

## Migratory pattern in the genus *Circus*: sex and age differential migration in Italy

MARCO GUSTIN & TOMMASO PIZZARI

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### Abstract

The migratory patterns of Marsh *Circus aeruginosus*, Pallid *C. macrourus*, and Montagu's *C. pygargus* Harrier were studied in spring in south-east Italy. Differences in the time of passage during the season were found between sexes and age classes in all three species. Adult males showed a significant tendency to migrate earlier than females and the latter earlier than juveniles. Also, adult Marsh and Montagu's Harriers passed significantly earlier during the day than second calendar year individuals. Such

patterns are explained in the light of the selective pressure exerted on adults to reach the breeding territories early in the reproductive season.

Marco Gustin, Via Gobbi 8, 42027 Montecchio Emilia, Italy, and Lega Italiana Protezione Uccelli (LIPU), Via Trento 49, 43100 Parma, Italy.

Tommaso Pizzari, Department of Animal and Plant Sciences, The University of Sheffield, Sheffield, S10 2TN, UK.

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### Introduction

The Italian peninsula intersects a major passage of trans-Saharan migrants crossing the Mediterranean Sea during spring (Spina et al. 1991, Massi et al. 1992). Spring migration is characterised by different times of passage of males and females in many bird species. That adult males move earlier in the season than females and young birds has been observed in many passerines (Pettersson et al. 1990, Magnani et al. 1991, Wood 1992) and raptors (Newton 1979, Kjellén 1992). Such a pattern has also been observed in several raptors in different peninsulas along the Mediterranean coast (Thiollay 1975, 1977, Baghino & Leugio 1990, Shirihai & Christie 1992), where they concentrate in order to avoid crossing the open sea (Cramp & Simmons 1980). This is particularly evident for some species of the genus *Circus* (Newton 1979, Cramp & Simmons 1980, Shirihai & Christie 1992). On the other hand, although these species are known to migrate throughout the whole day (Spaar & Bruderer 1997), no circadian difference has been reported in the time of passage between sexes and age classes.

The migratory pattern of three species, Marsh *Circus aeruginosus*, Pallid *C. macrourus* and Montagu's *C. pygargus* Harrier, were studied, and both

seasonal and circadian sex and age specific patterns of passage were investigated.

### Study area and methods

The study was carried out in south-east Italy, on the south Adriatic coast, 5 km south of the town of Otranto (40°06' N – 18°30' E), about 700 m. from the Mediterranean Sea. Good visibility of the passing raptors was achieved offshore and inland from the viewpoint. The survey was carried out in spring 1989 over three periods: 10–20 March, 6–16 April, 7–19 May, in total 291 hours of observation. One to three observers surveyed the area using binoculars 10x40 from 1–2 hours after sunrise until 1 hour after sunset.

Since the majority of the birds passed in a "corridor" (Kjellén 1992) around the observation point, the use of telescopes was unpractical and unnecessary. The day was divided in four quarters (7–9 a.m., 10–12 noon, 1–3 p.m. and 4–6 p.m.). Harriers were sexed and aged in adults (Euring code: 6) and second calendar year birds (Euring code: 5). For some individuals it was not possible to determine sex, age or even the species. These birds were not included in the analysis. The proportion of undetermined birds

(with respect to age and sex) varied from 11% in the Marsh Harrier to 3% in the Montagu's Harrier and 5% in the Pallid Harrier. In April, 9% of female Montagu's/Pallid harriers were undetermined, whereas in May some birds were left undetermined due to possible confusion between juvenile and adult female plumages (Shirihai & Christie 1992). The data have been subjected to statistical analysis using  $\chi^2$  tests.

## Results

### Seasonal patterns of migration

In total 323 individual Marsh Harriers were observed, of which 15% were adult males. A highly significant difference was found between the time of passage of adult males, adult females and first-year birds ( $\chi^2=184.85$ ,  $P=0.001$ ; Figure 1a). Adult males

passed significantly earlier in the season than did females ( $\chi^2=3.9$ ,  $P=0.05$ ) and the latter passed earlier than juveniles ( $\chi^2=161.1$ ,  $P=0.001$ ). Overall, 36% of the adult males were seen in March, 62% in April, and none in May.

Seventy-two individual Pallid Harriers were observed, of which 3 (4.17%) were adult males. A highly significant difference was found in the passage time of adult males, adult females and first-year birds throughout the season ( $\chi^2=96.93$ ,  $P<0.001$ ; Figure 1b). All male Pallid Harriers passed in March, while the passage of females was concentrated in April (63%) and decreased in May (37%). Most (96%) juvenile birds were recorded in May.

Overall, 132 individual Montagu's Harriers were recorded passing and adult males accounted for ca 20% of the total numbers passing. In this species no difference in the period of passage was found between adult males and females.

Both sexes showed their main passage in April (the median of passage, 12 April, was not statistically different between sexes). However, the passage of juvenile Montagu's Harriers was significantly later than the passage of adults ( $\chi^2=58.42$ ,  $P=0.001$ ; Figure 1c).

