

MIGRATION OF RAPTORS, SWALLOWS AND OTHER DIURNAL MIGRATORY BIRDS THROUGH THE DARIEN OF COLOMBIA

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Resumen. – **Migración de rapaces, golondrinas y otras especies de aves migratorias diurnas en el Darién Colombiano.** – La región del Darién en el noroccidente de Colombia marca el final de la estrecha masa continental Centroamericana, un corredor que conecta Norte América con Sur América y funciona como una ruta migratoria para las aves entre los dos continentes. No existe información publicada sobre la migración diurna en el Darién Colombiano a pesar de su posición estratégica como puerta de entrada del continente Suramericano y ser uno de los puntos más angosto del corredor. Con el fin de llenar este vacío de información, realizamos conteos de aves migratorias durante dos temporadas de otoño y una de primavera alrededor de Sapzurro en la frontera entre Colombia y Panamá. Registramos 22 especies de aves migratorias diurnas que incluyeron 6 aves acuáticas (principalmente garzas), 9 especies de rapaces y 7 de aves terrestres. El grupo más abundante en el otoño fue el de las rapaces (513,974 individuos, otoño del 2012), la mayoría entre mediados de octubre a mediados de noviembre. Las Golondrinas también fueron muy abundantes durante el otoño (> 170,000 por año), mientras que otras especies como *Chaetura pelagica* (5788 en 2012), *Tyrannus tyrannus* (41,305 en 2011), y *Spiza americana* (4586 en 2011) fueron registradas en números menores. Durante la primavera también registramos grandes cantidades de rapaces y golondrinas. Aunque la mayoría de las aves observadas no se detuvieron en los sitios de estudio, encontramos grandes dormideros de *Cathartes aura*, los cuales pueden ser vulnerables a las altas tasas de deforestación en la región. Nuestros resultados resaltan a la región del Darién como un lugar de concentración para la migración de las aves terrestres y los conteos totales en cada temporada sitúan a Sapzurro entre los primeros cinco puntos de observación de rapaces en las Américas.

Abstract. – The Darién region of north-west Colombia marks the end of the Mesoamerican landmass, an ever narrowing corridor of land that connects North and South America and acts as a major flyway for birds migrating between the two continents. Despite its strategic location, at the gateway to South America and at one of the corridors' narrowest points, there is no published information on diurnal migration in the Darién. To address this knowledge gap, we carried out migration counts during two fall and one spring migration around the village of Sapzurro on the Colombia-Panama border. We recorded 22 species of diurnally migrating birds including 6 waterbirds (mainly herons), 9 raptor species, and 7 non-raptor landbirds. The most abundant group in fall were the raptors (513,974 individuals, fall 2012), of which the majority passed between mid-October and mid-November. Swallows were also highly abundant fall migrants (> 170,000 per year), while lesser but notable numbers of Chimney Swift (*Chaetura pelagica*) (5788 in 2012), Eastern Kingbird (*Tyrannus tyrannus*) (41,305 in 2011), and Dickcissel (*Spiza americana*) (4586 in 2011) were recorded. During spring large numbers of both raptors and swallows were also noted. Although most birds migrated directly overhead, large roosts of Turkey Vultures were observed, and these may be vulnerable to the high rates of deforestation in the region. These results highlight the Darién as a major bottleneck for migrating landbirds and the raptor totals place the Sapzurro watchsite among the top five watchsites in the Americas. *Accepted 26 May 2014.*

Key words: Caribbean coast, flyway, migration watchsite, migratory bottleneck, Nearctic-Neotropical migration, roosting sites.

INTRODUCTION

Nearctic-Neotropical birds that migrate between North and South America must either make long-over sea crossings, negotiating the Gulf of Mexico and the Caribbean Sea, or follow the Mesoamerican landmass, a land bridge between the breeding and non-breeding areas of many species. The geography of Mesoamerica funnels north-south migrating birds through an ever narrowing corridor of land that reaches its thinnest point in the Darién of Panamá and Colombia (Smith 1985). This natural bottleneck, like others in Central America, channels the flyways of many migratory birds and can result in spectacular concentrations, especially of migratory raptors (Bildstein 2004). Indeed, the interaction of the mountainous spine of Central America, the Caribbean coast and a narrowing land mass at various sites in Mesoamerica produces the greatest concentrations of migratory raptors identified in the World to date (Zalles & Bildstein 2000). Counts from sites in Costa Rica and Panama regularly exceed one million raptors and in Veracruz, Mexico, counts can exceed five million individuals (Batista *et al.* 2005, Porrás-Peñaranda *et al.* 2004, Ruelas *et al.* 2010).

