

Autumn migration of raptors on Capri

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Abstract - In this paper we present the first documentation of raptor migration on Capri, Italy. During the autumns of 1994 and 1995 daily observations were made. The two most common species were Honey Buzzard (*Pernis apivorus*) and Marsh Harrier (*Circus aeruginosus*), but the total number was low compared to the Strait of Gibraltar and the Bosphorus. The high numbers from Gibraltar is, however, the result of full-scale counts across the entire width of the Strait. Hence, the numbers are not comparable. A large part of the Honey Buzzards and Marsh Harriers migrated in late September - early October, when observations are scarce or lacking at the Strait of Gibraltar and the Bosphorus. We suggest that these late migrating Honey Buzzards and Marsh Harriers have a more eastern origin compared to the birds observed earlier in the season.

Introduction

For a long time, it has been more or less accepted that the autumn passage of raptors across the central Mediterranean is not very extensive compared with the well-documented migration at the Strait of Gibraltar and the Bosphorus. Moreau (1953, 1961) concluded that no important concentrations are found at the crossing to Africa via Sicily. However, the spring migration at Cap Bon, Tunisia, and the Strait of Messina, Italy, is rather extensive (e.g. Thiollay 1975, Thiollay 1977, Agostini 1992).

More than twenty years ago, a study of the visible migration over the Maltese Islands was published (Beaman and Galea 1974). The authors wrote in the introduction that "systematic observations of the movements across the central Mediterranean are seriously lacking". That is still true (but see Toffoli and Bellone 1996) and their study is one of the very few dealing with the autumn migration of raptors across the central Mediterranean.

In this paper we present the results from a study of raptor migration over the island of Capri, Italy, during the autumns of 1994 and 1995. The purpose of the study was to investigate which species are using this flight route, in which numbers they occur (compared with Gibraltar and the Bosphorus), what time of the season they pass, how the daily visible migration is distributed in time, and finally, the geographical direction of the movements. Furthermore, we tried to identify as many birds as possible concerning age and sex

to be able to detect age/sex specific timing of migration.

Study site and methods

In autumn 1994, systematic observations of raptors passing over Capri were made between August 17 and October 19. In 1995 the observation period was restricted to September 1 until October 13.

The island is rather small (10 km²) and situated about 4 km south-west of the peninsula of Soreto and 25 km south of Naples. The study of the migratory movements was carried out from the old genuine castle, Castello Barbarossa, on the top of Monte Barbarossa (405 m a.s.l., see fig. 1): South of the castle rises Monte Capello (515m a.s.l.) and east of the mountain is a depression (Cetrella), which works as a corridor for migrating raptors. For further details, see Pettersson *et al.* (1990).

Daily observations were made throughout daylight by a minimum of two observers, using 8-10x binoculars and 20-30x telescopes. Each individual was identified to species and, if possible, to age and sex. Furthermore, the direction of the single raptors was simply estimated by using a compass. A problem occurred if the raptors were gliding at low altitude and "disappeared" behind Mt. Capello. To find out whether the low-flying raptors changed direction when they were invisible from the castle, the flight directions were also estimated a few times from Mt. Capello. The

