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RAPTOR MIGRATION IN THE CAUCA RIVER VALLEY OF NORTHERN COLOMBIA

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Resumen. – **Migración de rapaces en el Valle del Río Cauca en el norte de Colombia.** – Llevamos a cabo conteos de rapaces migratorias en un mirador situado en el Norte de los Andes Suramericanos en la Cordillera Central de Colombia, desde 1999 hasta el 2004. Veintiocho especies de rapaces se registraron durante el periodo de 6 años, siendo 10 de ellas migratorias. Un promedio de 21 000 y cerca de 19 000 rapaces migratorias se contaron en cada temporada de otoño y primavera, respectivamente. Dos especies, el Gavilán de Alas Anchas (*Buteo platypterus*) y el Gavilán de Swainson (*Buteo swainsoni*) representaron más del 99% de los conteos totales por temporada. La migración del Gavilán de Alas Anchas tuvo su pico en un periodo de 4 días entre el 19 y el 22 de Octubre en el otoño, y entre el 15 y el 21 de Marzo en la primavera. El pico de migración del Gavilán de Swainson ocurrió una semana después entre el 27 de Octubre y el 2 de Noviembre en el otoño, y entre el 31 de Marzo y el 3 de Abril en la primavera. De las ocho especies de rapaces migratorias restantes observadas, el Águila Pescadora (*Pandion haliaetus*) y el Halcón Peregrino (*Falco peregrinus*) fueron las especies registradas más consistentemente para todas las temporadas. Ocasionalmente, observamos Aguilillas Tijeretas (*Elanoides forficatus*), Aguilillas del Mississippi (*Ictinia mississippiensis*), Esmerejones (*Falco columbarius*), y un Aguilucho Pálido (*Circus cyaneus*). Realizamos dos observaciones de Gavilán de Cola Roja (*Buteo jamaicensis*), las cuales representaron los primeros registros de la especie en Colombia y Sudamérica. Tanto para el otoño como para la primavera, la mayoría de las rapaces migraron después del mediodía cuando las térmicas fueron más abundantes y en todo tipo de clima, pero se presentó la tendencia a evitar migrar durante tormentas fuertes.

Abstract. – We conducted full-season raptor migration counts at a watchsite in the northernmost part of the South American Andes in the Central Cordillera of Colombia from 1999 to 2004. Twenty-eight species of raptors were recorded over the 6-year period, 10 of which were migratory. Averages of approximately 21,000 and 19,000 migrating raptors were counted each autumn and spring, respectively. Two species, the

Broad-winged Hawk (*Buteo platypterus*) and Swainson's Hawk (*Buteo swainsoni*) made up > 99% of the count in both seasons. The migration of Broad-winged Hawks peaked over a 4-day period between 19 and 22 October in the autumn and between 15 and 21 March in the spring. The main migration of Swainson's Hawks peaked a week later between 27 October and 2 November in the autumn, and 31 March and 3 April in the spring. Of the remaining eight migratory species observed, Ospreys (*Pandion haliaetus*) and Peregrine Falcons (*Falco peregrinus*) were most consistently recorded across all seasons. We occasionally observed migrating American Swallow-tailed Kites (*Elanoides forficatus*), Mississippi Kites (*Ictinia mississippiensis*) and Merlins (*Falco columbarius*), and a single Northern Harrier (*Circus cyaneus*). We made two sightings of Red-tailed Hawks (*Buteo jamaicensis*) which were the first records for the species in Colombia and South America. Both during autumn and spring, most raptors migrated after midday when thermals were most abundant but they migrated in all types of weather, except heavy rainstorms which they avoided. *Accepted 15 November 2005.*

Key words: *Buteo platypterus*, *Buteo swainsoni*, migration watchsite, raptor migration, Broad-winged Hawk, Swainson's Hawk, Colombia, northern Andes Mountains.

INTRODUCTION

Over half of the 31 species of North American Falconiformes are complete or partial migrants (Kerlinger 1989, Johnsgard 1990) and many of them use the Mesoamerican Land Corridor stretching 4000 km from the southern coast of Texas to northwestern Colombia to reach their wintering grounds in Central America and austral grounds in South America (Bildstein & Zalles 2001). Because raptors typically concentrate at local geomorphological sites such as ridges, coastlines, and peninsulas, their migration has traditionally been studied at watchsites situated along "leading lines" where each species can be identified and counted during migration (Mueller & Berger 1967). Indeed, more than 100 such concentration sites have been identified in North America, especially in eastern Canada and the United States (Harwood 1975, Heintzleman 1975) where counts have been made annually since the 1930s (Broun 1935, 1939; Allen & Peterson 1936). Using standardized methods, observers scan the sky and note the number and identity of migrants passing from early morning until late afternoon (Fuller & Mosher 1987).