Despite being recognized as the most numerous raptor flyway in the World, the Mesoamerican flyway has only been intensively studied at a small number of sites (Bildstein 2004). Indeed, the natural bottleneck formed by the Darién, at the entry point to South America, is an obligatory part of the flyway for all raptors that migrate overland and winter in South America. Despite this, there are no published accounts of raptor migration in this region to date. Aside concentrating the flow of at least five million raptors, the Darién is also expected to act as a

funnel for other diurnally migrating landbirds and waterbirds that travel via Central America. Concentration points and associated counts for diurnally migrating species, excluding raptors, have rarely been reported in the literature (Winkler 2006, McCrary & Young 2008), despite their importance for determining migration routes and stopover sites. Such information is essential for identifying where birds may be vulnerable to pressures such as direct persecution or the construction of wind turbines, high buildings, and communication towers (Longcore *et al.* 2013).

We documented the species composition, relative abundance and phenology of diurnally migrating raptors, passerine landbirds, and waterbirds along the Caribbean coast of the Colombian Darién based on daily migration counts during two fall migrations and one spring migration. We discuss the results of this study in terms of the importance of the Darién as a concentration point for migratory birds, and draw attention to conservation issues such as increasing rates of deforestation in the region.

METHODS

This study was carried out around the village of Sapzurro (08°39'44"N, 77°21'48"W; 50 m a.s.l.) on the border of Colombia and Panama, on the Caribbean coast of the Darién (Fig. 1). Three main vantage points were used for migration counts: the first was situated on an east facing slope above the village in order to count passerine landbirds migrating along the coast (early mornings only); the second was located on the village's longest jetty, enabling simultaneous counts of raptors migrating over the foothills behind the village and landbirds following the coastline (primarily late afternoons); the third was located at a border

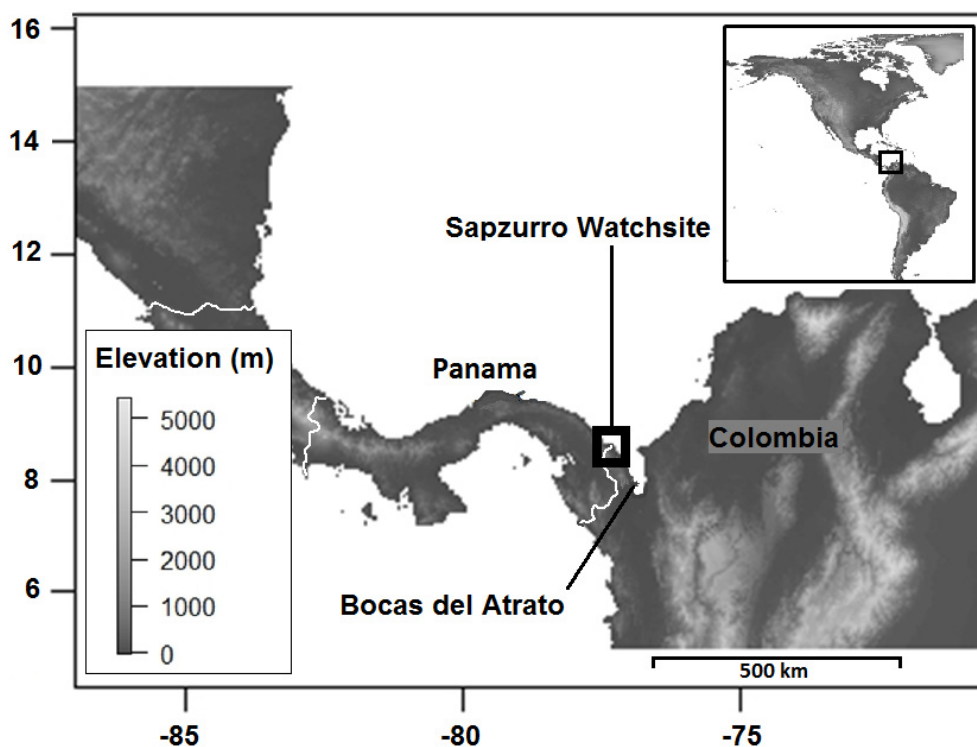


FIG. 1. Location of the study region in north-western Colombia. The elevation raster used to construct this map was downloaded from <http://www.worldclim.org/>.

post on a ridge north-west of the village that gave views of two ridgelines that run north-south from Panama to Colombia (afternoon raptor counts).

