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ANALYSIS OF THE AUTUMN MIGRATION OF JUVENILE HONEY-BUZZARDS (*PERNIS APIVORUS*) ACROSS THE CENTRAL MEDITERRANEAN

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The existence of innate-migratory orientation in many birds is supported by those cases in which juveniles migrate to wintering areas independently of adult birds (Marks and Redmond 1994, Berthold 2001). The European Honey-buzzard (*Pernis apivorus*) is such a species. This buzzard is a long-distance migrant with birds breeding in Europe and wintering in west-central equatorial Africa (Cramp and Simmons 1980). During autumn migration in the central Mediterranean area, adults passing through central Italy tend to follow the peninsula, crossing the Straits of Messina (between southern continental Italy and Sicily), then deviate westward using the same migration route as in spring between western Sicily and Tunisia (Agostini et al. 2000). This pattern suggests true navigational abilities (Agostini and Logozzo 1995, 1997, Agostini et al. 2000). Only juveniles that occasionally migrate in flocks of adults seem to be able to learn this route by information transmission (Agostini et al. 1999). However, more commonly, juveniles of this species tend to migrate 2 wk later than adults, after the first 10 d of September (Kjellén 1992, Agostini and Logozzo 1995, Schmid 2000). Similar to adults, juveniles often fly in flocks (Agostini et al. 1999, 2002). Hundreds of juveniles migrate along the Calabrian Apennines (southern continental Italy; Agostini and Logozzo 1995, 1997, Agostini et al. 1999) and cross the sea at its widest point between Sicily and Libya via Malta (Agostini et al. 1999, 2002), moving in a southwestern direction (Agostini and Logozzo 1995, Agostini et al. 1999; Fig. 1). Along the western coast of central Italy, a similar passage was recorded at the Circeo promontory (Corbi et al. 1999, Agostini et al. 2002; Fig. 1). At this site, birds apparently cross the Tyrrhenian Sea moving toward the island of Ponza, located about 30 km south-southwest of the promontory (Fig. 1).

However, contemporaneous observations made at the Circeo promontory and Malta during the second half of September 2000, showed a correspondence between migratory pulses of buzzards suggesting that juveniles tend to follow the Italian peninsula deviating southeast during

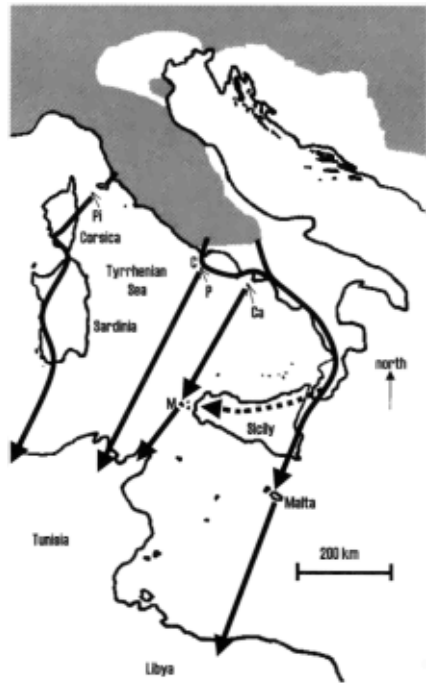


Figure 1. Study area and presumed routes used by juvenile European Honey-buzzards during the autumn migration across the central Mediterranean (Pi = Pianosa, C = Circeo, P = Ponza, Ca = Capri, M = Marettimo; dotted arrow: only migrating flocks of adults; the breeding areas of the honey-buzzard are shown in grey, [Gensbøl 1992]).

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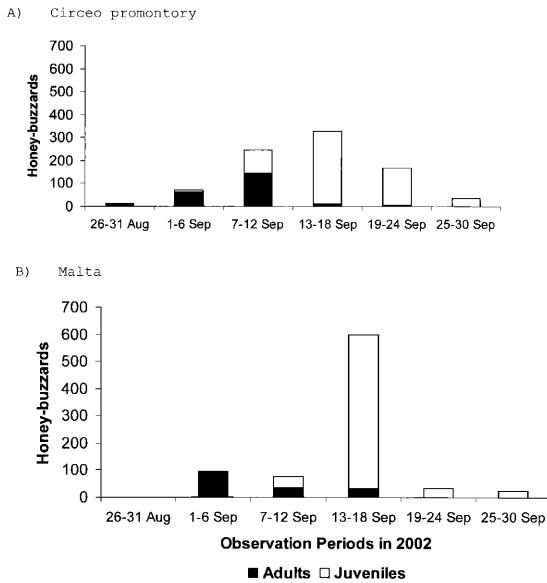


Figure 2. Adult and juvenile European Honey-buzzards estimated in the six 6-d periods at the Circeo promontory (A) and over Malta (B), according to their proportion among the identified individuals.

migration through central Italy (Agostini et al. 2002). Thus, juveniles may change their innate direction of migration (probably to the southwest), somewhat in response to geographic barriers (e.g., open water). The aim of this study was to test this suggestion by counting migrants at these two sites simultaneously during autumn 2002.

