Spring 2010 raptor migration at Talamanca, Costa Rica

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El Corredor Mesoamericano es considerado la ruta migratoria más importante de América, ya que durante el otoño y la primavera al menos 33 especies de rapaces migran desde Norteamérica hacia Centro y Sudamérica a través de él. En los trópicos se han llevado a cabo estudios principalmente en la migración de otoño, por lo que la migración de primavera ha sido poco estudiada. Durante la primavera del 2010 se llevó a cabo el monitoreo de rapaces migratorias en Kèköldi, Costa Rica, uno de los tres sitios de conteo de rapaces más importantes a nivel mundial. Durante 83 días de conteo se registró un total de 613.849 individuos pertenecientes a 16 especies de rapaces, una especie de cigüeña y una especie de garza. El Aura Cabeza Roja *Cathartes aura*, junto con el Aguilucho Alas Anchas *Buteo platypterus*, el Aguilucho Langostero *B. swainsoni* y el Milano Mississippi *Ictinia mississippiensis* representaron el 98% del conteo total. El patrón diario de migración muestra más actividad por la mañana y por la tarde (09h00 y 14h00–15h00). Algunas especies continúan migrando con lluvia. Recomiendo continuar con el conteo de rapaces durante la migración de primavera para entender las diferencias o similitudes con respecto a la migración de otoño, así como con otros sitios de conteo.

Thirty-three species of North American raptors have been recorded migrating along the Mesoamerican Land Corridor[1,10], which is considered to be the most important raptor migration flyway in the New World[4]. Although raptor migration has been well studied in North America, relatively little is known about this phenomenon in the tropics[2,25], where studies have focused primarily on autumn migration; the geography and phenology of return migration in spring is less well understood[4].

Kèköldi Indigenous Reserve, on the Caribbean slope of Costa Rica, is considered an Important Bird Area[21]. Furthermore, the reserve ranks as one of the three most important hawkwatch sites worldwide, because of the number of migrant raptors sighted annually[2]; however, only autumn flights have been documented[17,18]. This study documents the spring 2010 migration through Kèköldi, including species composition and abundance, and the seasonal and diel timing of migration.

Study area and Methods

The watchsite is on a mountain 200 m above sea level in the Kèköldi Indigenous Reserve (09°37'57"N 82°47'13"W), in the Caribbean lowlands of south-east Talamanca, Costa Rica. Vegetation is mostly second-growth rainforest and abandoned cacao plantations[18]. The site provides a 330° view north and north-east to Limon city; west and north-west to Bri-brí, the Sixaola Valley and the Sierra de Panamá; east and south-east to the Caribbean Sea; and south to Puerto Viejo. The Caribbean Sea on one side and the Sierra de Talamanca on the other, funnel birds through the region's coastal lowlands[18], making this area one of the major bottlenecks along the Mesoamerican Land Corridor[25].

One or two trained observers counted birds daily between 17 February and 17 May 2010, at 07h00–17h00 each day, from a 10-m over-canopy tower. As well as counting migrating raptors, the observers recorded hourly climatic and flight variables, including visibility, temperature (°C), cloud cover (0, 25, 50, 75 or 100%), wind speed and direction, precipitation, flight height and direction, number of observers and minutes of observation, following a protocol modified from the standardised procedure of the Hawk Migration Association of North America[5,11,15]. Observers excluded those considered non-migrants from the count; i.e. any raptors exhibiting territorial behaviour, hunting flights, hovering or flying contrary to the main path. Observers systematically scanned all areas of sky using the unaided eye, 10 × 50 binoculars and a 20–60× spotting scope. Three different field guides were employed for species identification[6,22,24] and hand-held tally devices (mechanical clickers) to help count migrants.

Results

Migrant totals.—The total count during 83 days (904 hours) of observation was 612,152 individuals of 16 raptor species. Turkey Vulture *Cathartes aura* was the commonest species, representing 63% of the total count; Broad-winged Hawk *Buteo platypterus* was second commonest (19%), Swainson's Hawk *B. swainsoni* was next (9%) and Mississippi Kite *Ictinia mississippiensis* was the fourth commonest species (7%). Together, these four species represented 98% of the total count (Table 1). Other migrants recorded included 1,696 Wood Storks *Mycteria americana* and one Great Blue Heron *Ardea herodias*.