Recently-established watchsites in Central America at Veracruz, Mexico and Talamanca,

Costa Rica indicate over 3,000,000 North American raptors utilize the Mesoamerican Land Corridor on the outbound migration in boreal autumn (Bildstein & Zalles 2000, Porras-Pañaranda 2004). Their flightlines converge in coastal Veracruz, Mexico, after which the bulk of the flight crosses to the Pacific slope (Tilly *et al.* 1990). Further south, most migrants enter the lowlands of northwestern Costa Rica where they track the foothills of the Atlantic slope southeast into Panama (Porras-Pañaranda *et al.* 2004) and, from there, most of the flight crosses to the Pacific slope before entering northwestern Colombia via the Darien of Panama (Bildstein 2004).

Unfortunately, few details are available on the migration of North American raptors once they reach South America primarily due to the fact that there have never been any long-term watchsites established along leading lines in the South American continent. Nevertheless, satellite trackings indicate that the Broad-winged Hawks (*Buteo platypterus*) begin to fall out of the flight as far north as El Salvador, and most have left the main flightline before reaching southern Colombia, as have most Ospreys (*Pandion haliaetus*), and Turkey Vultures (*Cathartes aura*) (Bildstein 2004). Satellite trackings of outbound Swainson's Hawks (*Buteo swainsoni*) suggest that the



FIG. 1. Location of the Fredonia watchsite in the northern Andes of Colombia.

main flightline turns south in northern Colombia and follows either the Cordillera Central or Oriental of the Andes Mountains south through the Magdalena River Valley in central Colombia (Bechard & Márquez 1997) to the Amazon lowlands of eastern Ecuador and Peru en route to east-central Bolivia, and ultimately the Pampas of northeastern Argentina (Fuller *et al.* 1998, Bildstein 2004). However, there are no details concerning the timing of the passage of migrants nor the specific routes that are taken. Herein, we report

on a project we undertook from 1999 to 2004 to establish a long-term watchsite in the northern Andes Mountains of Colombia where the migration of North American raptors can be monitored as they first enter into South American continent.

METHODS

The observation point we chose is on a mountain ridge (elevation 1550 m) in the northern portion of the Colombian Andes

TABLE 1. Total numbers of migrant raptors counted at the Fredonia watchsite between 1 October and 15 November, and between 15 March and 15 April, from 1999 to 2004, in the northern Andes of Colombia.

Species	1999		2000		2001		2002		2003		2004	
	Autumn	Spring	Autumn	Spring	Autumn	Autumn	Spring	Autumn	Spring	Autumn	Spring	
Broad-winged Hawk (<i>Buteo platypterus</i>)	25,987	39,239	51,412	14,728	5584	20,787	20,335	12,994	13,292			
Swainson's Hawk (<i>Buteo swainsoni</i>)	16,160	17,430	33,453	33,453	936	18,814	11,545	25,984	11,056			
Turkey Vulture (<i>Cathartes aura</i>)	0	0	1	0	0	0	0	0	0			
Peregrine Falcon (<i>Falco peregrinus</i>)	12	1	23	1	3	5	0	2	0			
Osprey (<i>Pandion haliaetus</i>)	19	29	17	8	6	2	1	4	7			
Merlin (<i>Falco columbarius</i>)	0	2	1	0	0	0	0	0	0			
American Swallow-tailed Kite (<i>Elanoides forficatus</i>)	0	19	0	0	0	0	0	0	0			
Mississippi Kite (<i>Ictinia mississippiensis</i>)	0	1	0	0	0	0	0	0	0			
Red-tailed Hawk (<i>Buteo jamaicensis</i>)	0	1	1	0	0	0	1	0	0			
Northern Harrier (<i>Circus cyaneus</i>)	1	0	0	0	0	0	0	0	0			

TABLE 2. Local raptor species observed at the Fredonia watchsite between 1 October and 15 November, and between 15 March and 15 April, from 1999 to 2004, in the northern Andes of Colombia.