#### STUDY AREA AND METHODS

Observations were made between 26 August and 30 September 2002, each day from 0900 H until dusk aided with telescopes and binoculars. The Circeo promontory is located in the southernmost point of the Pianura Pontina reaching 541 m above sea level (masl; Fig. 1). At this location, we used an observation site (altitude ca. 400 m) in a military zone, on the roof of the Ente Nazionale Assistenza Volo building; from this look-out it was possible to observe birds undertaking a water-crossing toward the island of Ponza, which was nearly always visible. Malta is situated about 90 km south of Sicily and 335 km north of Libya (Fig. 1). Raptors concentrate along the cliffs on the western side of the island (Beaman and Galea 1974). The observation site was located in this area, on one of the highest points of the island (250 masl). We divided the 36 d of observation into six 6-d periods and attempted to distinguish adults and juveniles. Generally when buzzards were very close (<150 m) we were able to classify ages. The number of adults and juveniles was derived by multiplying their proportions in the sample of identified individuals to the total count during each 6-d period, following the method used in previous studies

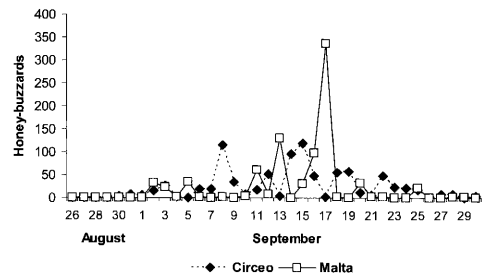


Figure 3. Occurrence of migrating European Honey-buzzards at Circeo and over Malta between 26 August and 30 September 2002.

(Agostini and Logozzo 1997, Agostini et al. 1999). Using direct visual sampling, we likely missed some proportion of migrants passing at both sites. However, our aim was to obtain a reasonable sample of birds to compare the variation of the migratory flows at the two study locations

#### RESULTS AND DISCUSSION

At the Circeo promontory, a total of 860 honey buzzards were counted; of these, 726 individuals undertook the crossing of the Tyrrhenian Sea toward the island of Ponza, 85 flew east-southeast along the coast while 49 birds roosted near the observation site. During the six 6-d periods, the passage of 235 (27%) adults and 625 (73%) juveniles was estimated (114 adults and 308 juveniles identified). Nearly all adults were seen during the first three 6-d periods (Fig. 2A). The daily variation of the migratory flow showed two pulses of movement on 8 and 14–16 September, when a total of 115 and 265 birds were counted, respectively (Fig. 3). Both adults and juveniles showed a strong tendency to remain in flocks after reaching the water barrier. Only on 10 occasions (7.8% of flocks,  $N = 129$ ) did we observe individuals to separate from the crossing flock and return inland. Over the island of Malta, 824 honey-buzzards were observed, and we estimated the passage of 662 (80%) juveniles and 162 (20%) adults (Fig. 2B; 111 adults and 474 juveniles identified). The difference between the number of individuals belonging to the two age classes estimated at the two sites was significant among adults ( $\chi^2 = 13.06$ ,  $df = 1$ ,  $P < 0.01$ ), but not among juveniles ( $\chi^2 = 1.00$ ,  $df = 1$ ,  $P > 0.05$ ). Similar to Circeo promontory, the migratory flow over the island of Malta showed two pulses of movements, on 13 and 16–17 September, when 130 and 435 individuals were recorded, respectively (Fig. 3).

These results agree with those of the previous study made at these two sites (Agostini et al. 2002). We suggest that many honey-buzzards seen undertaking the crossing of the Tyrrhenian Sea heading toward the island of Ponza, probably deviated eastward to reach the Italian peninsula again, passing over Malta 2–5 d later. Based on our data and other observations (Kerlinger 1989), honey-buzzards seem to travel 350–500 km/d. However, during the

second week of September 2002, both in central and southern Italy, the weather was characterized by frequent rain because of the passage of low pressure cells. We suggest that because of these weather conditions, honey-buzzards took 5 d to cover about 750 km between Circeo and Malta.

