

Autumn migration strategies of honey buzzards, black kites, marsh and Montagu's harriers over land and over water in the Central Mediterranean

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Abstract – Observations on the autumn migration of honey buzzards *Pernis apivorus*, black kites *Milvus migrans*, marsh *Circus aeruginosus* and Montagu's harriers *C. pygargus* were made between 24 August and 10 September 2004 at the western slope of the Calabrian Apennines (Straits of Messina) and over Panarea (Lipari Islands). The aim was to compare the post-reproductive migration patterns of these raptors over land and over water along two parallel flight paths, as well as to verify the existence of a migratory movement of the black kite across the southern Tyrrhenian Sea in this period. A total of 7738 raptors were counted at both sites, most of which were honey buzzards (73.7%), black kites (9.1%) and marsh harriers (16.0%). Only 838 birds were seen over Panarea, most of which were marsh harriers (75.3%). No black kites were observed on Panarea. Thus, while marsh harriers migrated on a broad front, honey buzzards and black kites migrated over land and approached the Straits of Messina en route towards the Channel of Sicily, between western Sicily and Cap Bon in north Africa. This study shows no indication of a black kite migration across the southern Tyrrhenian Sea. Finally, our results confirm that, unlike spring migration, few Montagu's harriers cross the Central Mediterranean during post-reproductive movements.

Riassunto – *Le strategie di migrazione autunnale di falco pecchiaiolo, nibbio bruno, falco di palude e albanella minore sul mare e sulla terraferma nel Mediterraneo centrale.* Sono state effettuate osservazioni sulla migrazione autunnale del falco pecchiaiolo *Pernis apivorus*, del nibbio bruno *Milvus migrans*, del falco di palude *Circus aeruginosus* e dell'albanella minore *C. pygargus*, tra il 24 agosto ed il 10 settembre 2004, lungo l'Appennino calabrese (Stretto di Messina) e sull'isola di Panarea (Eolie). Lo scopo era quello di effettuare uno studio comparato dei movimenti post-riproduttivi di questi rapaci sulla terraferma e sul mare lungo due vie di migrazione parallele, anche per verificare l'esistenza di un flusso migratorio del nibbio bruno attraverso il Tirreno meridionale in questo periodo. Nei due siti è stato rilevato il passaggio di 7738 rapaci, quasi tutti falchi pecchiaioli (73.7%), nibbi bruni (9.1%) e falchi di palude (16.0%). Soltanto 838 uccelli sono stati osservati sull'isola di Panarea, prevalentemente falchi di palude (75.3%), e nessun nibbio bruno. Conseguentemente, mentre i falchi di palude migrano su un ampio fronte, sia i falchi pecchiaioli sia i nibbi bruni si spostano lungo la penisola raggiungendo lo Stretto di Messina diretti verso il Canale di Sicilia, tra la Sicilia occidentale e la penisola di Cap Bon (Nord Africa). L'esistenza di una migrazione autunnale di nibbio bruno attraverso il Tirreno meridionale non è confermata. Infine, le nostre osservazioni indicano che, diversamente dal periodo primaverile, poche albanelle minori attraversano il Mediterraneo Centrale durante i movimenti post-riproduttivi.

Water surfaces are natural barriers for Accipitiformes during migration (Kerlinger 1985, 1989). In fact, migrating raptors tend to use soaring and gliding flight over land exploiting thermals to minimize energy costs and avoiding long powered flights over water (Kerlinger 1989). Among species breeding in Europe and wintering in Africa, those with broad wings (eagles, buzzards, vultures) concentrate the crossing of the Mediterranean Sea at the Straits of

Gibraltar and at the Bosphorus (Cramp and Simmons 1980, Finlayson 1992), while rarely undertaking the longer crossing of the Central Mediterranean region (Agostini 2001, 2002, 2005, Agostini and Malara 1997, Beaman and Galea 1974, Corso 2001, Panuccio *et al.* 2004, Sammut and Bonavia 2004).

