initial capture in the previous season (Legare *et al.* 2000), compared to an average distance of 245 m for Rufous-collared Sparrow in our study (Table 4). Sedgwick (2004) reports that the median distance between capture and re-capture in consecu-

TABLE 4. Average distance between capture and re-capture or observation of color-banded individuals of Neotropical Austral migrant species in consecutive breeding or winter seasons at the Biosphere Reserve of Ñacuñán, Argentina. The number of individuals is shown in brackets. Range of distances between capture, re-capture, or observation of color-banded individuals between breeding or winter seasons.

Season	Species	Distance (m)	Range[1] (m)
Breeding season	Crowned Slaty-Flycatcher	206 [1]	-
	Southern Scrub-Flycatcher	71 [3]	50–112
	Hudson's Black-Tyrant	100 [1]	-
	Gray-crowned Tyrannulet	133 [3]	35–206
	White-tipped Plantcutter	0 [1]	-
	Total Average distance	102 [9]	0–206
Winter season	Scale-throated Earthcreeper	128 [2]	50–200
	Patagonian Mockingbird	224 [1]	-
	Rufous-collared Sparrow	245 [4]	50–400
	Total Average distance	208 [7]	50–400

tive years for > 75% of Willow Flycatchers (*Empidonax traillii*) in Oregon, USA was ≤ 52 m, compared to average distances for flycatchers in our study of 71 m for Southern Scrub-Flycatcher and 206 m for Crowned Slaty-Flycatcher (Table 4).

At CBS and REB, the tropical and northernmost temperate study sites, respectively, all three species for which site fidelity was documented belong to the family Tyrannidae, while at BRÑ (a temperate site) migrants with site fidelity pertain to the Furnariidae, Tyrannidae, Cotingidae, Mimiidae, and Emberizidae. These differences demonstrate the taxonomic diversity of the Neotropical Austral migratory system and highlight the fact that characteristics of this migratory system will likely be site- and species-specific.

Future research in South America on site fidelity would benefit from coordinated, standardized research across multiple study sites, providing an even greater level of detail than that which is currently available. Such data could offer valuable insights into the conservation of migratory birds, since the selective mechanisms driving patterns of breeding site fidelity could in turn affect reproductive success (Hoover 2003), while those driving winter site fidelity may ultimately affect survival during the non-breeding season. Furthermore, information on patterns of site fidelity in combination with that on other population parameters, such as connectivity, could prove to be valuable for modeling population dynamics and for directing conservation planning for specific Neotropical Austral migrant populations on both breeding and wintering grounds.

ACKNOWLEDGMENTS

Patricia Capllonch, Rosendo Fraga, and an anonymous reviewer provided many helpful insights which greatly improved the manuscript. We thank the many volunteers and students that helped with fieldwork as well as Jaime Rozenman and Guillermo Weise for their hospitality and ongoing support of research at CBS. Funding for research at CBS was provided by the National Science Foundation (OISE-0313429, 0612025), Optics for the Tropics, Western Bird Banding Association, Wilson Ornithological Society, American Ornithologists' Union, and the School of Nat-

ural Resources and Environment - University of Florida. Funding for research at BRÑ was provided by CONICET (through PIP 6141), Universidad de Buenos Aires (through UBACyT X/144), Agencia Nacional de Promoción Científica y Tecnológica (most recently through PICT 01-12199), and the Association of Field Ornithologists. Funding for research at REB was provided by ALPARAMIS SA, and Aves Argentinas/Asociación Ornitológica del Plata. This is contribution no. 63 of the Desert Community Ecology Research Team (Ecodes) of the IADIZA Institute (CONICET) and FCEyN (Universidad de Buenos Aires).

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