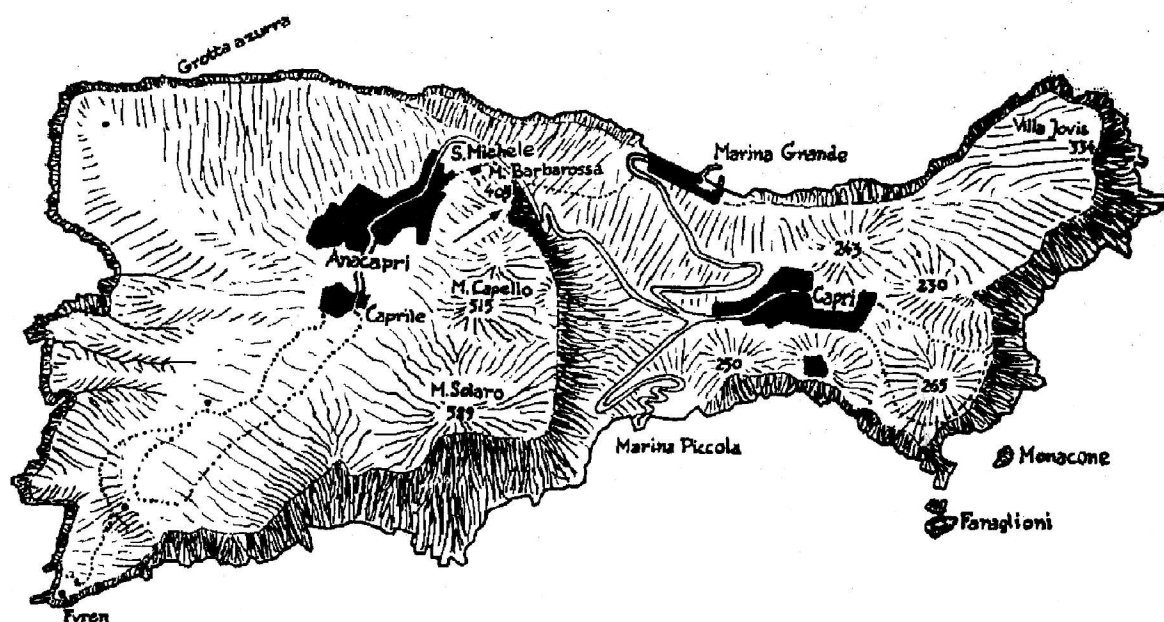


Figure 1. The island of Capri. Castello Barbarossa, where the study was carried out, is marked by an arrow.

mean flight track was calculated and tested according to the Rayleigh test (Batschelet 1981). Because of the high number of observations, the flight directions are not presented in a circular diagram but as the percentage of raptors leaving in each direction.

In 1994, west and south-west were the dominating wind directions during August and September. The visible migration, however, seemed to be more affected by the force than the direction of the wind. During the second third of September, strong winds from the western sector dominated and the migration was more or less absent. The highest numbers occurred during hot days with light west-south-easterly wind.

The following year, the first third of September was dominated by strong winds from the west. The rest of the autumn was a mixture of hot days with light wind and stormy days with rainfall.

Results

A total of 356 raptors of 14 species were seen on migration during the first autumn (table 1). The following year a total of 407 individuals of 12 species were counted. The two most common species were Honey Buzzard (*Pernis apivorus*) and Marsh Harrier (*Circus aeruginosus*), which made up 90 % of the total number during both years. Furthermore, Eleonora's Falcon (*Falco eleonora*) was observed a few times in August and early September. These

birds were probably not migrating and are therefore excluded in table 1.

As many as 79 % of the Honey Buzzards and 78 % of the Marsh Harriers migrated in flock. The flock sizes varied between 2 and 16 (4.1 ± 2.9 S.D.) in Honey Buzzard and 2 and 14 (3.7 ± 2.5 S.D.) in Marsh Harrier. Also mixed flocks of Honey Buzzard / Marsh Harrier and some other species, e.g. Black Kite (*Milvus migrans*) and Booted Eagle (*Hieraaetus pennatus*), were seen.

Time of the season

The first raptors showed up when the observations started in the middle of August and the last observations were made on 13 October. Most of the birds passed during September, but the distribution differed between the autumns. In 1994 the median date was 12 September for both Honey Buzzard and Marsh Harrier. Both species showed two obvious peaks; the first and last third of September. The first passage of Honey Buzzard was earlier than the corresponding peak at Gibraltar and the Bosphorus, but the second peak occurred when the Honey Buzzards already have passed Gibraltar and the Bosphorus (fig. 2). On the other hand, the first peak of Marsh Harriers coincided with the main passage at Gibraltar, but during the last third of September very few Marsh Harriers are observed there (fig. 3). Also the migration of Black Kite and Montagu's Harrier (*Circus pygargus*) culminated during the first third of

Table 1. Number of raptors recorded on Capri in autumn 1994 and 1995 compared to the relative scale of migration at the Strait of Gibraltar and the Bosphorus. Data on the scale of migration at the Strait of Gibraltar and the Bosphorus from Finlayson (1992).