Conversely, species with relatively long wings, that reduce the energy costs of powered flight by minimizing the induced drag (Kerlinger 1985) (such as ospreys *Pandion haliaetus*, harriers, kites and honey buzzards *Pernis apivorus*) show a broad migration front over water. During spring migration

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in the Central Mediterranean, many of them concentrate their passage across the 150-km wide Channel of Sicily, some via the islands of Marettimo and Pantelleria (Fig. 1; Agostini 2001, Agostini and Logozzo 1998, Gustin *et al.* in press). Once they reach western Sicily, thousands of honey buzzards and at least hundreds of harriers and black kites *Milvus migrans* bypass the Straits of Messina by flying over the Tyrrhenian Sea via Ustica and the Lipari Islands (Fig. 1; Panuccio *et al.* 2004, our unpubl. data).

In this study, we report on simultaneous observations performed during autumn migration at two parallel migration paths over land and over water, along the Calabrian Apennines (area of the Straits of Messina) and over the island of Panarea (Tyrrhenian Sea, Lipari Islands, Fig. 1), in order to compare the patterns of migration of the most widespread migrating raptors at these sites and to verify the existence of migratory flow of black kites across the southern Tyrrhenian Sea in this period (Agostini and Logozzo 1997).

STUDY AREA AND METHODS

Observations were made between 24 August and 10 September 2004. In this period, a large overlap in the migration flow of black kites, honey buzzards, marsh *Circus aeruginosus* and Montagu's harriers *Circus pygargus* occurs in the Central Mediterranean region (Agostini and Logozzo 1997). At the Straits of Messina the post was located along the Calabrian Apennines, at an altitude of c. 1100 m a.s.l. (Fig. 1). On Panarea, a small volcanic island about 65 NW off the Straits (Fig. 1), the post was located at its highest point, c. 400 m a.s.l. At present, observations on the autumn migration of raptors at this site were lacking. To investigate the circadian pattern of migration, each observation day was divided into five time periods: 08:00-09:59, 10:00-11:59, 12:00-13:59, 14:00:15:59, 16:00:18:00 (solar time). In the case of the marsh harrier, at each site we estimated the total of adult males, adult females and juveniles according to their proportions among identified individuals (Panarea = 298 identified birds; Straits of Messina = 226). In order to exclude a bias due to the easier identification of adult males, the proportion of females and juveniles was estimated dividing unidentified individuals of the group female/juvenile between the two age groups according to their proportion among the identified birds (Kjellén 1992, Agostini and Logozzo 1997).

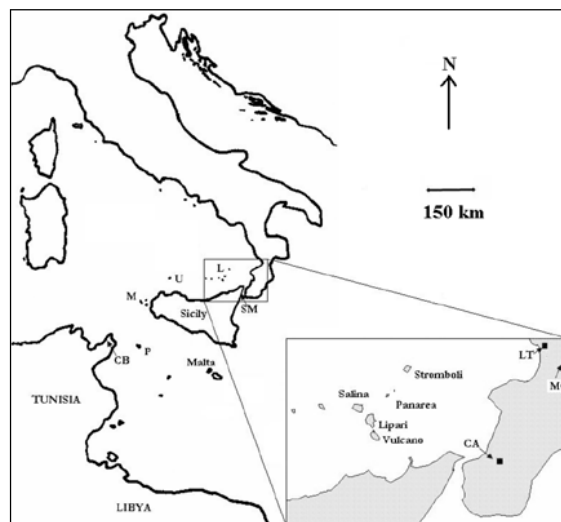


Figure 1. The Central Mediterranean area (CB = Cap Bon Peninsula; P = Pantelleria; M = Marettimo; U = Ustica; L = Lipari islands; SM = Straits of Messina; CA = the observation post along the Calabrian Apennines; MC = Mount Covello; LT = meteorological station of Lamezia Terme). – *L'area del Mediterraneo centrale* (CB = Penisola di Cap Bon; P = Pantelleria; M = Marettimo; U = Ustica; L = Isole Eolie; SM = Stretto di Messina; CA = postazione lungo l'Appennino calabrese; MC = Monte Covello; LT = Stazione meteorologica di Lamezia Terme).