During fall migration, daily counts (mainly for passerine landbirds) were carried out during the first 1.5 to 4 hours of the morning, depending on the strength of passage, between 13 September and 31 October 2011, and 24 September and 5 November 2012 by one observer. Raptor counts were made on a near daily basis between 13:00 and 16:00 h in 2011, and between 09:00 and 11:00 h and 13:00 and 16:00 h in 2012. Raptor counts were carried out by one or two observers, with two observers regularly covering the afternoon session on peak passage days. In

2012, opportunistic raptor counts extended into early December. Additional counts were made outside of these standardized periods when, for example, climatic conditions gave rise to large movements of swallows, particularly between 16:00 and 18:00 h. Effort in terms of days and hours of observation was: 2011 – Morning counts, 50 days, 168 hours; Raptor counts, 25 days, 49.6 hours; Additional counts, 15 days, 15.8 hours; 2012 – Morning counts, 41 days, 124.6 hours; Raptor counts, 35 days, 99.4 hours; Additional counts, 12 days, 15.3 hours.

During the spring migration of 2012, non-standardized counts were carried out between 23 March and 3 May by one observer (MR), primarily on peak migration days when the

observer was alerted to large numbers of migrants. In addition to counts at Sapzurro, opportunistic fall counts were made at a number of points south of Sapzurro and around the Gulf of Urabá, e.g., Bocas del Atrato (08°05'17"N, 76°50'12"W; 1 m a.s.l.).

All counts were made with 8 x 42 binoculars, with observers regularly scanning the air-space above ridgelines for migrating raptors. The following field guides were used for identification: Sibley (2000), Hilty & Brown (1986), and Ferguson-Lees & Christie (2006). Birds were considered as migrating when they showed a clear and consistent directional movement, i.e., north to south in fall and vice versa in spring. When the number of birds migrating precluded the possibility of counting all individuals, we used the following methods to estimate numbers: A. Swallows – observers were trained to count birds in groups of 10 to 50 individuals by first counting birds individually until they learnt the relative size of such groups. To assign resulting counts to species, various sample counts of 30 to 50 birds per session were made, in which all individuals were identified to species. The resulting percentages by species were used to estimate the total count for each species for a session. B. Raptors – as with swallows, observers were trained to estimate groups of birds in sums of 50 or 100 birds and then estimate the number of individuals in large kettles (spirals). On peak passage days when two observers were counting, one observer focused on counting Turkey Vultures and the other on Broad-winged and Swainson's Hawks.

RESULTS

Waterbirds. Six species of waterbird were recorded migrating along the coast during fall migration, consisting of five herons and one duck species (Table 1). Of these, the Great Egret (*Ardea alba*) was the species most com-

monly observed throughout the migration period. Although similar numbers of Blue-winged Teal (*Anas discors*) were recorded, they passed in large flocks on just a handful of days. The observations of Great-blue Heron (*Ardea herodias*) are noteworthy as the status of this species is poorly known in South America (Hilty & Brown 1986). It is important to note that the opportunistic counts during spring were focused almost entirely on raptors and swallows, hence the lack of waterbirds.

Raptors. Raptors were already migrating when we arrived at the study site in September, however of the nine species recorded (Table 1), the three most numerous, Turkey Vulture (*Cathartes aura*), Broad-winged Hawk (*Buteo platypterus*), and Swainson's Hawk (*Buteo swainsonii*), were not recorded until early October. The main passage period for all raptors was in the second half of October, but large numbers of Turkey Vultures continued to pass in mid-November and smaller flocks were recorded well into December (Fig. 2). The three largest single day counts of raptors were on 20 October in both 2011 (33,490) and 2012 (42,364), and on 25 October 2012 (84,345). Fewer individuals of all species were recorded during spring migration, with the Turkey Vulture being by far the most numerous (Table 1). The Swallow-tailed Kite (*Elanoides forficatus*) featured more prominently during spring, presumably due to timing issues.