Migration phenology.—Swallow-tailed Kites *Elanoides forficatus* and Plumbeous Kites *Ictinia plumbea* were among the earliest migrants. Broad-winged and Swainson's Hawks predominated between mid March through mid April (Fig. 1). Mississippi Kites were among the latest migrants (Fig. 1), as were Merlins *Falco columbarius* and Peregrine Falcons *F. peregrinus*. Ospreys *Pandion haliaetus* were recorded throughout the period. Turkey Vultures also occurred throughout, although their passage was concentrated early in the season (Table 1).

Pooling data for all migrants across the season revealed a bimodal diel pattern, with the first peak between 09h00 and 10h00, and a second, slightly higher peak between 14h00 and 16h00 (Fig. 2).

Table 1. Raptor counts and timing by species at Kèköldi migration watchsite, Talamanca, Costa Rica, spring 2010.

Species	Total count	Peak one-day count	Peak day	Central 90% passage dates
Turkey Vulture *Cathartes aura*	385,699	51,705	7 Mar	24 Feb–9 May
Osprey *Pandion haliaetus*	906	103	23 Mar	7 Mar–24 Apr
Hook-billed Kite *Chondrohierax uncinatus*	5	2	2 Mar	2 Mar–28 Apr
Swallow-tailed Kite *Elanoides forficatus*	6,141	1792	8 Mar	26 Feb–18 Apr
Snail Kite *Rostrhamus sociabilis*	1	1	1 Apr	1 Apr
Mississippi Kite *Ictinia mississippiensis*	40,535	10,781	21 Apr	26 Mar–26 Apr
Plumbeous Kite *I. plumbea*	3,449	1,053	19 Feb	19 Feb–8 Mar
Northern Harrier *Circus cyaneus*	6	3	7 Mar	7 Mar–9 Mar
Sharp-shinned Hawk *Accipiter striatus*	2	2	4 Apr	4 Apr
Cooper's Hawk *A. cooperii*	1	1	13 Apr	13 Apr
Broad-winged Hawk *Buteo platypterus*	116,544	14,209	6 Apr	14 Mar–15 Apr
Swainson's Hawk *B. swainsoni*	55,496	10,704	12 Apr	15 Mar–19 Apr
Red-tailed Hawk *B. jamaicensis*	5	2	25 Mar	21 Mar–3 Apr
American Kestrel *Falco sparverius*	2	1	8 & 21 Apr	8 Apr–21 Apr
Merlin *F. columbarius*	9	2	6 & 14 Apr	3 Apr–28 Apr
Peregrine Falcon *F. peregrinus*	330	45	14 Apr	2 Mar–4 May
Unidentified *Accipiter*	5			
Unidentified *Buteo*	117			
Unidentified *Falco*	9			
Unidentified kites	52			
Unidentified raptors	2,834			
Other migrant raptors	4			
Migratory non-raptors	1,697			
Total	613,849	52,361	7 Mar	

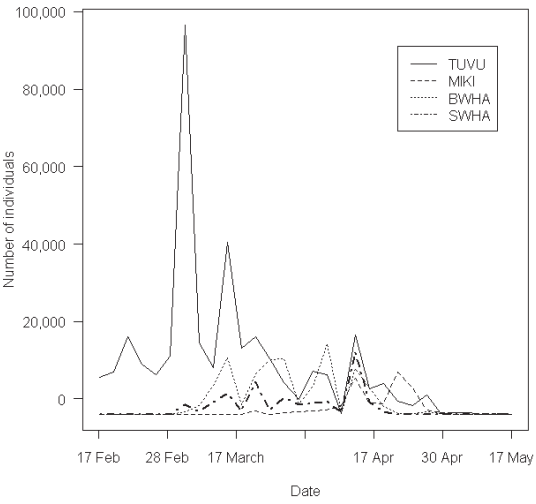

Figure. 1. Number of Turkey Vultures (TUVU) *Cathartes aura*, Mississippi Kites (MIKI) *Ictinia mississippiensis*, Broad-winged Hawks (BWHA) *Buteo platypterus* and Swainson's Hawks (SWHA) *B. swainsonii* counted at Kèköldi, Costa Rica, spring 2010.