Species	1999		2000		2001		2002		2003		2004	
	Autumn	Spring	Autumn	Spring	Autumn	Autumn	Spring	Autumn	Spring	Autumn	Spring	
Turkey Vulture (<i>Cathartes aura</i>)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Black Vulture (<i>Coragyps atratus</i>)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
King Vulture (<i>Sarcorampbus papa</i>)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hook-billed Kite (<i>Chondrohierax uncinatus</i>)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pearl Kite (<i>Gampsonyx swainsonii</i>)	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
White-tailed Kite (<i>Elanus leucurus</i>)	No	Yes	No	No	No	No	No	No	No	No	No	Yes
Plain-breasted Hawk (<i>Accipiter striatus ventralis</i>)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Savanna Hawk (<i>Buteogallus meridionalis</i>)	Yes	No	No	No	No	No	No	No	No	No	No	No
Roadside Hawk (<i>Buteo magnirostris</i>)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bicolored Hawk (<i>Accipiter bicolor</i>)	No	No	No	No	No	No	No	No	No	Yes	No	No
Black-and-chestnut Eagle (<i>Oroaetus isidori</i>)	Yes	No	No	No	No	No	No	No	No	No	No	No
Short-tailed Hawk (<i>Buteo brachyurus</i>)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
White-tailed Hawk (<i>Buteo albicaudatus</i>)	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	No	No
Crested Caracara (<i>Caracara plancus</i>)	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No	No
Yellow-headed Caracara (<i>Milvago chimachima</i>)	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
American Kestrel (<i>Falco sparverius</i>)	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bat Falcon (<i>Falco rufigularis</i>)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Applomado Falcon (<i>Falco femoralis</i>)	Yes	Yes	No	No	No	No	No	No	No	No	No	Yes

near the town of Fredonia, in the state of Antioquia (05°54'11.2"N, 75°43'4.9"W, Fig. 1), approximately 60 km from the city of Medellín. It is readily accessible by vehicle and it provides a panoramic view of the northern portion of the Cauca River valley between the Cordillera Occidental and Central of the Andes Mountains. Native vegetation in the surrounding habitat was mostly montane rainforest but most of it has now been replaced with sun and shade coffee, banana, and conifer plantations or is used for live-stock grazing.

We conducted observations at the watchsite between 09:00 and 16:00 h during the spring (15 March to 15 April) and autumn (1 October to 15 November) migration seasons of 1999–2004. We identified all raptors that passed the watchsite and estimated their numbers using 8 x 40 and 10 x 42 binoculars as well as noting their direction of flight, altitude, and distance. We also measured the following climatic and flight variables hourly: temperature, barometric pressure, visibility, cloud cover (0, 25, 50, 75, or 100%), precipitation, and wind speed and direction. Raptors flying repeatedly in the area and those exhibiting territorial behavior, hunting flights, hovering, or vocalizations were considered to be local residents and not migrants.

RESULTS

Numbers of species observed. We made observations every season from autumn 1999 through spring 2004, except the spring of 2002 when we were unable to operate the watchsite due to logistical constraints. We observed a total of 28 species of raptors over the 6-year period (Tables 1 and 2). Ten of these, the Osprey, American Swallow-tailed Kite (*Elanoides forficatus*), Mississippi Kite (*Ictinia mississippiensis*), Northern Harrier (*Circus cyaneus*), Broad-winged Hawk, Red-tailed Hawk (*Buteo jamaicensis*), Swainson's

Hawk, Merlin (*Falco columbarius*), Peregrine Falcon (*Falco peregrinus*), and the North American subspecies of the Turkey Vulture (*Cathartes aura meridionalis*) are considered to be migratory in northern Colombia (Table 1). Two species, the Broad-winged Hawk and Swainson's Hawk, made up > 99% of the migrating raptors we observed and we counted more of these two species both in autumn (mean = 21,208, SD = 14,383) and in spring (mean = 20,135, SD = 10,569). We also routinely observed 18 species of local resident raptors, most of which were Turkey Vultures (*Cathartes aura ruficollis*), Black Vultures (*Coragyps atratus*), King Vultures (*Sarcoramphus papa*), Hook-billed Kites (*Chondrohierax uncinatus*), Roadside Hawks (*Buteo magnirostris*), Short-tailed Hawks (*Buteo brachyurus*), Yellow-headed Caracaras (*Milvago chimachima*), and Bat Falcons (*Falco rufigularis*). We distinguished North American Turkey Vultures from individuals of the local resident subspecies (*C. a. ruficollis*) based on the fact that local residents do not flock and they have a distinguishing white band across the nape of the neck (del Hoyo *et al.* 1994) (Table 2).