To explain the tendency of juvenile honey-buzzards to undertake the crossing of the Tyrrhenian Sea, we have suggested that during their first migration, birds do not know the migratory routes and do not have experience with the higher energetic cost of flying over water (Agostini et al. 2002). Also, because many individuals observed at the Circeo promontory presumably belong to the breeding population in central Italy (Fig. 1), they are heavy with fat at the beginning of migration (Agostini et al. 2002). Finally, the geographic characteristics of the site could also play a role. At this point, the orientation of the coast changes, bending more easterly for ca. 60 km. Thus, the Circeo promontory, located in the southernmost point of the Pianura Pontina, appears as a natural springboard toward the sea. However, although the difference between number of juveniles recorded at the Circeo and over Malta was not significant, the analysis of the timing of passage seems to suggest that the birds used alternative migratory routes. During the peak passage (14–17 September) only about half of the birds counted over Malta were recorded at the Circeo promontory. Conversely, 262 birds were counted in central Italy between 18–30 September, but only 60 over Malta (Fig. 3). Also during autumn 2000, a marked difference was recorded between counts made at the two sites during the peak passage (21–24 September; Agostini et al. 2002). In particular, a total of 368 birds were seen over Malta, while only 237 individuals were counted at the Circeo promontory two days earlier. Apparently, some of the birds seen over Malta were not seen at the Circeo promontory. On the other hand, previous observations showed that at least some juvenile honey-buzzards reach Tunisia crossing this Mediterranean area via the islands of Capri and Marettimo (Fig. 1; Jonzén and Pettersson 1999, Agostini et al. 2002). Moreover, a recent study using satellite telemetry suggests that wind drift could affect this decision (crossing the Tyrrhenian Sea or not). In particular, juvenile honey-buzzards, like juvenile Ospreys (*Pandion haliaetus*), are susceptible to drift by crosswinds, whereas adults compensate and are less affected by wind (Thorup et al. 2003). Consequently, during easterly winds, juvenile birds that leave the Italian peninsula may be more likely to cross the Tyrrhenian Sea (Fig. 1).

During the second half of September 2002, observations on the migration of honey-buzzards were also made over Pianosa, a small island located about 40 km east of Corsica and 300 km northwest of the Circeo promontory (Fig. 1). At this site Paesani and Politi (2002) recorded 533 honey-buzzards en route to Corsica, nearly all (408) observed on 19 September. Because a similar late passage was not recorded over Circeo and Malta, these birds

probably reached Africa via the islands of Corsica and Sardinia (Fig. 1). This conclusion would agree with data reported by Thibault (1983) and Grusso (2001) concerning a late passage of flocks of honey-buzzards using the Corsica-Sardinia route (Fig. 1). The existence of two different responses among juveniles of this species when reaching water barriers (crossing the sea following the innate-migratory direction vs. following the coast), could explain why young honey-buzzards cross the Mediterranean Sea on a broader front than adults.

**RESUMEN.**—Durante la migración de otoño los juveniles europeos de *Pernis apivorus* tienden a emigrar dos semanas después de los adultos, concentrando su paso a través del mediterráneo después del 10 de septiembre. En el área del Mediterráneo central, cientos de juveniles de *Pernis apivorus* son observados en el promontorio del Circeo (Italia central) y sobre la Isla de Malta. Aquí probamos la sugerencia que las aves juveniles que llegan al Mar Mediterráneo siguen la península italiana y cruzan las aguas abiertas entre Sicilia y Libia con datos colectados en el promontorio de Circeo y Malta entre el 26 de Agosto y el 30 de Septiembre del 2002. En el promontorio de Circeo, 860 aves fueron contabilizadas con un estimado de 625 juveniles y con un pico entre 14–16 de Septiembre. Sobre Malta, 824 aves fueron contabilizadas incluyendo un estimado de 662 juveniles y con un pico entre 16–17 de Septiembre. Estos resultados surgieron que muchas de las aves contabilizadas en el promontorio de Circeo también pasan cerca de nuestro sitio de muestreo en Malta 2–3 días después. Aunque la diferencia entre el número de juveniles registrado en estos dos sitios no fue significativa, el análisis de las variaciones diarias del flujo de la migración parece sugerir que parte de las aves vistas en el promontorio Circeo no pasaron sobre Malta y tal vez cruzaron el Mar Tirreno. La existencia de dos estrategias diferentes usadas por los juveniles de estas especies para abordar las barreras acuáticas (cruzar el mar o seguir la costa) puede explicar el por qué los juveniles de esta especie tienden a cruzar el mar en un frente mas amplió que los adultos.

[Traducción de César Márquez]

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