Hoopoe
Upupa epops

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Range

The Hoopoe breeds in upper middle to lower latitudes of the W Palearctic (Cramp, 1998). Beyond the W Palearctic, the species is widely distributed in C and S Asia, in Arabia and Madagascar. Small numbers winter in N Africa and the Mediterranean basin, but the European breeding populations winters mostly south of the Sahara (Hagemeijer & Blair, 1997). The Hoopoe breeds in low numbers at some study sites in Catalonia, Morocco and the larger islands of the Balearics, but the vast majority of captures refer to migrants.

Migratory route

The five recoveries available show a predominance of SW-NE movements (fig. 1). One further recovery (not depicted) involves a bird ringed in SE Morocco in April and recovered in Slovakia the following 2 June, 300 km to the NE (Thévenot et al., 2003). The species, therefore, seems to follow a similar axis of movement to that observed in autumn, although in the opposite direction (Cramp, 1985). Some recoveries involve birds migrating across the Mediterranean Sea. In fact, captures are highest, both in relative frequency and in mean daily number, on islands from the dry Balearics where the species does not breed (*e.g.* L'Illa de l'Aire and Cabrera; fig. 2). Although these figures are, perhaps, somewhat overestimated due to a certain attraction effect, they agree with other published data suggesting that the species migrates on a broad front across the Mediterranean (Cramp, 1998). Very few birds are trapped at Moroccan sites, where it is uncommon during migration (Thévenot et al., 2003).

Phenology

Passage starts in early March, peaks between the end of this month and early April and then decreases progressively until mid-May; birds trapped in the second half of May apparently include a significant number of local birds (fig. 3). No differences in the median date of passage is observed between adults and second-year birds. Overall the pattern of passage is similar to that observed in S France (Blondel & Isenmann, 1981) and C Italy (Spina et al., 1993; Rubolini et al., 2004; Spina & Volpini, 2008). In S Iberia migration starts earlier than suggested by present data, being already apparent in February and peaking in March (Finlayson, 1992; Telleria et al., 1999). In Morocco passage is also more advanced and starts in early January in the south and by mid-January in the north, although the main passage period takes place from mid-February to March (Thévenot et al., 2003).

Biometry and physical condition

Mean third primary length ranges from 110.9 in the Balearics to 111.8 on Els Columbrets; mean wing length ranges from 144.6 in the dry Balearics to 145.9 on Els Columbrets (even lower values recorded in the very small dataset from S Morocco; table 1). Mean wing lengths are lower than those reported from islands of the C Mediterranean (mean 147.2, n = 246; Spina et al., 1993) and at Eilat in the E Mediterranean (mean 147.4, n = 56; Morgan & Shirihai, 1997). The third primary does not show any significant temporal trend, probably because, despite the dimorphism in sexual size, protandry is very limited or non-existent and populations of NW Africa and Europe are rather uniform in size (Cramp, 1985; Rubolini et al., 2004).

Mean fat scores range between 0 and 1 and mean body mass varies between 61.4 on Els Columbrets to 67.4 in the wet Balearics (table 1). Fat does not show any appreciable geographic variation, although body mass is distinctly higher in Catalonia than in the dry Balearics and lower on Els Columbrets than in the other two areas (table 1, figs. 8-9). In the wet Balearics body mass is similar to Catalonia, but is also distinctly higher than on Els Columbrets. The poor overall state of birds on Els Columbrets is also reflected in their poorer physical condition (fig. 7). No clear overall trends in body mass and physical condition are observed, although fat does decrease significantly, particularly in the dry Balearics, and body mass and physical condition increase in Catalonia (figs. 7-9).

Mean body mass on Els Columbrets/dry Balearics is rather similar to that reported in the Tyrrhenian islands (mean 62.5, n = 247; Spina et al., 1993), but *c.* 5-9% lower than in continental NE Spain, indicating that birds crossing the Mediterranean Sea have higher energetic stress levels, particularly those captured at isolated and distant sites such as Els Columbrets. Reported mean body mass in La Camargue, S France, is rather low (mean March-May 62.9, n = 141; Cramp, 1985) compared with that from Catalonia and suggests a progressive depletion of energetic reserves during northwards movements through continental Europe. The mean body mass of the tiny data-set from S Morocco is higher than that reported at the nearby sites of Defilia (mean 60.3, n = 36; Ash, 1969) and Merzouga (mean 63.3, n = 17; Gargallo et al., unpubl.), although overall they indicate that many birds arrive in the area with rather low reserves. Body mass in S Morocco is on average up to 10% lower than in continental NE Spain, although a lack of data from N Morocco prevents more detailed analysis as to where and to what extent birds regain mass after crossing the Sahara.

