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DOES MIGRATION FLYWAY OF SHORT-TOED SNAKE-EAGLES BREEDING IN CENTRAL ITALY REFLECT THE COLONIZATION HISTORY?

KEY WORDS: *Short-toed Snake-Eagle*; *Circaetus gallicus*; *migration*.

Migration patterns are rather flexible systems, considering that the last glaciation occurred just a few thousand years ago and that postglacial changes in travel patterns indicate a high degree of evolutionary plasticity in migration traits (Alerstam 2006, *Science* 313:791–794). Many migrating birds do not use the shortest flyways to reach their destinations, but avoid the crossing of ecological barriers such as water surfaces, and follow detours where barrier passages are reduced (Alerstam 2001, *J. Theor. Biol.* 209:319–331). This is particularly evident in soaring birds, for which the extra costs (in terms of energy and safety) of flapping flight over water are higher than for other birds (Kerlinger 1989, *Flight strategies of migrating hawks*, Univ. of Chicago Press, Chicago, IL U.S.A.). In addition, migration routes are shaped by the historic processes of geographic range expansion and colonization (Sutherland 1998, *J. Avian Biol.* 29:441–446). In this letter, we detail a migratory route apparently reflecting the colonization process.

The Short-toed Snake-Eagle (*Circaetus gallicus*) is a summer breeder in Europe, wintering in the savannah zones south of the Sahara desert (Ferguson-Lees and Christie 2001, *Raptors of the world*, Helm Edition, London, U.K.). Adults breeding in central Italy cross the Mediterranean Sea at the Strait of Gibraltar, using a route through northwestern Italy during both autumn and spring migration (Fig. 1; Agostini et al. 2002, *J. Raptor Res.* 36:111–114; Premuda 2004, *Riv. Ital. Ornitol.* 74:119–124). Thus, while migrating along the western slope of central Italy, these eagles fly in the direction opposite to that taken by other species migrating in the same season.

Several circumstances suggest that the Short-toed Snake-Eagle is apparently still colonizing Italy from the western part of its European breeding range and that its population has not yet reached the carrying capacity. In particular, the bulk of the breeding pairs in Italy are located along its migration route (Agostini et al. 2002) and, despite ap-

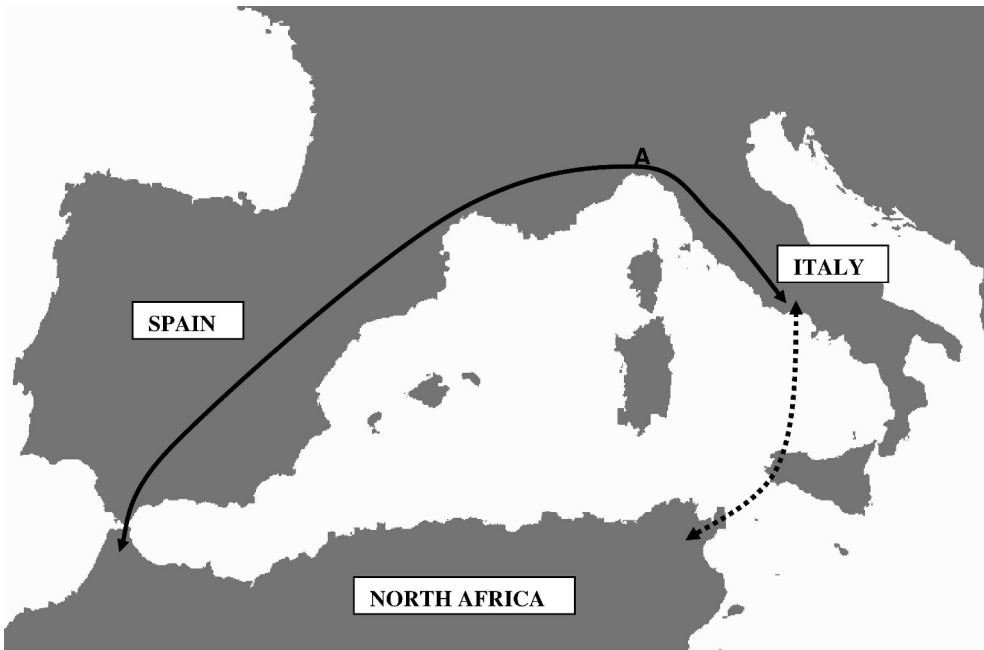


Figure 1. Approximate flyway used during both autumn and spring by adult Short-toed Snake-Eagles breeding in central Italy (solid arrow), and the alternative route (not used) across the central Mediterranean (A = Arenzano).

parent suitability, many areas of southern Italy have not been colonized or contain very few pairs (see Campora and Cattaneo 2006, *Riv. Ital. Ornitol.* 76:1–46). Moreover, new breeding sites outside the traditional range have been recently noted in central Italy (Campora and Cattaneo 2005, *Br. Birds* 98:369–380; Petretti 2008, *L'aquila dei serpenti*, Pandion Edizioni, Roma, Italy). Finally, an average of ca. 1300 adults were recorded in spring 2005–2006 at the important migration site of Arenzano, near Genoa in northern Italy (Fig. 1; Baghino and Premuda 2007, *Avocetta* 31:70–73), and although migrants were not counted there in the 1980s, it was estimated that peninsular Italy contained only 380–410 breeding pairs in the 1980s (Cattaneo and Petretti 1992, pages 520–527 in *Fauna d'Italia*, Aves, Calderini, Bologna, Italy); because the migrants were flying into the Italian peninsula in spring, the comparison suggests that the breeding population there has increased since the 1980s. It is interesting to note that Short-toed Snake-Eagles continue to use the route across the Strait of Gibraltar, despite the fact that at least some of the individuals hatched in central Italy know a shorter flyway, that across the central Mediterranean, which they follow as inexperienced birds during their first migration (Fig. 1; Agostini et al. 2004, *Avocetta* 28:37–40). As mentioned above, flying over a water barrier using flapping flight is much more costly and dangerous than soaring over land, but it allows birds to save time and reach their destination more quickly. For Short-toed Snake-Eagles breeding in

central Italy, the route across the central Mediterranean, although shorter than the route across Gibraltar (Fig. 1), includes a much longer water crossing (Agostini et al. 2002b). The benefits associated with the low cost of thermal soaring flight, compared to flapping flight over water, are probably great for these birds during both spring and autumn migrations, as this species has a low aspect ratio and is thus less well adapted to flapping flight than some other raptors (Kerlinger 1989). Thus, this example may show how colonization history, ecological barriers, and morphological characteristics of migrants probably interact in shaping migratory routes. Moreover, the adaptive value of the route followed by this species is indicated by the fact that, despite the availability of a more direct route between breeding and wintering grounds, Short-toed Snake-Eagles breeding in central Italy use the route that probably reflects the colonization process during both migrations. Thus, this “ancestral” route is not necessarily the result of evolutionary inertia, but seems to be optimal under present conditions, as in Red-backed Shrikes (*Lanius collurio*; Alerstam 2001; see also Sutherland 1998 and Alerstam 2006).

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