Species	Capri 1994	Capri 1995	Gibraltar	Bosphorus
Honey Buzzard <i>Pernis apivorus</i>	157	172	10,000-100,000	1,000-10,000
Black Nite <i>Milvus migrans</i>	24	11	10,000-100,000	1,000-10,000
Red Kite <i>Milvus milvus</i>	2	0	10-100	<10
Short-toed Eagle <i>Circus gallicus</i>	2	10	1,000-10,000	1,000-10,000
Marsh Harrier <i>Circus aeruginosus</i>	134	186	100-1,000	<10
Montagu's Harrier <i>Circus pygargus</i>	12	4	1,000-10,000	<10
Northern Goshawk <i>Accipiter gentilis</i>	0	1	10-100	<10
Eurasian Sparrowhawk <i>Accipiter nisus</i>	4	6	100-1,000	10-100
Common Buzzard <i>Buteo buteo</i>	4	2	100-1,000	10,000-100,000
Booted Eagle <i>Hieraetus pennatus</i>	3	2	1,000-10,000	100-1,000
Bonelli's Eagle <i>Hieraetus fasciatus</i>	1	0	<10	0
Osprey <i>Pandion haliaetus</i>	2	4	10-100	<10
Lesser Kestrel <i>Falco naumanni</i>	2	0	100-1,000	<10
Common Kestrel <i>Falco tinnunculus</i>	4	5	100-1,000	<10
Lesser/Common Kestrel	2	0	?	?
Eurasian Hobby <i>Falco subbuteo</i>	3	4	10-100	10-100
Total	356	407	23,540-235,410	13,120-131,270

September. Unfortunately, we were not able to age and sex a sufficiently large proportion of the raptors to be able to analyse the age/sex specific differences in detail.

In 1995 the pattern looked slightly different and we also managed to age and sex a considerable amount of the Honey Buzzards and Marsh Harriers. The Honey Buzzards increased in number from the beginning of September and reached a peak during the second third of the month. The combined median date for adults and juveniles was 12 September, but there was a significant difference between the age classes ($\chi^2=42.7$, $P<0.01$). Adults passed earlier (median date 11 September) than juveniles (median date 23 September). No observations were made in October. The migration of Marsh Harrier was weak in early

September but increased throughout the month. Median date was 21 September for adult males and juveniles, and only one day later for adult females. Very few second-year birds were observed.

Time of the day

Observations of migrating raptors were made from 06.30 until 19.00 (fig. 4). Concerning the time distribution of visual migration during the day there were differences between the two field seasons as well. In 1994 the movements increased gradually during the morning and reached a first peak between 11.00 and 12.00. At noon the passage decreased and very few birds were seen. Between 14.00 and 16.00 there was a second peak period, and the passage kept on until

