

A CONSERVATIVE STRATEGY IN MIGRATING SHORT-TOED EAGLES *CIRCAETUS GALLICUS*

UNA ESTRATEGIA MIGRATORIA CONSERVATIVA EN CULEBRERAS EUROPEAS *CIRCAETUS GALLICUS*

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The Short-toed Eagle *Circaetus gallicus* is a summer visitor to Europe, wintering in the savanna zones south of the Sahara desert (Cramp & Simmons, 1980). During migration across the Mediterranean basin, the largest concentration of individuals has been observed at the Straits of Gibraltar both during autumn and spring (Finlayson, 1992). Italy has a breeding population of 380-415 pairs, most of them in the Ligurian Apennines (northwest Italy) and along the western slopes of Central Italy (Cattaneo & Petretti, 1992; Fig. 1). Individuals breeding in central Italy cross the Mediterranean Sea through the Straits of Gibraltar, making a circuitous route through Northwestern Italy (Agostini & Malara, 1997; Agostini *et al.*, 2002; Baghino, 2002). The largest concentration of migrating Short-toed Eagles in Italy occurs over the Ligurian Apennines, near Arenzano (Northwestern Italy), both in autumn and in spring (Agostini *et al.*, 2002; Baghino, 2002). However, a notable concentration of Short-toed Eagles moving towards NW has been recently recorded during autumn along the western slopes of Central Italy, on the Apuane Alps, Tuscany (Agostini *et al.*, 2002). The aim of this study was to provide information on the visible autumn migration of Short-toed Eagles at these two sites of the Central Mediterranean through systematic observations made during the second half of September 2001.

At each site a total of 96 hours of observations, aided with binoculars and telescopes, were made from 15 to 26 September 2001, the peak of the autumn migration of the Short-toed

Eagle in the Mediterranean basin (Cramp & Simmons 1980). Each day was divided into four two-hours periods: 9:00-10:59 h., 11:00-12:59 h., 13:00-14:59 h., and 15:00-17:00 h. In the Ligurian Apennines the observation site was at the northernmost point of the mid-western Mediterranean Basin, near Arenzano (Fig. 1), where the ridge of Apennines, after running parallel to the coast, reaches the closest proximity to the sea (6 km) as well as the minimum transverse width in the entire Italian Peninsula. The observation site was on the closest culmination to the sea at 500 m. a.s.l. At the Apuane Alps the observation site was located on the slope of Mount Colegno, about 130 km SE of Arenzano (Fig. 1), at an altitude of c. 400 m. a.s.l. This site was located about 5 km inland of the Tyrrhenian coast.

On the Apuane Alps 351 Short-toed Eagles (3.7 per hour) were counted, with a peak on 22 September when 150 individuals were recorded (Fig. 2). With the exception of one bird seen moving towards the South, all Short-toed Eagles flew NW, towards the Ligurian Apennines. All other birds of prey recorded during this study (nine Marsh Harriers *Circus aeruginosus*, eight Honey Buzzards *Pernis apivorus* and six Hobbies *Falco subbuteo*) were migrating towards the South. A total of 77 flocks were observed (3.5 ± 0.2 [SE] birds/flock), as well as 81 (23%) individuals that were seen alone. Birds seen migrating together generally flew in loose flocks. On some occasions, both lone individuals and flocks were seen joining other birds of the same species in thermals, even when the directions were sometimes op-

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FIG. 1.—Study area. A = Arenzano; MC = Mount Colegno; M = island of Marettimo. Solid arrow = route observed; sketched arrow= alternative routes. In grey, breeding areas of Short-toed Eagles in Liguria and central Italy.

[Área de estudio. A = Arenzano; MC = Montet Colegno; M = isla de Marettimo. Flecha gruesa continua: ruta observada; flecha fina discontinua: rutas alternativas. En gris se señalan las áreas de cría de la Culebrera Europea en Liguria e Italia central.]

posed to the direction of migration (SE-NW). The migratory flow varied significantly throughout the day ($\chi^2 = 112.7$, d.f.=3, $P < 0.001$) with the largest proportion of birds observed during the last two-hours period (Fig. 3).