Roosting Turkey Vultures were observed on a forested ridge behind Sapzurro, with up to 1000 individuals present on at least three nights in October. A larger roost was recorded in mangroves at Bocas del Atrato, with an estimated 16,000 Turkey Vultures present on 2 November 2011.

For the most abundant raptor species, the number of birds recorded in 2012 represents ≈17% of the South American wintering pop-

TABLE 1: Season totals for diurnal migratory birds recorded at the Sapzurro watchsite on the Caribbean coast of the Darién, Colombia. *Identification not 100% but most likely this species.

| Common name | Scientific name | Fall | | Spring 2012 |
|---------------------|---------------------------------|---------|---------|-------------|
| | | 2011 | 2012 | |
| Great-blue Heron | <i>Ardea herodias</i> | 3 | 9 | - |
| Great Egret | <i>Ardea alba</i> | 89 | 176 | - |
| Snowy Egret | <i>Egretta thula</i> | 33 | 70 | - |
| Little Blue Heron | <i>Egretta caerulea</i> | 29 | 41 | - |
| Tricolored Heron | <i>Egretta tricolor</i> | 4 | 1 | - |
| Blue-winged Teal | <i>Anas discors</i> | 135 | 123 | - |
| Turkey Vulture | <i>Cathartes aura</i> | 110,504 | 345,192 | 18,883 |
| Osprey | <i>Pandion haliaetus</i> | 163 | 186 | - |
| Swallow-tailed Kite | <i>Elanoides forficatus</i> | 135 | | 580 |
| Mississippi Kite | <i>Ictinia mississippiensis</i> | 101 | 3968 | 70 |
| *Cooper's Hawk | <i>Accipiter cooperii</i> | 1 | | - |
| Broad-winged Hawk | <i>Buteo platypterus</i> | 99,846 | 139,548 | 12,069 |
| Swainson's Hawk | <i>Buteo swainsoni</i> | 9058 | 24,883 | 37 |
| Merlin | <i>Falco columbarius</i> | 71 | 65 | - |
| Peregrine Falcon | <i>Falco peregrinus</i> | 101 | 132 | - |
| Common Nighthawk | <i>Chordeiles minor</i> | 1353 | 1245 | 10 |
| Chimney Swift | <i>Chaetura pelagica</i> | 2168 | 5788 | - |
| Eastern Kingbird | <i>Tyrannus tyrannus</i> | 41,305 | 6575 | 85 |
| Bank Swallow | <i>Riparia riparia</i> | 22,898 | 21,661 | - |
| Barn Swallow | <i>Hirundo rustica</i> | 52,800 | 66,136 | 2016 |
| Cliff Swallow | <i>Petrochelidon pyrrhonota</i> | 99,842 | 98,406 | - |
| Swallow sp. | | 7737 | 8079 | 42,858 |
| Dickcissel | <i>Spiza americana</i> | 4586 | 978 | - |
| | Season Totals | 452,962 | 723,262 | 76,608 |

ulation of Turkey Vultures, 10% of the global population of Broad-winged Hawks, and 3% of the global population of Swainson's Hawks, based on population estimates in Bildstein (2004).

Non-raptor landbirds. In mid-September four species were already migrating in large numbers: Common Nighthawk (*Chordeiles minor*), Eastern Kingbird (*Tyrannus tyrannus*), Cliff Swallow (*Petrochelidon pyrrhonota*), and Barn Swallow (*Hirundo rustica*). The migration of the former two species appeared to peak shortly after we commenced migration counts, while swallow numbers peaked in mid-October. Other species recorded in

smaller numbers included Dickcissel (*Spiza americana*) and Bank Swallow (*Riparia riparia*). Of the most abundant landbirds, the last to appear was the Chimney Swift (*Chaetura pelagica*), which was recorded between 13–31 October, combining data from 2011 and 2012. During spring migration, swallows featured prominently but, as mentioned for waterbirds, the lack of other species may not reflect absence but instead the nature of the opportunistic counts during that season.

