

## MIGRATION PATTERNS OF MISSISSIPPI KITES (*ICTINIA MISSISSIPPIENSIS*) IN THE EASTERN LOWLANDS OF BOLIVIA

Cristian Olivo

Hawk Mountain Sanctuary, Casilla 13794, La Paz, Bolivia. *E-mail*: olivocris@yahoo.it

**Resumen.** – Migración del Milano boreal (*Ictinia mississippiensis*) en las tierras bajas orientales de Bolivia. – Bolivia está clasificada como un cruce de caminos para migradores australes, intratropicales y boreales. Concepción, uno de siete observatorios de migración de rapaces identificados en Bolivia hasta la fecha, registra el mayor número de rapaces contadas en el país. Entre el 17 de Septiembre y 26 de Noviembre del 2001, se monitoreó la migración del Milano boreal (*Ictinia mississippiensis*) en Concepción, donde un total de 118 153 milanos fueron contados. La especie migró de forma concentrada, en grandes bandadas, sobre el pueblo de Concepción. La tasa de paso promedio fue de 238 milanos/h. Los milanos concentraron su migración entre las 10:00 y 14:00 h. Las bandadas de milanos fueron de mayor tamaño entre las 10:00 y 14:00–16:00 h. Una diferencia significativa con conteos y observaciones previas de la especie en Concepción es que, durante la migración de 2001 hacia las áreas no-reproductivas, la mayoría de los milanos fueron observados migrando en el eje sur-norte, volando preferentemente con vientos de frente del norte o noroeste. El motivo para este tipo de movimiento errático es desconocido.

**Abstract.** – Bolivia is a crossroads for austral, intratropical and Nearctic migrants. Concepción, one of the seven raptor migration watchsites identified in Bolivia, has the highest counts of migrating raptors. Between 17 September and 26 November 2001, Mississippi Kite (*Ictinia mississippiensis*) migration was monitored in Concepción. A total of 118,153 kites, many of which migrated in large flocks, were counted during this period. The mean passage rate was 238 kites/h. Most kites passed between 10:00 and 14:00 h. Flocks of kites were largest around 11:00 h and between 14:00 and 16:00 h. The 2001 counts differed from earlier observations at Concepción in that most kites were seen migrating to the north into northern-northwestern head winds. The reason for enhanced migration during these conditions is unknown. *Accepted 15 January 2004.*

**Key words:** Bolivia, Mississippi Kites, *Ictinia mississippiensis*, Falconiformes, outbound migration, weather.

### INTRODUCTION

Bolivia has one of the highest diversities of birds in the world (Arribas *et al.* 1995). Included within the almost 1500 species of birds are 68 species of diurnal raptors, 40 of which are believed to migrate in at least part of their range (Zalles & Bildstein 2000). The country has been called a crossroads for austral, intratropical and Nearctic raptor migrants (Zalles & Bildstein 2000).

Mississippi Kites (*Ictinia mississippiensis*)

begin their outbound migration in the United States in August/September. Most pass over Veracruz, Mexico in September (E. Ruelas pers. com.), and reach Panama in October (Bolen & Flores 1993). The route followed once in South America is largely unknown, in spite records of thousands of migrating kites in eastern Bolivia (Davis 1989, 1993; Olivo 2001a, 2001b), suggesting that Bolivia forms part of a main migratory route for the species (Zalles & Bildstein 2000).

Anecdotal reports and a pilot study

TABLE 1. Numbers of Mississippi Kites (passage rates) migrating over Concepción, Bolivia, in September–November 2001.

	September (102 h)	October (205 h)	November (190 h)	Total (497 h)
Mississippi Kites	6,637 (65)	70,697 (345)	40,819 (215)	118,153 (238)
Unidentified kites	372 (4)	624 (3)	505 (3)	1,501 (3)
TOTAL	7,009 (69)	71,321 (348)	41,324 (218)	119,654 (241)

suggested that the town of Concepción, a “Hawks Aloft Worldwide” watchsite in eastern lowlands of Bolivia, is along an important migratory route for Mississippi Kites (Davis 1989, Olivo 2001b). In 1985–86 several thousands kites were observed migrating south through Concepción (Davis 1989) and, during an autumn pilot study at the site, more than 38,000 kites passed through the town. The purpose of the present study was to describe the outbound movements of Mississippi Kites at Concepción, including the timing and magnitude of the flight.