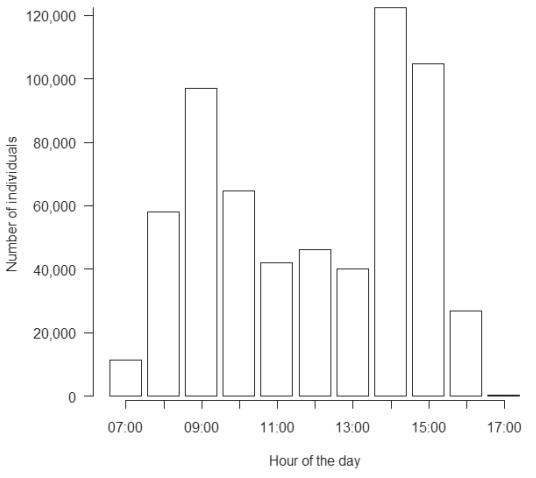

Figure. 2. Daily rhythm of raptor migration at Kèköldi, Costa Rica, spring 2010, with data for all species and the full season combined.

Species differed in their patterns, however, with Plumbeous Kite passage peaking between 11h00 and 12h00, and Wood Storks between 10h00 and 11h00 (Fig. 3).

Climatic effects.—There were 34 days with rain during the study. Turkey Vultures, Ospreys and Broad-winged Hawks continued to migrate during heavy rain. Swallow-tailed Kites migrated during light but not heavy rain. Observers also recorded a few Swainson's Hawks during heavy rain and noted

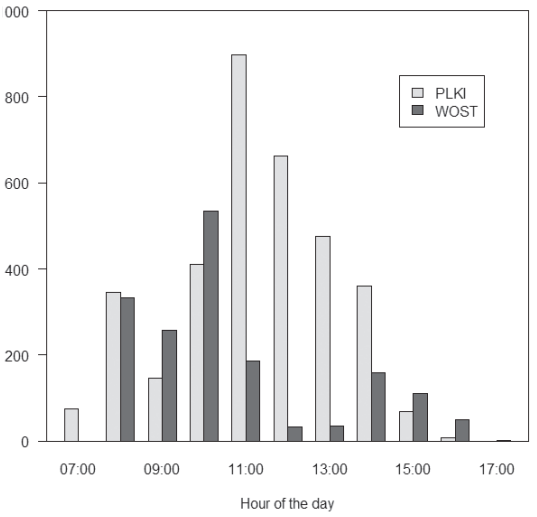

Figure. 3. Daily rhythm of Plumbeous Kite (PLKI) *Ictinia plumbea* and Wood Stork (WOST) *Mycteria americana* migration at Kèköldi, Costa Rica, spring 2010.

that one large flock of more than 2,000 Swainson's Hawks perched during heavy rain. Four wet days preceded the peak counts for Turkey Vultures and Peregrine Falcons, whereas the peak Osprey count occurred on such a day.

Discussion and Conclusion

Kèköldi is considered one of the most important concentration points for migrant raptors along the Mesoamerican Land Corridor during southbound migration[16]. Total counts in autumn 2001 and 2004 included c.3 million migrants[17,18].

This study is the first to document the spring migration at this site. In contrast to spring counts conducted in Veracruz, Mexico, in 1994–2011[12,20], a large proportion of spring migrants pass through Kèköldi en route to North America. Indeed, numbers of Ospreys, Swallow-tailed and Plumbeous Kites, and Peregrine Falcons recorded in spring at Kèköldi were much higher than in Veracruz. These species use different routes to move north from southern México, diverting via the Yucatán Peninsula across the Caribbean, rather than continuing north via Veracruz. Some Ospreys, for example, migrate across the Caribbean in spring, pausing in Cuba before continuing north to Florida[19]. Swallow-tailed Kites migrate south from Florida to the Yucatán Peninsula and then continue though Middle America[26]. Although there are no published data concerning the routes taken during spring migration, it can be assumed that they travel north using the same flyway, thereby bypassing Veracruz. Similarly, some Peregrine Falcons migrate via the Yucatán to cross the Gulf of Mexico to Texas in spring[9]. On the other hand, the small numbers of Plumbeous Kites recorded in Veracruz possibly reflect difficulties in identifying this species[20]. The watchsite lies close to the northern limit of the species' breeding range and therefore possibly a smaller proportion of the population passes through Veracruz than at Kèköldi[14,20].

In contrast to the above species, spring counts of Mississippi Kites, Broad-winged and Swainson's Hawks were lower at Kèköldi than in Veracruz. Broad-winged and Swainson's Hawks use another route in spring; they reach Costa Rica from western Panama, head north-east across the Valle Central, and then exit the country at the central border with Nicaragua[13]. Swainson's Hawks, especially, are more likely to follow the Pacific slope of Costa Rica during spring, thereby avoiding Kèköldi[3,13]. The geography of spring migration for Mississippi Kites is, however, less well understood[4] and merits further study.