RESULTS AND DISCUSSION

The passage of 7738 Accipitriformes of 12 species was reported at the two sites, most of which were honey buzzards (5703), black kites (704) and marsh harriers (1240). Moreover we observed 63 Montagu's harriers, 2 hen harriers *Circus cyaneus*, 2 pallid harriers *Circus macrourus*, 6 buzzards *Buteo buteo*, 1 red kite *Milvus milvus*, 5 sparrowhawks *Accipiter nisus*, 10 ospreys *Pandion haliaetus*, 1 short-toed eagle *Circus galli-cus* and 1 long-legged buzzard *Buteo rufinus*.

Honey buzzard

5513 (97%) individuals were counted at the Straits of Messina, peaking between 28-29 August (1494 birds, 26.2%) and on 5 September (825 birds, 14.5%). At this site, the daily variation of the migratory flow showed a clear peak in late morning and at midday (Fig. 2). On the island of Panarea, honey buzzards (190; 3%) were all counted between 6-10 September. Among aged birds, the proportion of juveniles was significantly higher at the latter site (Panarea: adults = 61; juveniles = 25; Straits of Messina: adults = 634; juveniles = 68; $\chi^2 = 25.79$, d.f. = 1, $P < 0.01$). These

results confirm that adult honey buzzards moving in the Central Mediterranean region follow the Italian Peninsula during autumn migration, while, unlike during spring movements (Panuccio *et al.* 2004, Gustin *et al.* in press), their passage over the Tyrrhenian Sea is virtually non-existent in this period (see also Agostini *et al.* 2003b, 2004a). After crossing the Straits of Messina, these raptors deviate westwards crossing the sea at its narrowest point, between western Sicily and the Cap Bon Peninsula, at least part of them concentrating over the islands of Marettimo and Pantelleria (Agostini and Logozzo 1997, Agostini *et al.* 2000, 2004b); at these two sites, 4045 birds were counted during the same period in 2003 (Agostini *et al.* 2004b). Although in this species juveniles tend to migrate later than adults, and cross the Mediterranean basin on a broader front after mid September, our data confirm that there is at least a partial overlap in the migration periods of birds belonging to the two age classes in the Central Mediterranean region (Agostini 2004, Agostini and Logozzo 1997, Agostini *et al.* 1999, 2002, 2004b). During observations made between 1992 and 1996 along the Calabrian Apennines (Mount Covello), approx. 90 km NE of the post used in this study (Fig. 1), a maximum of only 1544 honey buzzards were reported during post-reproductive movements (Agostini and Logozzo 1997). It remains unclear if the front of migration becomes narrower when approaching the Straits of Messina.

Black kite

Unlike honey buzzard, there is a large overlap in the migration periods of adult and juvenile black kites during autumn migration (Agostini and Logozzo 1997, Agostini *et al.* 2000, 2004b, Panuccio and Canale 2003). In our study, we observed 704 individuals, all at the Straits of Messina. Similarly to honey buzzards, our count is higher than the one reported by Agostini and Logozzo (1995, 1997) between 1992 and 1996 along the Calabrian Apennines (Mount Covello, max. 260 birds). The variation of the migratory flow during the day showed a clear late afternoon-evening peak (Fig. 2). Moreover, 123 (17.5%) birds, apparently coming from the coastal area, were seen to roost close to our observation post.