Autumn vs spring migration. In the autumn, the migration of Broad-winged Hawks peaked over a 4-day period between 19 and 22 October when flocks of > 20,000 individuals passed on a single day (Fig. 2). There was a second, smaller peak in the passage between 25 and 29 October which coincided with the main migration of Swainson's Hawks. Most Swainson's Hawks passed in a huge flock consisting of as many as 30,000 individuals on a single day between 27 October and 2 November. Again in the spring, Broad-winged Hawks migrated earliest with the flight peaking between 15 and 21 March when flocks of as many as 16,000 individuals were observed on a single day (Fig. 3). A second smaller peak in the passage also occurred in the

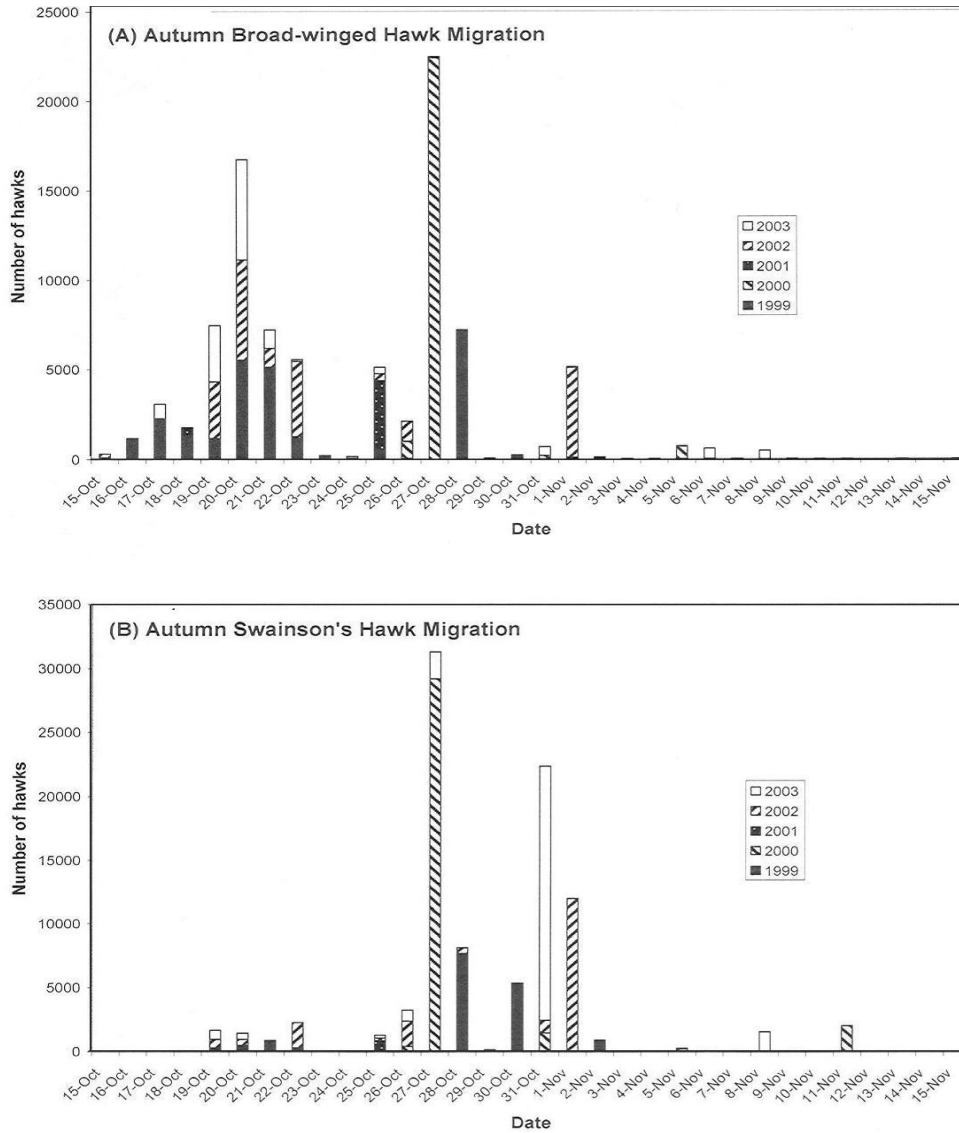


FIG. 2. (A) Seasonal occurrence of migrating Broad-winged Hawks during the autumn migration (1999–2003) at the Fredonia watchsite. (B) Seasonal occurrence of migrating Swainson’s Hawks during the autumn migration (1999–2003) at the Fredonia watchsite.