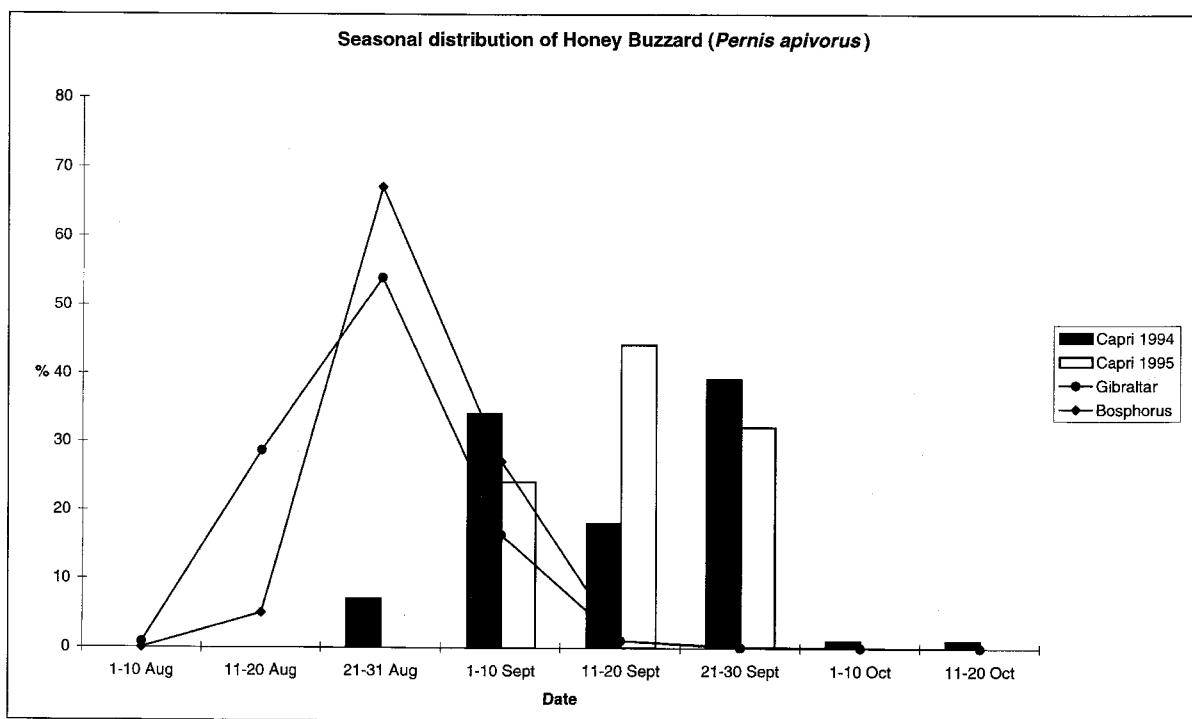


Figure 2. Seasonal distribution of migrating Honey Buzzards (*Pernis apivorus*) on Capri in the autumns of 1994 and 1995, compared to the Strait of Gibraltar (from Finlayson 1992) and the Bosphorus (from Porter and Willis 1968).