Black kite counts from southern continental Italy and the islands of Marettimo and Pantelleria show marked differences between these two Central Medi-

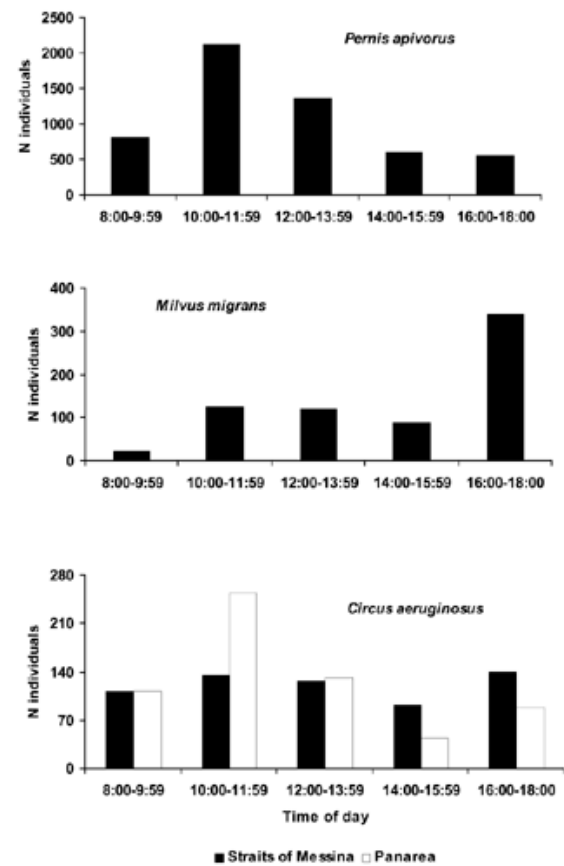


Figure 2. Variation of the circadian migratory flow (solar time) of honey buzzards *Pernis apivorus* (Straits of Messina), black kites *Milvus migrans* (Straits of Messina) and marsh harriers *Circus aeruginosus* (Straits of Messina-Panarea) in the period 24 August - 10 September 2004. - *Variazione del flusso migratorio dei falchi pecchiaioli *Pernis apivorus* (Stretto di Messina), dei nibbi bruni *Milvus migrans* (Stretto di Messina) e dei falchi di palude *Circus aeruginosus* (Stretto di Messina-Panarea) nel corso della giornata (ora solare), nel periodo 24 agosto - 10 settembre 2004.*

terranean areas. In this period the migratory flow of this species is greater between western Sicily and Tunisia (max. 3600 individuals counted between 24 August-14 September 1998 over Marettimo) rather than along the Calabrian Apennines (this study, Agostini and Logozzo 1997, Agostini *et al.* 2000, 2004b). To explain this result, Agostini and Logozzo (1997) suggested two alternative hypotheses: many black kites, like during spring movements (Panuccio *et al.* 2004), could cross the Tyrrhenian Sea choosing a more direct route between the Italian Peninsula and western Sicily or, alternatively, could move along coastal areas rather than along the mountain ranges of southern continental Italy. Our observations, like those made over Ustica, where not a single black

kite was reported between 25 August-6 September 2001 (N Agostini and D Logozzo, unpubl. data), seem to rule out the first hypothesis. Conversely, the circadian pattern of the migratory flow reported in this study is consistent with the alternative hypothesis. During migration, black kites are regularly seen while foraging at rubbish dumps (Blanco 1994, 1997) or hunting around burning fields (Provenza and Amato, unpubl. data). Most birds migrating along the Italian peninsula could perhaps choose to move onto flat areas close to the Tyrrhenian coast where they can find suitable areas for hunting en route to Africa. Under this hypothesis, it is interesting to note that many pairs of this species breed just along the Tyrrhenian slope of central Italy (Gensbøl 1992, Sergio 2002). In conclusion, like adult honey buzzards, black kites moving in the Central Mediterranean during autumn migration tend to fly over land and concentrate at the narrowest point, between western Sicily and the Cap Bon peninsula, perhaps as the result of an energy minimization strategy (see also Meyer *et al.* 2000).