spring from 27 March to 1 April and coincided with the peak in the migration of Swainson’s Hawks. The peak passage of Swainson’s Hawks occurred, again, on a single day between 31 March and 3 April

when over 10,000 individuals passed on a single day.

Of the other species of migratory raptors we observed at the watchsite, Ospreys were recorded most consistently across all of the

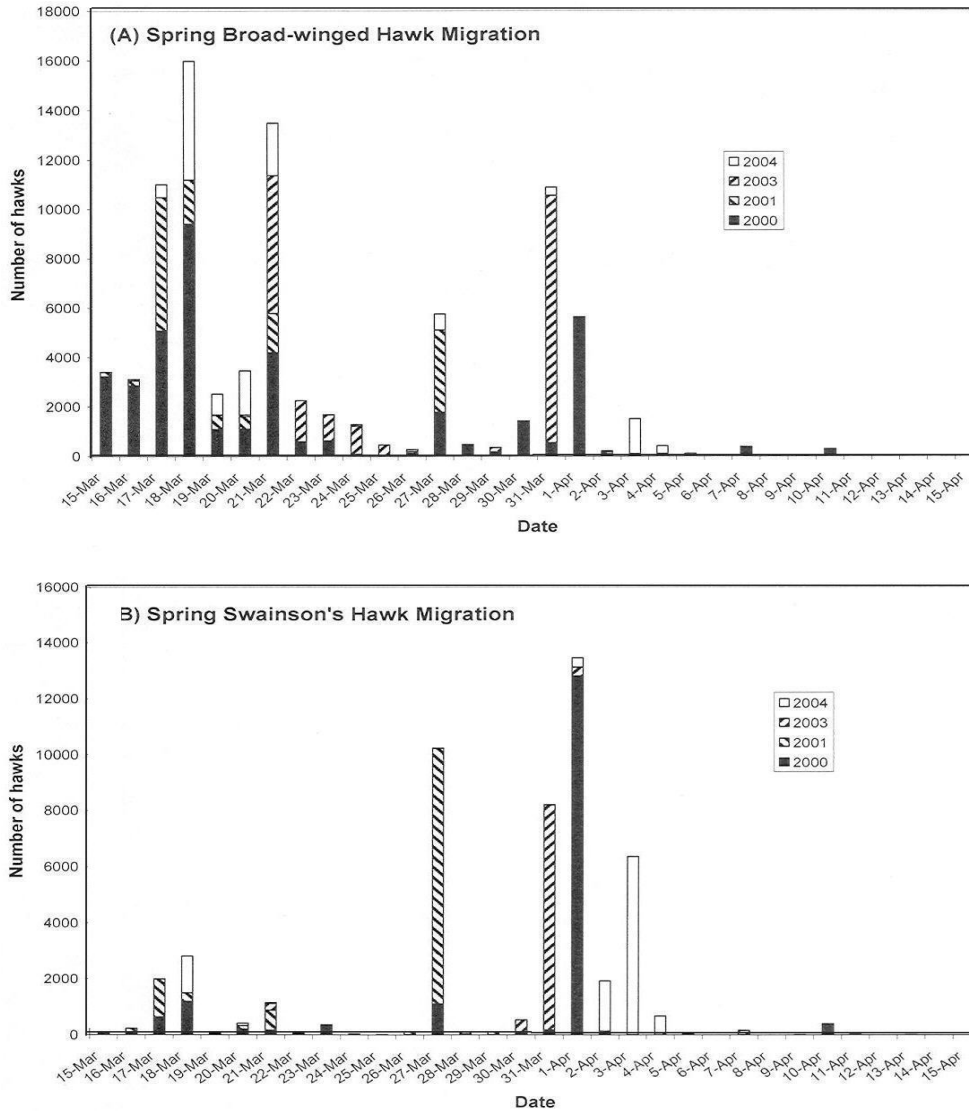


FIG. 3. (A) Seasonal occurrence of migrating Broad-winged Hawks during the spring migration (2000–2004) at the Fredonia watchsite. (B) Seasonal occurrence of migrating Swainson’s Hawks during the spring migration (2000–2004) at the Fredonia watchsite.