### Circadian patterns of migration

The passage of adult Marsh harriers was significantly concentrated within the first 5 hours after sunrise (males:  $\chi^2=48.4$ ,  $P=0.001$ ; females:  $\chi^2=18.50$ ,  $P=0.005$ ; Figure 2). This trend was not significant in first-year birds ( $\chi^2=6.6$ , N.S.). Similarly, Montagu's Harriers which migrated in April (mainly adults) migrated significantly earlier in the day than individuals passing in May (mostly juveniles;  $\chi^2=10.32$ ,  $P<0.05$ ; Figure 2). No differential pattern was observed between adult males and adult females in April ( $\chi^2=0.22$ , N.S.) There was no significant difference between Pallid Harriers observed in April (mainly adult females) and May (mainly first-year birds;  $\chi^2=2.27$ , N.S. Figure 2); or considering circadian differences of adult female passage in April and May ( $\chi^2=0.28$ , N.S.).

## Discussion

The proportion of adult male Marsh and Montagu's Harriers that was observed is consistent with the adult sex ratio recorded for these species during spring migration (Shirihai & Christie 1992). On the other hand, the unusually low number (Shirihai & Christie 1992) of adult male Pallid Harriers could be

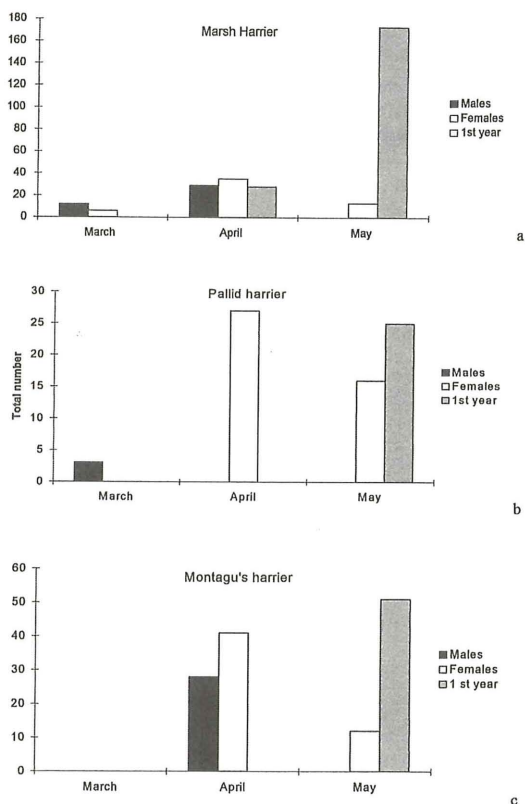


Figure 1a-c. The seasonal pattern of migration of male, female and 1st year Marsh, Pallid and Montagu's harriers.

*Flyttmönstret under säsongen för hanar, honor och ungfåglar av brun kärrhök, stäpphök och ängshök.*

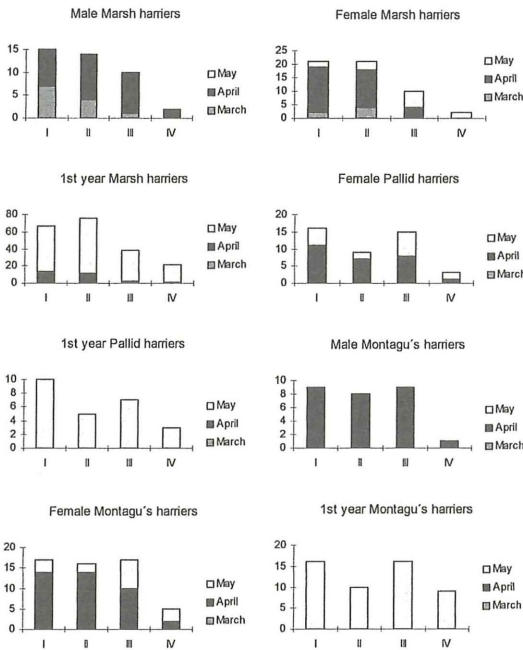


Figure 2. The circadian pattern of migration of male, female and 1st year Marsh harriers, female and 1st year Pallid harriers and male, female and 1st year Montagu's harriers from March to May. The day is divided in four periods (7–9 a.m., 10–12 noon, 1–3 p.m. and 4–6 p.m.).

*Flyttningmönstret under dygnet för hanar, honor och ungfåglar av brun kärrhök, honor och ungfåglar av stäpphök samt hanar, honor och ungfåglar av ängshök från mars till maj. Dagen har delats i fyra perioder (kl. 7–9, 10–12, 13–15 och 16–18).*

explained by the lack of observation from 22 March to 5 April, which might have biased the data. Nevertheless, it is possible that relatively few adult males cross Italy due to the eastern breeding distribution of this species (Cramp & Simmons 1980). Thus, it is unlikely that this lack of data would have affected the proportion of age and sex classes.