Some species showed marked differences in abundance between the two fall migrations, which could be an effect of variation in the timing of sampling effort (e.g. in Eastern

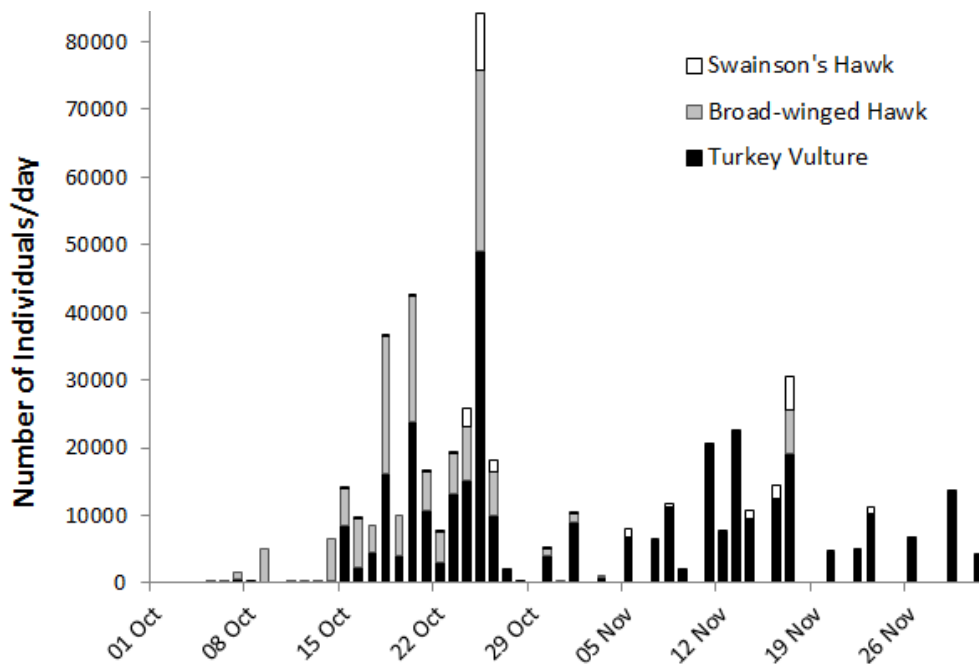


FIG. 2. Fall migration phenology of the three most abundant raptor species in the Darién of Colombia during 2012.

Kingbirds) or of natural fluctuations (e.g., in Dickcissel) depending on the species.

DISCUSSION

Our findings confirm the Darién of Colombia as a globally important flyway for diurnal migrants during fall, with > 450,000 birds recorded in 2011 and > 720,000 in 2012. Taking into account the lack of published accounts on diurnal migration in Colombia (but see Colorado *et al.* 2006), these data draw attention to the magnitude of flyways there and provide baseline information for decision makers at a regional, national and international level. In total, we recorded 22 species of diurnal migrants including aquatic species such as herons, aerial insectivores like swallows and Chimney Swifts, noteworthy numbers of Dickcissel and Eastern King-

bird (Morton 1971), and nine species of raptors.

The most numerous group of diurnal migrants recorded in this study was the raptors, of which more than half a million individuals were counted during 2012 (513,974 individuals). This count is significant at the national level, given that the largest published count for Colombia is 21,000 individuals (Colorado *et al.* 2006). The Sapzurro watchsite is also important at a regional and global level, currently ranking fourth in the Americas, alongside Corpus Christi in Texas (5-year mean 443,200; max. 536,000, 2011) and behind Ancon Hill in Panama (1.4 million, 2007; Batista *et al.* 2005), Talamanca in Costa Rica (> 3 million individuals; Porrás-Peñaranda *et al.* 2004), and Veracruz in Mexico (average of 5.1 million; Ruelas *et al.* 2010). Globally, Sapzurro is one of just six sites with

season counts of over half a million migrating birds (Zalles & Bildstein 2000). These findings fill an important knowledge gap with regards to raptor migration at the gateway to South America, where there is a dearth of watchsites compared to North America (Zalles & Bildstein 2000, Bildstein 2004, Jahunt 2011). Of all the raptor counts, perhaps that of Mississippi Kites is the most noteworthy, as counts of this species in South America are rare outside of Bolivia (Juhant & Areta 2013).