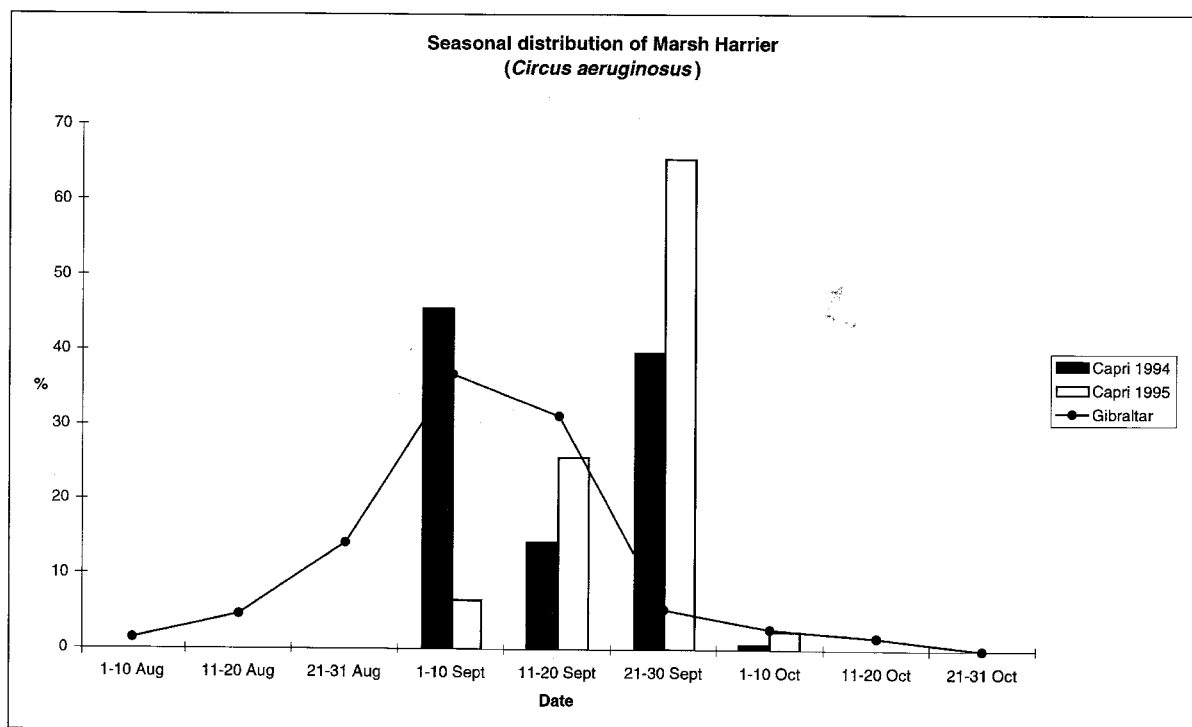


Figure 3. Seasonal distribution of migrating Marsh Harriers (*Circus aeruginosus*) on Capri in the autumns of 1994 and 1995, compared to the Strait of Gibraltar (from Finlayson 1992).

dusk. The peak between 11.00 and 12.00 was only obvious during August and the first half of September. After that, heavy westerly winds dominated a few days and the temperature fell. When the wind slowed down and the heat returned, the visual migration culminated between 14.00 and 16.00. The earlier peak just before noon was gone. The Honey Buzzard also showed a new, but smaller, peak between 09.00-10.00, but observations of Marsh Harrier before the afternoon were scarce.

During the autumn of 1995, an increasing number of raptors were noted throughout the day with the peak between 14.00 and 16.00 as previous year. Surprisingly, the visible migration did not decline at noon.

Direction

The main passage was in south-westerly direction (mean vector =201 degrees, $p < 0.01$, see fig. 5.). A total of 76 % chose a direction between south/south-west and west, 12 % headed due south, 7 % turned back to the mainland and 5 % flew in a south-easterly direction. All birds arrived from Naples or the Sorrento peninsula and the major part entered the thermal rich depression (Cetrella) south-east of the castle. They reached Mt. Capello, gained height by soaring and left the island, using gliding flight.

As mentioned before, raptors gliding at low altitude were impossible to follow from the castle after they passed Mt. Capello. The observations from Mt. Capello showed that the birds glided towards Mt. Solaro (see fig. 1), gained height by utilising thermals and finally headed south-west. Hence, their direction did not differ from the direction of the high-flying birds.

The direction of departure suggests that the north-western part of Sicily is the next destination. From there the shortest sea-crossing to Africa is to head for Cap Bon in Tunisia. Some Honey Buzzards showed a very strong westerly component (> 215 degrees) and if they kept the track they would fly to the west of Sicily. This gives support of a direct flight between Capri and Cap Bon, a distance of about 460 km and about 200 km further than Capri-Sicily.

Discussion

A total of only 356 and 407 raptors counted during the two autumns are not very impressive. But one must bear in mind that the higher numbers from Gibraltar presented in fig.1 are the result of full-scale counts of raptors across the entire width of the Strait (Bernis 1980). The mean number of migrating Honey Buzzards and Marsh Harriers counted only