seasons but, on average, most were observed in the spring (mean = 12, Table 1). Peregrine Falcons were less frequently observed but, on average, most of them were observed in the autumn (mean = 5). Other species of interest

that we observed in the autumn migration included a Northern Harrier (*Circus cyaneus*) and a Red-tailed Hawk observed in 1999. In the spring migration, we observed 19 Swallow-tailed Kites, 1 Mississippi Kite, 1 Red-

tailed Hawk and 2 Merlins in 2000, and another Red-tailed Hawk in the spring of 2003.

Autumn flights of migrants were most concentrated in the early afternoon between 13:00 and 15:00 h whereas, in spring, they were more evenly distributed across the afternoon beginning at 12:00 h and continuing until 17:00 h. Large flocks rarely occurred before noon. During both spring and autumn, daily temperatures ranged between 24 and 34°C and usually peaked between 12:00 and 14:00 h so the peak in the daily passage of migrants corresponded with the warmest part of the day when thermals were most abundant. Daily winds were typically light and never strong, but they varied in direction. In the autumn, winds from the north and northwest generally occurred on days when the passage of Broad-winged Hawks peaked early in the season and south or southwest winds were associated with the highest counts of migrating Swainson's Hawks later in the season. In the spring, the passage of both Broad-winged and Swainson's Hawks peaked on days when winds were light and from the west. Cloud cover was variable and ranged between 30 and 100%. Barometric pressure was also variable and ranged between 854 and 865 mm Hg. Neither cloud cover nor barometric pressure were correlated with the numbers of migrants we counted ($P > 0.05$) but there was a tendency for greater numbers of migrants to occur on days when cloud cover was $< 70\%$. Migrants sometimes flew into clouds and glided out of clouds apparently unaffected. They did avoid thick storm clouds, either by flying below or around them. We observed migrants during periods of light rain but they did not migrate during rainstorms.

DISCUSSION

We counted over 300,000 migrating raptors over the 9 seasons that we conducted obser-

vations at the Fredonia watchsite, for an average of just over 20,000 migrants per season which puts the watchsite among the 20 more important sites for counting migratory raptors in the New World (Zalles & Bildstein 2000). Two species, the Broad-winged Hawk and Swainson's Hawk, accounted for $> 99\%$ the migrants we observed. In autumn, the main passage period occurred from 19 October to 1 November with the main migration of Broad-winged Hawks passing earlier than that of Swainson's Hawks between 19 and 22 October. The main migration of Swainson's Hawks passed at least a week later and usually on a single day either in late October or early November and coincided with a second, smaller passage of Broad-winged Hawks. Counts made at the Kéköldi lookout in Talamanca, Costa Rica also show that Broad-winged Hawks pass earlier than Swainson's Hawks peaking in late September and early October. Swainson's Hawks peak in late October to early November (Porrás-Peñaranda *et al.* 2004).

Our autumn counts were small when compared to counts made at lookouts in Veracruz, Mexico and Talamanca, Costa Rica where upwards of 3,000,000 migrants are counted each autumn (Ruelas Inzunza *et al.* 2000, Zalles & Bildstein 2000, Porrás-Peñaranda 2004). At both of these locations, Turkey Vultures and Broad-winged Hawks make up the bulk of the migration count. Our smaller counts may have been due to the fact that both of these species begin to drop out of the main flightline in Central America (Bildstein 2004); nevertheless, with nearly 3,000,000 migrating Turkey Vultures, Broad-winged Hawks, and Swainson's Hawks counted during the autumn migration season in Panama (K. Bildstein pers. com.), most North American migrants appear to continue their migration further south entering into South America. Our small counts of Turkey Vultures and Broad-winged Hawks suggest

that migrants either settle onto wintering grounds in northern Colombia or the main flightline expands over a broad front extending across much of northern Colombia and includes all three of the Andean Cordilleras. While Broad-winged Hawks and Swainson's Hawks dominated our counts each autumn and appeared to continue their migration through Colombia, we did not observe a single flock of migrating Turkey Vultures. Flocks of Turkey Vultures are known to occur in the northwestern portion of the country but migrants are seldom observed in the Central Cordillera, probably because most of them avoid the northern Andes and settle onto wintering grounds in the coastal plains of northern Colombia near the Caribbean coast where thousands North American Turkey Vultures are observed each year in the Gulf of Uraba (G. Colorado pers. observ.).