On the Ligurian Apennines a total of 542 Short-toed Eagles (5.6 per hour) were counted. It is interesting to note that by comparing the variation of the migratory flows at the two sites, there was a lack of correspondence on 20

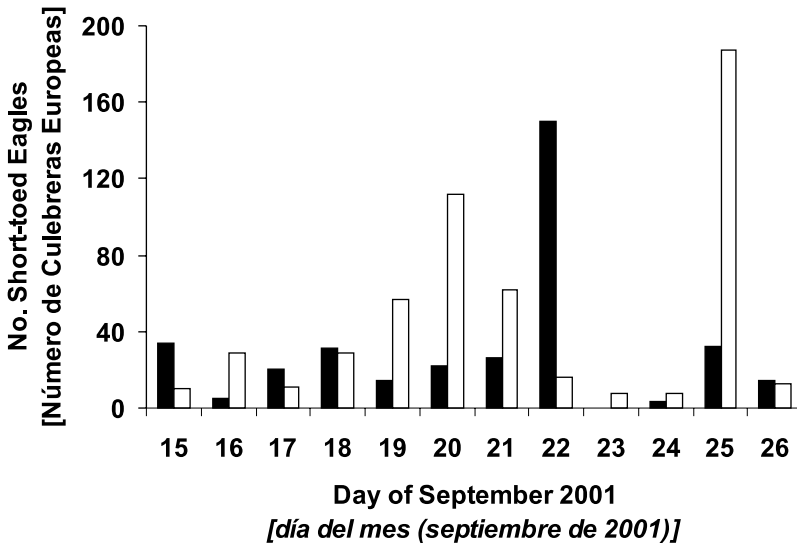


FIG. 2.—Occurrence of migrating Short-toed Eagles over the Apuane Alps (closed bars) and the Ligurian Apennines (open bars) between 15 and 26 September 2001.

[Número de Culebreras Europeas en migración sobre los Alpes Apuanos (barras rellenas) y los Apeninos Ligures (barras vacías) entre el 15 y el 26 de septiembre de 2001.]

September while a similar passage was recorded on 22 in the Apuane Alps and on 25 in the Ligurian Apennines (150 vs 187, $\chi^2 = 3.8$, d.f. = 1, $P > 0.05$; Fig. 2). Considering the variation of the migratory flow throughout the day, on the Ligurian Apennines the largest proportion of birds was recorded during the second two-hours period ($\chi^2 = 112.3$, d.f. = 3, $P < 0.001$; Fig. 3). At this site, 467 Short-toed Eagles migrated in flocks with an average flock size of 7.0 ± 0.3 (SE) birds.

The larger number of Short-toed Eagles counted at Arenzano was probably caused mostly by the passage of birds breeding in the eastern side of the Ligurian Apennines, north of the Apuane Alps. This would agree with the lack of correspondence in the migratory flows recorded at the two sites on 20 September, when the first peak at the Ligurian Apennines occurred. During migration over land, when soaring raptors reach highest altitude at midday they become difficult to see (Kerlinger, 1989). The lower number of Short-toed Eagles reported both for the Apuane Alps and Ligurian Apennines between 13:00 and 15:00 would suggest that many individuals may have passed by undetected during the day. A recent study

made by satellite-tracking showed that the distance covered daily by an adult Short-toed Eagle during migration greatly varies in relation to atmospheric conditions (Meyburg *et al.*, 1998). During favourable weather, the raptor covered hundreds of kilometres in a day but very few (sometimes less than 20 km) in days characterized by frequent rain (Meyburg *et al.*, 1998). During our observations, on 23 and 24 September, the weather was characterized by frequent rain both in central and northwest Italy. The similar passage recorded at the two sites on 22 and 25 September suggests that, during this period, Short-toed Eagles took about three days to cover 130 km between Mount Colegno and Arenzano (on average about 43 km per day). Short-toed Eagles breeding in central Italy could take more than ten days to reach Africa across the Straits of Gibraltar, flying about 1800 km over land and 14 km over water. Why do these birds not reach Africa crossing the central Mediterranean, as Honey Buzzards and Black Kites *Milvus migrans* breeding in the same area do (Agostini & Logozzo 1997; Agostini *et al.*, 2000), minimizing migration time? Short-toed Eagles could use three alternative routes. They could cross the sea directly