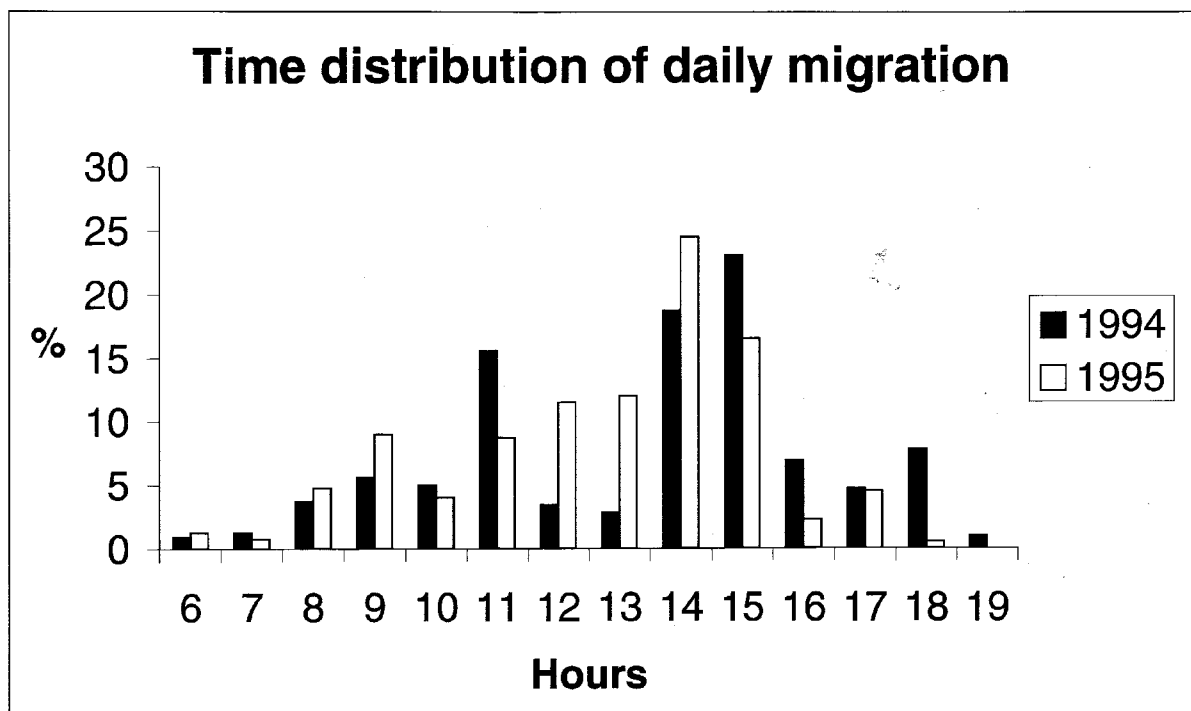


Figure 4. The percentage of migrating raptors observed in each hourly period on Capri in the autumns of 1994 and 1995.