Swainson's Hawks do not begin to settle onto their austral summer grounds until they are much farther south (Fuller *et al.* 1997). With nearly 800,000 Swainson's Hawks counted during the autumn migration in Panama (K. Bildstein pers. com.), undoubtedly the main flightline of Swainson's Hawks splits in northern Colombia with migrants using all three cordilleras of the Andes as leading lines to reach the Amazon lowlands. Satellite trackings of Swainson's Hawks support this, showing individuals using all three of the Andean Cordilleras as well as the central Magdalena River valley to pass through Colombia (Bechard & Márquez 1997). There are as many as 200,000 Mississippi Kites observed annually on migration in Costa Rica and migrant Mississippi Kites are observed in Bolivia (Olivo 2004) so their migratory route must pass through Colombia (Zalles & Bildstein 2000). The fact that we observed only one Mississippi Kite over the 5 autumn seasons we made observations indicates that Mississippi Kites either migrate earlier in September or they do not use the Cauca River

valley to reach their austral grounds perhaps following an alternate route either through one of the other Andean cordilleras in Colombia or perhaps along the Pacific coast.

Very little is known about the return spring migration of North American raptors using the Transamerican Flyway (Bildstein 2004). Limited spring counts have been reported in Panama (Smith 1985) and Costa Rica (Skutch 1945), but there has never been a long-term watchsite established to record spring migration in either Central or northern South America which makes our observations at the Fredonia watchsite novel. What we have found supports the general assumption that the return flightline largely retraces the outbound route. We counted between 24,000 and 56,000 migrants over 4 spring seasons. Overall, our spring counts were less than our autumn counts. As in autumn, the spring migration was dominated by Broad-winged Hawks that passed earliest between 17 and 21 March followed by Swainson's Hawks that passed from 31 March to 3 April. We also observed a greater number and variety of migrants in spring including Turkey Vultures, Ospreys, Mississippi Kites, American Swallow-tailed Kites, and Merlins. The fact that we routinely observed migrants at the Fredonia lookout both in spring and autumn indicated that it was a very reliable location to monitor migration during either migration season.

We recorded four separate sightings of Red-tailed Hawks in the autumn of 1999, the spring of 2000, the spring of 2003, and again recently in the spring of 2005 (G. Colorado pers. observ.). These sightings are noteworthy because they are the first documented records of Red-tailed Hawks in Colombia (Castaño & Colorado 2002). While most Red-tailed Hawks winter in Mexico and northern Central America, our observations indicate that at least a few individuals continue to migrate farther south occasionally entering into South America.

We observed raptors migrating in all types of weather conditions from cloudless, windless days to windy, completely overcast days. Flight conditions are quite different in the tropics than in temperate zones (Smith 1985) which may explain why raptors in the tropics seem to migrate in what would be considered “sub-optimal” conditions at temperate latitudes. Raptors can be grounded for several days in heavy tropical rainstorms (Loflin 1967) so it is not surprising that they are frequently observed migrating on overcast days when thermals are poorly developed. While weather conditions are variable to some degree in the tropics, there are seldom occurrences of cold fronts such as those that are experienced in North America (Kerlinger 1993) and in more southern regions of South America such as Bolivia (Olivo 2005).

Our results show quite clearly that in order to quantify the annual migration of North American raptors in northern South America several watchsites must be established to simultaneously monitor the migration through the northern Andes. Satellite trackings of Swainson’s Hawks show that they use both sides of the Magdalena River valley to migrate through Colombia. Watchsites should be established on both sides of the valley in the Cordillera Oriental and Cordillera Central at sites that provide panoramic views of the river valley where counts can be made. In the Cordillera Oriental, a site should be established at Cerro Neiva in southern Colombia where satellite trackings indicate most migrating Swainson’s Hawks pass (Bechard & Márquez 1997). In the Cordillera Central, a site could be developed in the Combeima River valley near the city of Ibagué.

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