Most of the information about raptor movements along the Mesoamerican land corridor has been gathered from observations at a few major watchsites (Ruelas *et al.* 2010, Porras-Peñaranda *et al.* 2004, Smith 1985) and by satellite telemetry (Kochert *et al.* 2011). These studies show that during the fall, most raptors follow the Caribbean slope of Costa Rica before crossing to the Pacific slope in central Panama (Bildstein 2004). Our results from the Caribbean slope of the Colombian Darién appear to confirm this switch to the Pacific coast, as we recorded fewer individuals than sites in both Costa Rica and Panama. However, our data also suggest that migratory routes differed between the three most numerous species as they passed into South America, as we recorded a greater number of Turkey Vultures relative to Broad-winged Hawks and Swainson's Hawks. This ties in with the expected route of Turkey Vultures, which on reaching South America spread eastwards to the Caribbean lowlands of Colombia and the Llanos of Colombia and Venezuela and therefore would be expected to cross back to the Caribbean coast (Koester 1982, Kirk & Currall 1994). Meanwhile, satellite tracks of Swainson's Hawks suggest that most birds migrate through the center of the Darien as they follow a southerly course (Kochert *et al.* 2011). This variation in route between species presumably explains why counts at Sapzurro were lower than at other

sites in Mesoamerica, alongside the fact that this coastal site does not afford views of birds migrating further inland. Indeed, the largest counts of raptors were associated with thunderstorms forming over the mountainous spine of the Darién, which appeared to force birds towards the coast (NB pers. observ.).

Aside raptors, swallows were also especially abundant migrants in the Darién, with Cliff Swallow being the commonest followed by Barn Swallow and Bank Swallow (Table 1). Numbers of swallows were broadly similar during both fall migration seasons giving rise to season totals of > 170,000 individuals. These counts, while notable, are relatively low compared to counts in Veracruz, where they exceed 1 million individuals for each species and season totals are > 7 million (Winkler 2006). Counts at Sapzurro are unlikely to increase significantly by initiating migration counts in early August when the first swallows are observed (MR pers. observ.). Other abundant diurnal migrants included Chimney Swift, a poorly known species in Colombia (Hilty & Brown 1986).

Large counts of both raptors and swallows were also made during spring migration, and while these were only opportunistic counts, they highlight the probable importance of this region as a bottleneck during spring. Further monitoring efforts in spring are a clear research priority and should take into account anecdotal reports of large gatherings of Turkey Vultures on the Cerro del Águila to the north of Necoclí (on the peninsula directly to the east of Sapzurro Fig. 1).

While most of the diurnal migrants in this study passed straight over the study site, Eastern Kingbird flocks regularly landed in the forest and were observed consuming abundant fruits (NB pers. observ.). These observations contrast with reports from Panama, where most birds passed high overhead (Morton 1971). Turkey Vultures were observed roosting in Sapzurro and in the mangroves of

Bocas del Atrato. These roost sites may be important to a successful migration (Ruelas Inzunza *et al.* 2009) and future research should focus on identifying major roosting sites in the region, for both raptors and swallows. An effort to identify other possible watchsites, would also help us to better understand the nature and scale of migration through this region, particularly on the Pacific side of the Serranía del Darién. Given the increasing rates of deforestation in the region, time may be running out for the protection of roosting sites but it is unclear if further deforestation would affect diurnal migrants in other ways.

On a more positive note, raptor migration in the Darién also provides an opportunity to develop ecotourism initiatives that in turn could be used to promote the conservation of migratory birds alongside the Darién's unique biodiversity. Long-term watchsites and associated projects, like the Veracruz River of Raptors project and Hawk Mountain Sanctuary, use raptors as a flagship group to attract upwards of 80,000 visitors a year (Zalles & Bildstein 2000, Ruelas Inzunza *et al.* 2009). A similar ecotourism initiative in the Colombian Darién could bolster current tourism activities and catalyze a sustainable economic alternative with the potential to decrease deforestation rates, while simultaneously providing a forum for educating visitors and local communities about bird migration and biodiversity conservation.

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