Stopover

The percentage of retrapped birds is low to very low (fig. 5, table 2), suggesting a high turnover of birds. At the two areas with available retraps, fuel deposition rates do not show any significant pattern and retrapped birds do not have significantly different initial body mass than those not trapped again. Mean minimum stopover-length is quite short and is probably somewhat inflated due to the presence of some local breeding birds.

Table 1. Mean (± SD), range and sample size of main biometric parameters according to area.

	n	Wing	Third primary	Body mass	Fat score
Catalonia	82	145.0 ± 4.9 (130.9-155.0)	111.7 ± 4.1 (102.5-120.0)	67.2 ± 6.2 (51.0-86.0)	0.8 ± 0.8 (0-3)
Columbrets	37	145.9 ± 4.8 (133.0-156.0)	111.8 ± 4.3 (98.0-122.0)	61.4 ± 7.5 (44.5-89.1)	0.4 ± 0.5 (0-2)
Balearics (dry)	378	144.6 ± 4.9 (131.0-156.0)	110.9 ± 4.5 (98.0-123.0)	63.9 ± 7.5 (43.9-90.6)	0.8 ± 0.7 (0-4)
Balearics (wet)	11	145.2 ± 5.2 (138.0-153.0)	110.9 ± 3.9 (104.5-116.0)	67.4 ± 8.1 (53.7-80.4)	0.8 ± 0.7 (0-2)
Chafarinas	0				
N Morocco	0				
S Morocco	3	143.7 ± 5.5 (137.5-148.0)	108.7 ± 3.3 (105.0-111.5)	67.1 ± 6.6 (61.8-74.5)	

Table 2. Variation in fuel deposition rate (g/day) according to area and type of retraps involved (mean ± 95% CI and sample size are given).

	Catalonia	Columbrets	Balearics (dry)	Balearics (wet)	Chafarinas	N Morocco
All retraps	0.14 ± 1.20 (5)		-0.52 ± 0.79 (44)			
Retraps >1 day	-0.03 ± 0.25 (3)		0.22 ± 0.56 (25)			

Figure 1. Map of recoveries of birds captured in the study area during the study period (March to May).

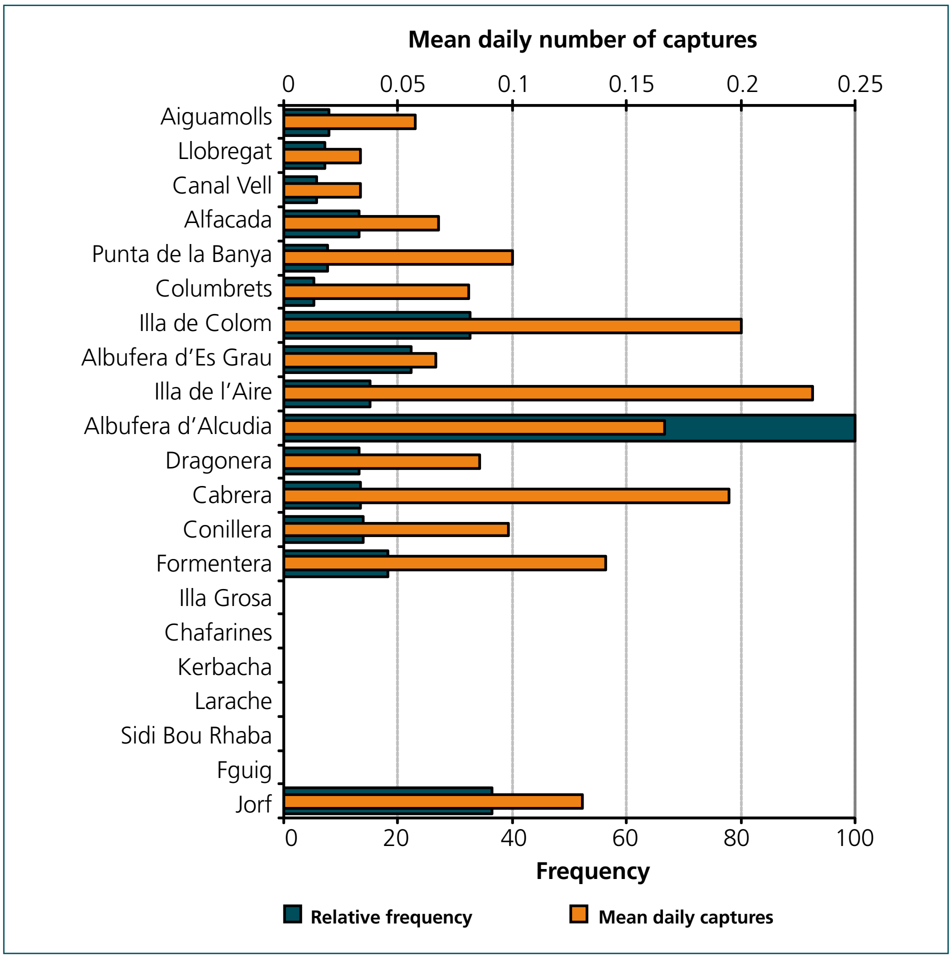


Figure 2. Relative frequency of captures and mean daily numbers according to site during the standard period (16 April to 15 May).