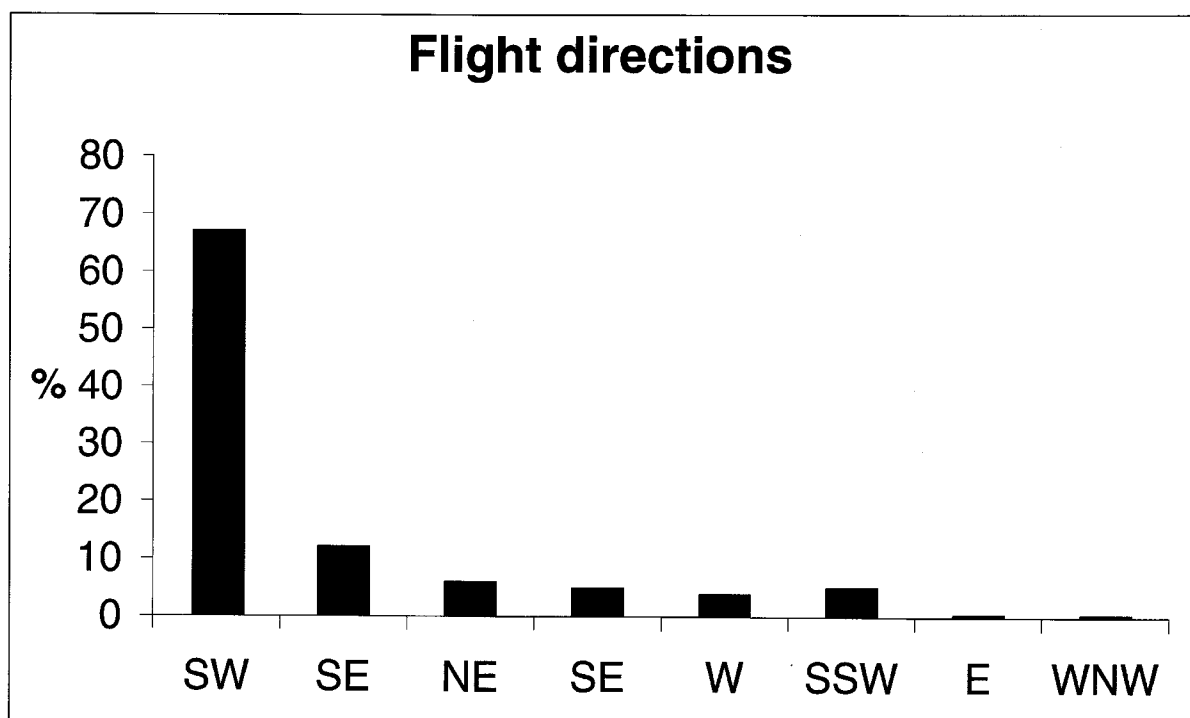


Figure 5. The percentage distribution of raptors leaving in each direction. The mean vector was 201 degrees (number of birds (N)=440, mean vector length (r)=0.67, $p < 0.001$, according to the Rayleigh test (Batschelet 1981).

from the Rock of Gibraltar during the autumns of 1991-93 are 8997 and 30 individuals, respectively (Perez 1991, 1992a, 1992b, 1993). Furthermore, Capri is not located in a place of concentration for migrating raptors, such as Gibraltar of the Bosphorus. Hence, to obtain a fair comparison between the Strait of Gibraltar, the Bosphorus and the central European flyway via Italy, full scale counts from each region should be compared. Actually, the high number of migrating Honey Buzzards in northern Italy (Toffoli and Bellone 1996), suggests that the importance of the central flyway in autumn may be underestimated. Interestingly, Toffoli and Bellone (1996) observed very few Marsh Harriers compared to our study.

The most interesting features of the species composition on Capri were the high number of Marsh Harrier and the scarcity of falcons. The tendency of the Marsh Harrier to fly over the open sea is well-known and the autumn migration through Europe probably takes place on a broad front. Beaman and Galea (1974) recorded considerably lower numbers (8-80 individuals) over the Maltese Islands 1969-73, but our investigation suggests a greater importance of the central flyway via Italy. Furthermore, the observation of rather large flocks is contradictory to the situation at Gibraltar, where the species is a soli-

tary migrant or occurs in presumed family parties during autumn (Finlayson 1992). One explanation might be that the passage over Capri was more concentrated in time over the season, compared to what is normal at Gibraltar. This increases the chances of the individuals coming into contact (Thake 1980). In Falsterbo, Sweden, the Marsh Harriers tend to occur in flocks during days of high numbers and good thermal conditions (Nils Kjellén, pers. comm.).

The very few observations of falcons are in accordance with Moreau (1961, 1972), who suggested that the insectivorous falcons make continuous high-altitude overflights of the Mediterranean and the Sahara in autumn. However, this suggestion has not been proven and another explanation to why falcons are so little recorded may be that small falcons cross the sea over a broader front than other non-soaring raptors (anonymous referee).

In 1994, both Honey Buzzard and Marsh Harrier showed two obvious migration peaks, in the first and last third of September. The period between these peaks was dominated by heavy west winds, unsuitable for migration, which might be an explanation to this phenomenon. Further support of this explanation is given by the different pattern during the following season when the migration of Honey Buzzard culmi-

nated as late as mid-September, maybe because of bad weather conditions in early September, and the number of Marsh Harriers increased gradually until the peak in late September.