Marsh harrier

We reported 609 individuals at the Straits of Messina and 631 over Panarea. Among adults, males outnumbered females at both sites (Panarea: 346 vs. 128; $\chi^2 = 99.34$, d.f. = 1, $P < 0.01$. Straits of Messina: 328 vs. 55; $\chi^2 = 193.17$, d.f. = 1, $P < 0.01$) (see also Agostini and Logozzo 2000, Agostini *et al.* 2003a). While females migrated mostly via Panarea (128 vs. 55; $\chi^2 = 28.33$, d.f. = 1, $P < 0.01$), higher numbers of juveniles moved along the Calabrian Apennines (226 vs. 157; $\chi^2 = 12.07$, d.f. = 1, $P < 0.01$). Similarly to the pattern reported along the Falsterbo peninsula in Sweden (Kjellén 1992), many juveniles choose to follow the leading line of the mainland during their first southward migration. The circadian variation of the migratory flow differed between the two sites: over Panarea, marsh harriers were seen mostly during late morning (10:00-11:59), whereas at the Straits of Messina their passage did not show an evident peak ($\chi^2 = 64.56$, d.f. = 4, $P < 0.01$; Fig. 2). In order to investigate the relationships between the intensity of the migratory flow of this species at the two sites and prevailing winds, hourly wind direction data for the southern Tyrrhenian Sea were recorded from the meteorological station of Lamezia Terme (Fig. 1) at

the web site <http://www.ilmeteo.it>. Apparently prevailing winds, from WNW-W-WSW (frequency = 157 hours) and E-ESE (frequency = 20 hours), supposedly shifting the path of the migrants laterally, did not affect the migratory flow of this species at the two locations: the proportions of birds reported during each wind condition were similar at the two sites (Straits of Messina: 343 birds with westerly winds and 98 with easterly winds; Panarea: 352 birds with westerly winds and 132 with easterly winds; $\chi^2 = 2.88$, d.f. = 1, $P > 0.05$).

These results agree with Agostini *et al.* (2001), which suggested that, during post-reproductive migration across the Central Mediterranean, marsh harriers tend to move along parallel NE-SW flyways. They undertake long water crossings mostly in the morning (Agostini and Panuccio 2003) and use parallel migration paths over water or over land independently of the direction of lateral winds.

Montagu's harrier

The species was scarcely recorded at both sites. Individuals observed at the Straits of Messina outnumbered those seen over Panarea. Unlike during spring movements (Corso 2001, Panuccio *et al.* 2004), few Montagu's harriers cross the Central Mediterranean during autumn migration (Agostini and Logozzo 1995, 1997, Agostini *et al.* 2000, 2004b, Agostini and Panuccio 2003, Jonzén and Pettersson 1999, Sammut and Bonavia 2004). Some authors suggested that many individuals use a loop migration in the Mediterranean basin, crossing the Central Mediterranean during spring and concentrating at the Straits of Gibraltar during autumn migration (Agostini and Logozzo 1997, García and Arroyo 1998). Since at least some Montagu's harriers do not suspend moult during autumn migration (Arroyo and King 1996), Agostini and Logozzo (1997) supposed that a loop migration could be explained by assuming that gaps in the wings would imply higher energy costs during the long powered flight across the Central Mediterranean during post-reproductive movements. Moreover, moult is associated with elevated energy costs because of synthesis of new feathers (Gorney and Yom Tov 2001, see also Lindstrom *et al.* 1993, Ginn and Melville 1983). In our study it was possible to age 27 individuals; of them, 14 (51.9%) were juveniles and 13 (48.1%) adults (11 males vs 2 females); among adults, not a single individual showed clear

signs of wing feather moult. In agreement with recent observations along the southern Mediterranean coast of Spain (Meyer *et al.* 2003), at least a fraction of Montagu's harriers, perhaps mostly juveniles (moving along an innate direction NE-SW during their first migration) and not moulting adults, undertake long water crossings (> 100 km) during autumn migration. Unfortunately, Meyer *et al.* (2003) did not include information about the age and the plumage of migrants.

In conclusion, during autumn movements across the Central Mediterranean, marsh harriers, unlike black kites and adult honey buzzards, show a broad front of migration. Like in spring, they undertake long powered flights over water, apparently using more direct paths between breeding and wintering areas, perhaps to minimize the migration time. In the case of Montagu's harriers, our results seem to confirm a loop migration in the Mediterranean basin.

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