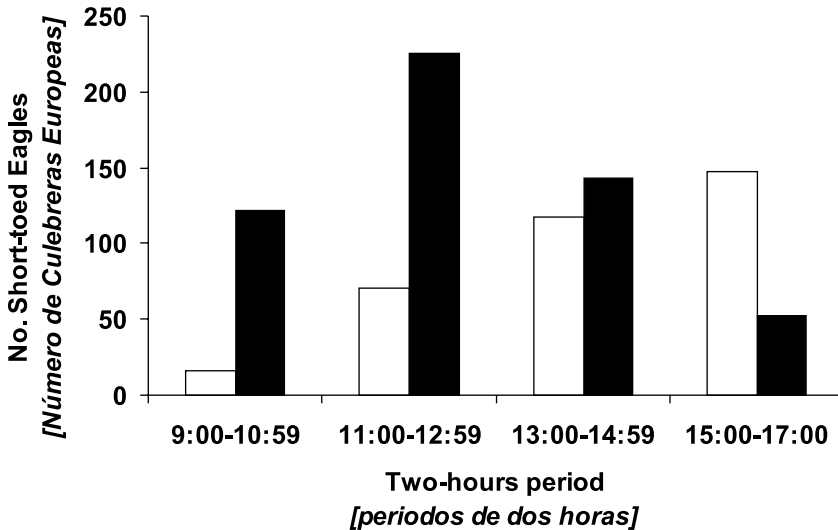


FIG. 3.—Variation of the migratory flow of Short-toed Eagles throughout the day over the Apuane Alps (open bars) and the Ligurian Apennines (closed bars).

[Variación a lo largo del día del flujo migratorio de *Culebreras Europeas* sobre los Alpes Apuanos (barras vacías) y los Apeninos Ligures (barras rellenas).]

from central Italy flying about 500 km via western Sicily (for instance via the island of Marettimo; Fig. 1). Otherwise, they could follow the Italian peninsula and Sicily crossing the central Mediterranean at its narrowest point between western Sicily and Tunisia (approximately 1000 km over land and 150 over water) or at its widest point between southern Sicily and Libya via Malta (approx. 900 km over land and 430 over water; Fig.1). Since thermals are almost absent over water, migrants cannot use soaring during its crossing, as they do over land (Kerlinger, 1989). Thus the crossing of the central Mediterranean would imply a long powered flight with a considerable expenditure of energy. In particular, during powered flight “the cost of transport will increase by three to six times the cost of soaring flight” (Kerlinger, 1989). Moreover, the risk of mortality increases during the sea crossing, especially during adverse weather. The Short-toed Eagle, differently from the Honey Buzzard and Black Kite, is characterized by large and broad wings showing a low aspect ratio (Kerlinger, 1989). Studies made on the water crossing behaviour of some species of raptors in North America showed that raptors with relatively short wings (low aspect ratio) are less suited to undertake

crossings of large bodies of water, as this feature increases the induced drag, and thus the energy needed for powered flight (Kerlinger, 1984; 1985). Assuming an increase of six times in energetic cost for a species with low aspect ratio wings, and considering the nucleus of Short-toed Eagles breeding in central Italy, the crossing of the central Mediterranean would imply a higher energetic cost for this bird of prey. Short-toed Eagles seem to choose the route limiting the flight over water (only 14 km across the Straits of Gibraltar) probably for making a safe migration as the result of a conservative strategy. This would explain why Short-toed Eagles (species with low aspect ratio wings) breeding in central Italy, differently from Honey Buzzards and Black Kites (a species with high aspect ratio wings; Kerlinger, 1989), do not cross the central Mediterranean, the last two species probably minimizing both time and energy using this route.

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