Seasonal differential migration of age classes and sexes was observed in the three species of harriers, most clearly in the Marsh and the Pallid Harrier in which early movements of adult males were followed by adult females and eventually by first-year birds. This pattern of differential migration has also been observed in Israel for these species (Reuven 1996). However, seasonal differential migration of the two sexes does not confirm previous information according to which adult Pallid Harriers arrive at the breeding territories already paired, implying that males and females tend to migrate together (Cramp

& Simmons 1980). On the other hand, it can be argued that most raptors are found paired when first seen at the breeding areas (Newton, pers. comm.). Adult Montagu's Harriers passed earlier than juveniles did but no difference was noted between adults of the two sexes. This pattern of age related differential passage is somehow mirrored in the autumn migration in many migrant raptors (e.g. Newton 1979, Kjellén 1992), including harriers (Kjellén 1992).

Generally, adults tended to migrate in the first hours of the day. This pattern was particularly evident in the Marsh Harrier (especially females), which concentrated in the first quarter of the day in March and April, when adults passed, as well as in the Montagu's Harrier.

Because harriers can alternate between soaring-gliding and flapping gliding flight styles they are more independent of environmental conditions (e.g. thermal updrafts) than purely soaring raptors and can migrate throughout the whole day (Spaar & Bruderer 1997). Marsh Harriers, in particular, are known to make use of flapping-gliding flight to start migrating in the first hours before sunrise when thermal updrafts are scarce or weak (Spaar & Bruderer 1997).

According to Newton (1979) and Elkins (1988) meteorological conditions have a greater effect on the migratory movements of first-year birds which therefore migrate more slowly and later than adults. Moreover, the costs of late arrival to the breeding territories and consequential delayed breeding might be very high in some migrating harrier species (Simmons et al. 1986). Thus, it is probable that juveniles, not yet sexually mature, are not under the selective pressure of the adults to move early in the season and during the day to reach breeding territories as soon as possible. On the other hand, an early arrival allows adult males to settle in better territories (Newton 1979) and adult females to obtain mates of better genetic quality, in better conditions and/or with better territories (e.g. Alatalo et al. 1990), through assortative mating (Hedenström 1987, Johnstone et al. 1996).

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## Sammanfattning

*Flyttningmönster hos kärrhök: tidsmässiga köns- och ålderskillnader i Italien*

Hos många fåglar råder en tidsmässig skillnad i flyttningstid mellan köns- och/eller ålderskategorier, där hanar normalt anländer före honor från vårflyttningen till häckningsområdet och gamla fåglar anländer före ungfåglar. I denna studie ålders- och könsbestämdes passerande kärrhök vid en sträcklokal i SE Italien (ca 5 km S Otranto, 40°06'N, 18°30'E) våren 1989. Räkningarna genomfördes 10–20 mars, 6–16 april och 7–19 maj, med en sammanlagd observationstid på 291 timmar.

Hos brun kärrhök passerade adulta hanar tidigare än adulta honor (Figur 1a;  $c^2= 3.9$ ,  $P= 0.05$ ) och adulta honor passerade före ungfågarna (Figur 1a;  $c^2= 161.1$ ,  $P= 0.001$ ). Samma mönster fanns hos stäpphök (Figur 1b), men betydligt lägre andel utgjordes av adulta hanar (4%) jämfört med brun kärrhök (15%). Hos ängshök var 20 % av totala antalet sträckare adulta hanar. Det fanns emellertid inte någon tidsskillnad i passage mellan adulta hanar och honor av ängshök, men ungfågarna passerade senare än adulterna (Figur 1c).

Observationerna delades in i fyra tidsintervall (I: kl. 07–09, II: kl. 10–12, III: kl. 13–15, IV: kl. 16–18). Passagen av adulta bruna kärrhök var koncentrerad till dagens fem första timmar (Figur 2), men trenden var inte signifikant hos ungfågarna. Hos ängshök passerade fåglarna tidigare på dagen i april jämfört med maj (Figur 2), men det var ingen skillnad mellan könen. Hos stäpphöken fanns inga statistiskt belagda skillnader i dagsrytm (Figur 2).

Proportionen adulta hanar hos brun kärrhök och ängshök överensstämmer väl med data från vårflyttningen på andra lokaler (jmf. Shirihai & Christie 1992). Relativt färre adulta stäpphökhanar observerades emellertid i vår studie jämfört med en sträckstudie i Israel, vilket kan bero på artens östliga utbredningsområde och att adulta hanar därför tar en östligare rutt på vårflyttningen. Anledningen till de säsongsmässiga skillnaderna i passage mellan köns- och åldersgrupperna kan bero på högre grad av konkurrens bland adulta hanar att erhålla häckningsrevir av hög kvalitet, och tidigt anländande individer får en konkurrensmässig fördel jämfört med honor och ungfåglar. Detta gäller sannolikt även adulta honor till en större grad än ungfåglar, som inte alls häckar som ettåringar.

Varför fåglarna i större utsträckning observerades tidigt på dagen kan förklaras av att kärrhök flyttar med aktiv flykt på låg höjd tidigt på morgonen och är då lättare att upptäcka än senare på dagen då termik utnyttjas.