#### STUDY AREA AND METHODS

Concepción is in the Departamento de Santa Cruz, in Provincia Ñuflo de Chávez, at 16°08'S, 62°02'W (elevation 250–400 m a.s.l.),

270 km from Santa Cruz. The city has a savannah sub-humid dry climate (Davis 1993), with mean temperatures of 24.5°C, with a maximum of 36.1°C and a minimum of 5.8°C (Administración de Aeropuertos y Servicios Auxiliares a la Navegación Aérea 2000).

The migration watchsite is on the outskirts of town, near the water reservoir created by a dam on the Zapocoz River. Maximum visibility at the site is 15 km to the Serranía de San Lorenzo.

Counts were made during 70 days from 17 September to 26 November 2001, usually from 09:00 to 17:00 h. Observations were made using Tasco 12x50 binoculars and a 10–60x20 Bushnell scope.

Counts were recorded on daily report forms modeled after Hawk Migration Association of North America (HMANA) Daily Report Forms, and completed forms were

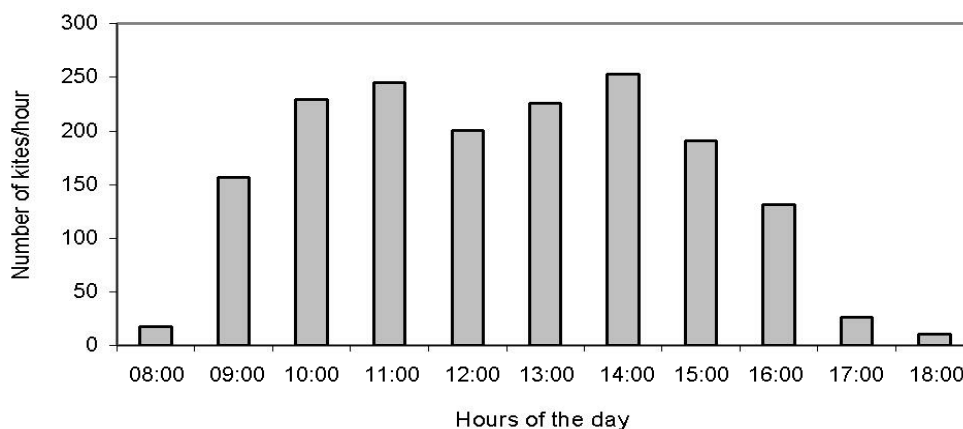


FIG. 1. Passage rates of Mississippi Kites at Concepción, Bolivia, in September–November 2001.

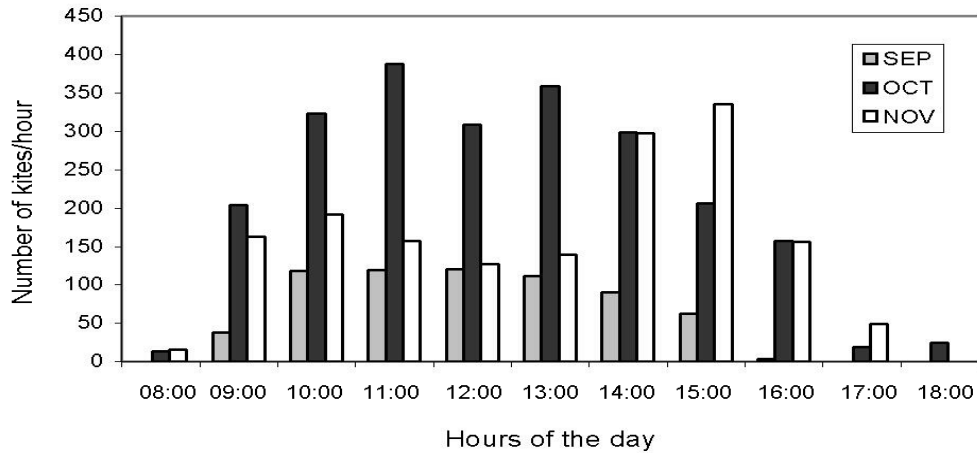


FIG. 2. Passage rates of the Mississippi Kites at Concepción, Bolivia, in September–November 2001.