Another possible explanation is that we are dealing with birds from two separated breeding areas. The first peak of Marsh Harrier in 1994 coincided with the corresponding peak at Gibraltar and the first peak of Honey Buzzard was a few days after the culmination at Gibraltar and the Bosphorus. The birds passing over Capri during this time are probably of Swedish and central European origin, although the majority of adult Swedish and West European Honey Buzzards travel south-west and cross at the Strait of Gibraltar (Bernis 1980, Cramp 1980). Also the Marsh Harriers observed at Gibraltar are mainly of Scandinavian, west- and central European origin (Bernis 1980, Cramp 1980).

The second peak of Honey Buzzards and Marsh Harriers in 1994 and the peak of Marsh Harrier in 1995 occurred at a time when no Honey Buzzards are seen at Gibraltar or the Bosphorus and observations of Marsh Harrier at Gibraltar are scarce. This may suggest that birds from eastern populations, probably from Finland and maybe the Baltic, are passing Capri in late September. The Honey Buzzards of Finnish origin are likely to migrate via the Bosphorus, but the proportion of Finnish Honey Buzzards using the central flyway via Italy is probably larger than the proportion of Swedish Honey Buzzards (Finlayson 1992). Late migration of Honey Buzzard has previously been observed at the Bretolet Pass, in the Southern Alps (Thiollay 1966, 1967a, b).

A third explanation why two separated peaks occurred is a difference in the timing between age- and sex groups. Such difference is well established at Falsterbo in south-western Sweden (e.g. Sögård and Österby 1989, Kjellén 1995). The Honey Buzzard demonstrated the same migration order between the age groups as in Falsterbo, with adults preceding juveniles, but the migration pattern of the Marsh Harrier differed somewhat. Do the juveniles catch up with the adults before crossing of the Mediterranean? This is possible but an alternative and more likely explanation is that the age- and sex specific migration pattern is "blurred" by the passage of different populations.

An overwhelming majority of the raptors left the island in the sector between south-south-west and west, suggesting the next destination to be the north-western part of Sicily. Beaman and Galea (1974) assumed that most of the raptors observed over the Maltese Islands probably cross from the south coast of Sicily or make direct flights from the Italian mainland.

But from the western part of Sicily the shortest sea-crossing to Africa is south-west to Cap Bon in Tunisia, not via the Maltese Islands. Hence, the birds counted over the Maltese Islands are probably not migrating via Capri. Further support to this idea is given by the composition of the passage over Capri and the Maltese Islands respectively. On Capri the Marsh Harrier is the second most common species but falcons were scarce, while the opposite is true for the Maltese Islands (Beaman and Galea 1974).

The birds heading against Cap Bon have a 9 hours flight ahead, if we assume that the flight speed of Honey Buzzard is 14.4 m/s (maximum range speed, V_{mr}, calculated according to Pennyquick (1989)). Since many birds left the island during late afternoon-early evening a possible conclusion is that species like Honey Buzzard and Marsh Harrier sometimes are partially nocturnal migrants. Stark and Liechti (1993) suggested that Levant Sparrowhawks (*Accipiter brevipes*) use flapping flight at night to reduce time spent on autumn migration.

Conclusions:

The central flyway via Italy seems undeniable to comprise several flight routes. Mainly species less dependent on soaring flight use this flyway, but the proportion of the different species varies at least between Capri and the Maltese Islands. Furthermore, Marsh Harriers from different breeding areas probably pass over Capri in autumn. The individuals migrating in late September-early October probably have a more eastern origin compared to birds observed earlier in the season.

To increase our knowledge about the importance of the central Mediterranean region for migrating raptors during autumn, full-scale counts, or at least comparisons between counts at different spots along the central Mediterranean flyway, should be carried out. This would also give a more fair and interesting comparison between this flyway, the Strait of Gibraltar and the Bosphorus.

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