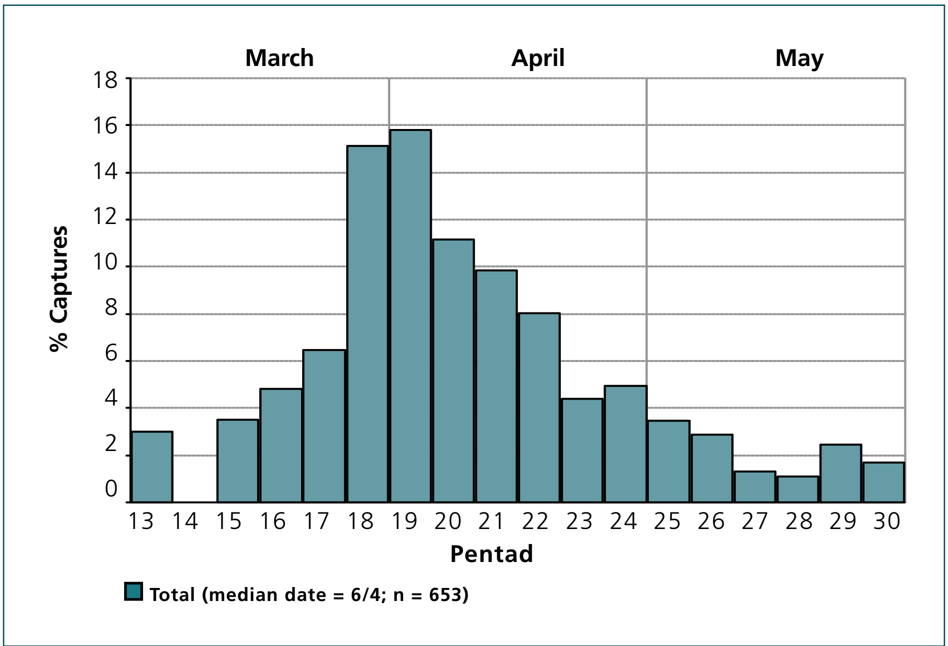


Figure 3. Frequency of captures during the study period.

Figure 4. Variation in body mass and fat score according to site during the standard period (16 April to 15 May).