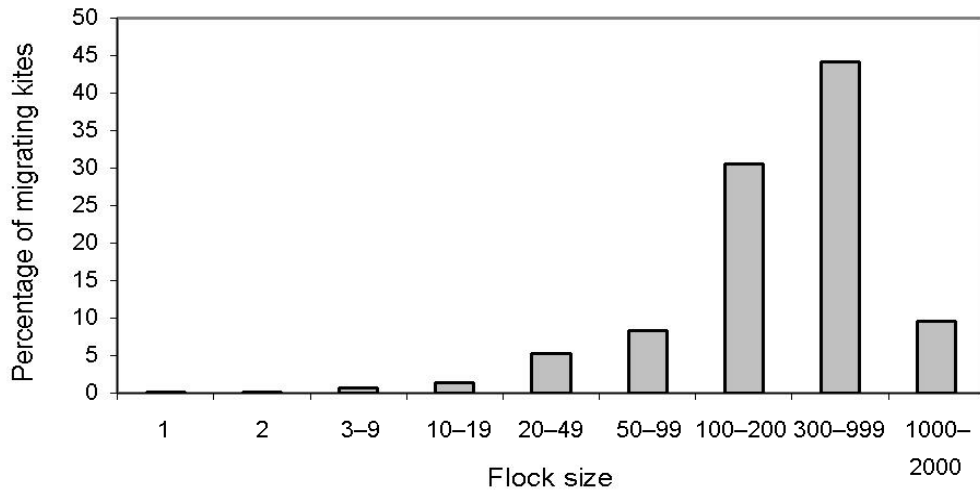


FIG. 3. Flock size of Mississippi Kites at Concepción, Bolivia, in September–November 2001.

sent to the HMANA archives at Hawk Mountain Sanctuary.

From each flock, numbers of individuals, species composition, and, when possible, age and sex or morph of the migrants were recorded.

Chi-square ( $\chi^2$ ) analyses and likelihood tests were used to document the extent of statistical differences in various aspects of

the flight (Dunne *et al.* 1984, Sokal & Rohlf 1995).

## RESULTS

*Diversity and relative abundance.* A total of 118,153 migrating kites was recorded during 497 observation hours on 70 days, for a mean passage rate of 238 kites/h (Table 1). Most

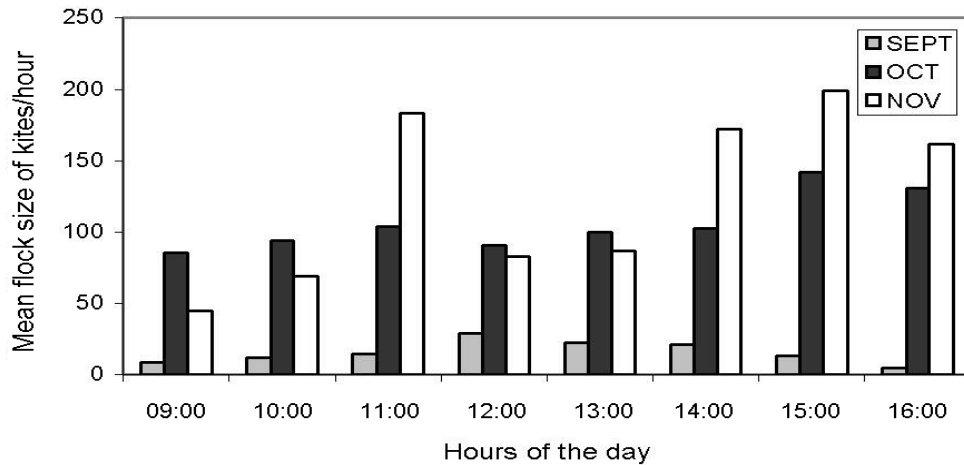


FIG. 4. Hourly mean flock size variation of Mississippi Kites migrating over Concepción, Bolivia, in September–November 2001.

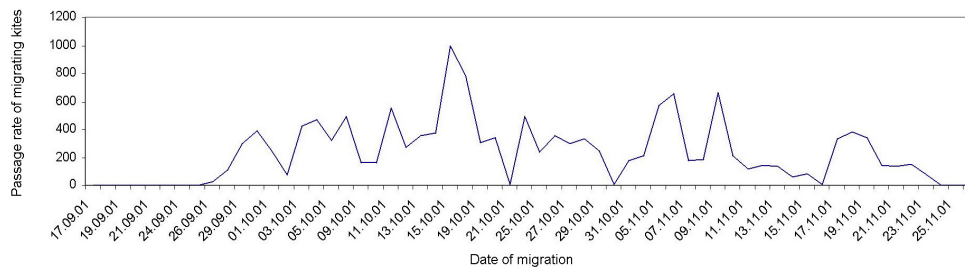


FIG. 5. Variation of the passage rates of Mississippi Kites migrating over Concepción, Bolivia, in September–November 2001.

migrants were counted in October. Approximately 40% of the flight that was aged, of these aged birds, more than 95% were adults.