The smaller numbers recorded at Kèköldi of Northern Harrier *Circus cyaneus*, Sharp-shinned Hawk *Accipiter striatus*, Cooper's Hawk *A. cooperii*, Red-tailed Hawk *Buteo jamaicensis*, American Kestrel *Falco sparverius* and Merlin probably reflect that these species primarily winter further north[4,7,10,22]; however, Red-tailed Hawks and American Kestrels are also known to migrate over the Pacific slope of Costa Rica[13,22].

Numbers of Turkey Vultures at Kèköldi were similar to counts in Veracruz. According to the Turkey Vulture Migration Project[23], some individuals migrate from Venezuela to Costa Rica via the Caribbean slope, as well as along the coast of the Gulf of Mexico. Therefore many of the same individuals are probably counted at both Kèköldi and Veracruz.

The autumn migration at Kèköldi concentrates large numbers of individuals from species that migrate in flocks. The four commonest species recorded during spring migration are the same as in autumn, but numbers recorded in spring are much smaller. In autumn, populations are larger, with juveniles making their first migration, some of which then remain in their wintering areas; in spring, populations are smaller and all birds have undertaken at least one previous migration[16]. Indeed, some populations take different routes or use different stopover sites in autumn and spring. The total counts in 2001 and 2004 were of c.3 million migrants, of 17 species[17,18], only one which was not observed during spring 2010, Zone-tailed Hawk *Buteo albonotatus*, whose numbers on southbound migration are low[17,18]. Little is known concerning Zone-tailed Hawk migration, and they may use another route through Middle America en route to North America.

Kèköldi Indigenous Reserve is important for migratory raptors, not only because of the numbers

of migrants that pass through, but also because they use the site to roost. Observers commonly reported Turkey Vultures, Mississippi Kites, Plumbeous Kites, Broad-winged Hawks, Swainson's Hawks and Peregrine Falcons perched within the reserve and its environs during late evening (c.17h00) and early morning (07h00–09h00), confirming that the area provides important stopover habitat for migrant raptors.

In North America, as elsewhere, migrants are both more abundant and tend to concentrate along topographic features to a greater extent in autumn than in spring[2,10]. Nevertheless, comparing autumn to spring counts may facilitate greater understanding of migration and population dynamics[8]. Continued monitoring of the spring migration at Kèköldi and other Middle American sites is recommended, in order to increase our understanding of raptor migration in the tropics.

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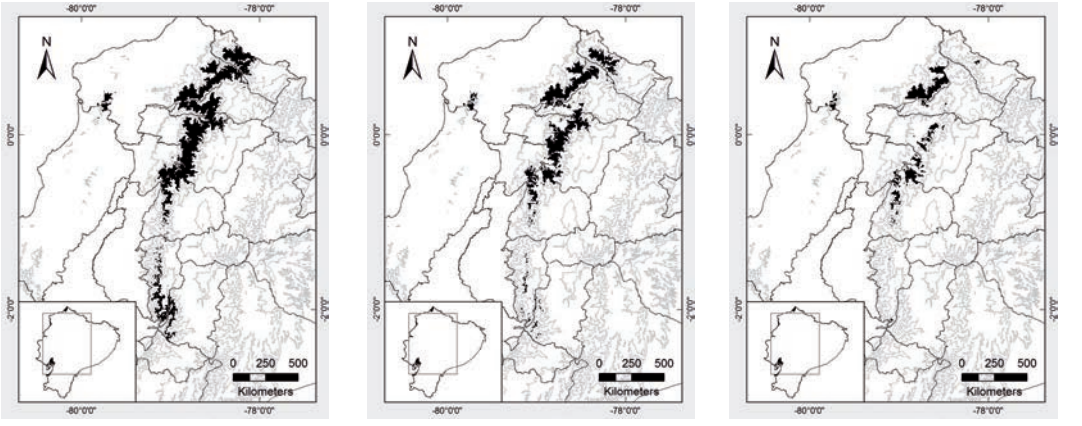
Erratum

The figures in Freile & Castro (2013, *Cotinga* 35: 8–9) depicting the historical, current and protected ranges of Colombian Screech Owl *Megascops colombianus* and Cloud-forest Pygmy Owl *Glaucidium nubicola* were incorrectly duplicated (both figures correspond to the pygmy owl). The correct Fig. 1 is reproduced below.



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