A total of 3250 individuals (roughly 2.8% of the total) were considered as immatures. The total passage rate of immatures was 6.5/h, versus 231/h for adults. Immatures started migrating in October, and their maximum passage rates was in November, while adults had their maximum passage rate in October, decreasing in November.

*Daily and monthly variation in migratory flow.* Most kites passed between 09:00 and 16:00 h

(97%). Passage rates were highest between 10:00 and 11:00 and 13:00 and 14:00 h (Fig. 1) ( $\chi^2 = 576.7$ ,  $df = 7$ ,  $P < 0.01$ ). In September and October kites tended to pass between 10:00 and 13:00 h (71% and 60%, respectively), whereas in November they tended to pass between 14:00 and 15:00 h (39%) (Fig. 2).

*Flock size and composition variation in time.* Kites tended to migrate in single-species flocks, normally of more than 50 individuals (93%, Fig. 3).

When the birds glided between thermals,

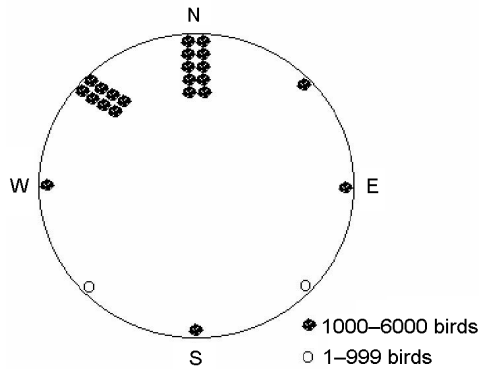


FIG. 6. Flight directions of Mississippi Kites migrating over Concepción, Bolivia, in September–November 2001.

flocks were longer than wide. In general, most flocks of more than 1000 birds were 1–3 km long, with an approximate width of 150 m. Flocks of 50–1000 individuals were about 1-km long, with an approximate width of 50–100 m. Flocks of fewer than 50 birds were about 50 m long and wide. Flocks were larger around 11:00 h and between 14:00 and 16:00 h ( $\chi^2 = 53.2$ ,  $df = 7$ ,  $P < 0.01$ ) (Fig. 4).

*Raptor migration calendar.* Although Mississippi Kites passed from 21 September until 25 November, 60% did so in October (Fig. 5). Migration peaked on 5 October.

The seasonal timing of immature and adult movements differed. Immatures started passing over Concepción 11 days after the adults. Fifty-seven percent of the 3250 immature kites (1852 birds) passed between 5 and 19 November. Immatures always flew in mixed flocks with adults. The maximum number of immatures seen on a single day was 405 birds on 5 November.

*Migratory directions.* Despite the fact that, during a given hour, kites were seen flying in different directions, 57895 (49% all kites) individuals migrated on the axis south-north,

and 47261 (40%) on the axis south-northwest (Fig. 6), with only a small fraction flying in other directions.

Flight directions changed depending upon wind direction (Likelihood test = 232.23,  $P < 0.05$ ). Independently from wind direction, most kites flew toward the north (49%) and northwest (40%). Wind directions during the study were mainly from the northwest and from the north. On northerly winds, however, only 21% of all kites migrated to the north or northwest, and on northwesterly winds only 28% of all kites migrated to the north or northwest.

## DISCUSSION

The Mississippi kites I watched passed Concepción from 21 September through 24 November. These dates coincide with those found by Davis (1989), who in 1985 recorded migrants over Concepción between 18 September and mid-November, and in 1986 between 31 September and 25 November.

Most kites passed the watchsite between 10:00 and 14:00 h, probably because temperatures were highest and thermals strongest then.

Most kites migrated north instead south at the site (see, for example Davis 1989 and Olivo 2001a), a behavior for which I can offer no immediate explanation. It may be that the birds already had concluded their long-distance movements and, when seen in Concepción, were moving about in an attempt to locate specific wintering habitat. This type of nomadic behavior has been reported for Swainsons Hawks (*Buteo swainsoni*) on their wintering areas in Argentina (Jaramillo 1993).

It is not known if Mississippi Kites have a concentrated corridor migration into South America such as that of Swainsons Hawks (see Fuller *et al.* 1998). The species, however is known to concentrate at “bottle-necks” in Veracruz, México and Keköldi, Costa Rica

where, between September and November 2001, 51,989 and 207,915 kites, respectively, were counted (K. Bildstein pers. com.). Assuming that the last number could represent a significant portion of the world population for the species, the flight observed in Concepción represents a significant portion of the world population as well.

It appears that adult Mississippi Kites pass through Concepción earlier than immatures. The reason for this is unclear.

#### ACKNOWLEDGMENTS

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