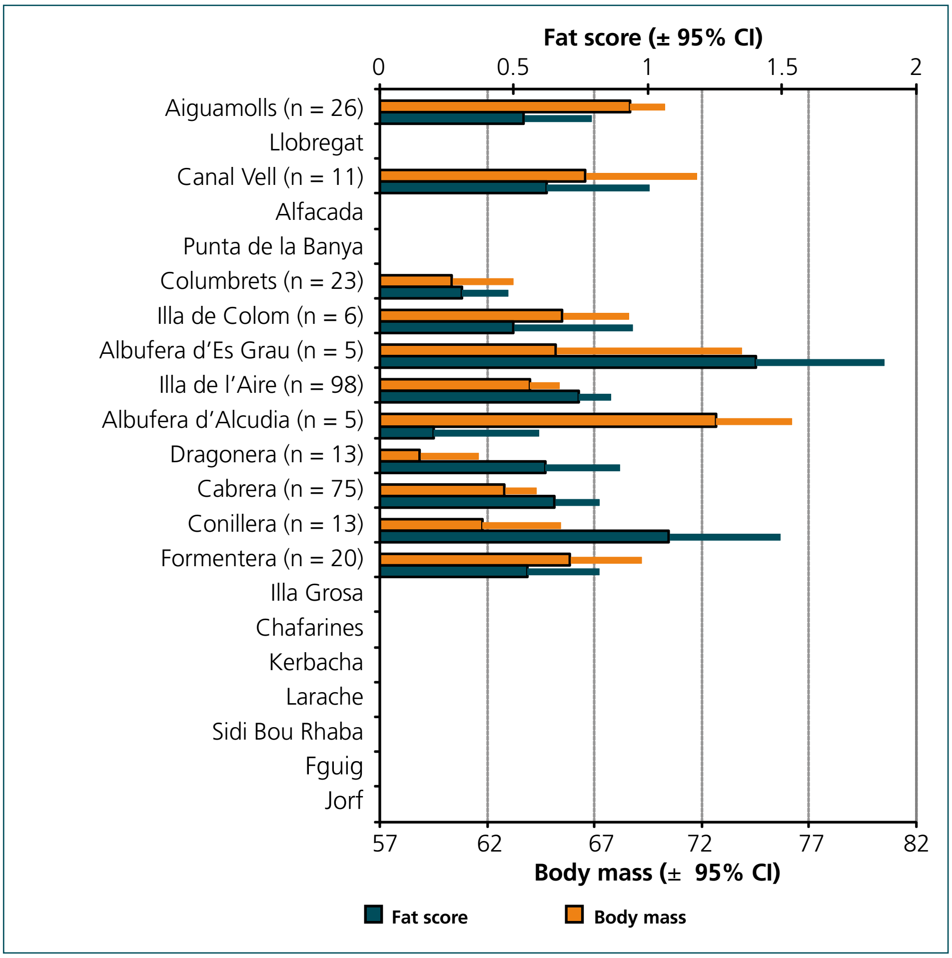
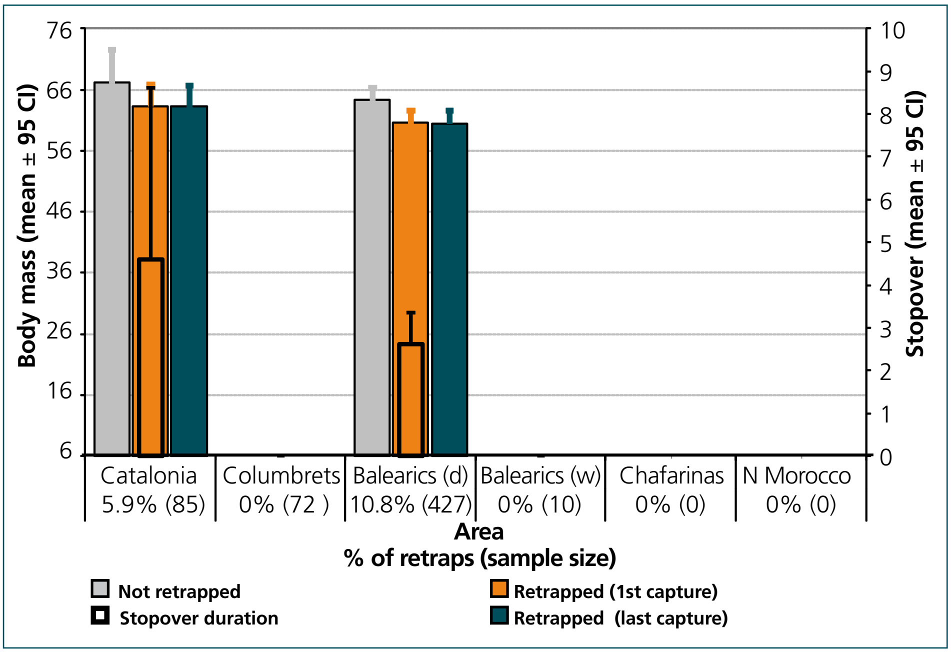


Figure 5. Variation in body mass by trapping status, minimum stopover length and frequency of retraps according to area.



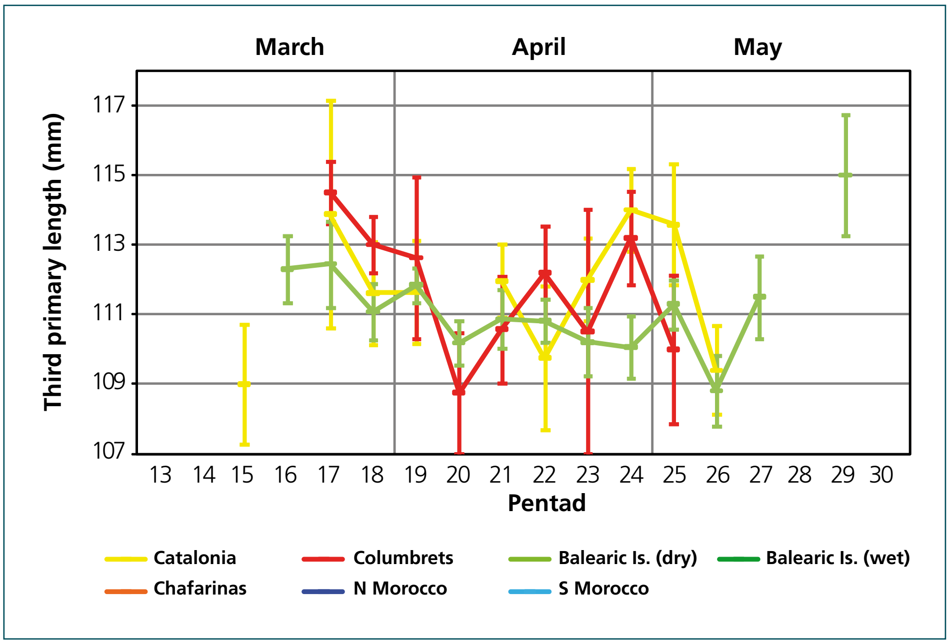


Figure 6. Temporal variation of third primary length according to area.

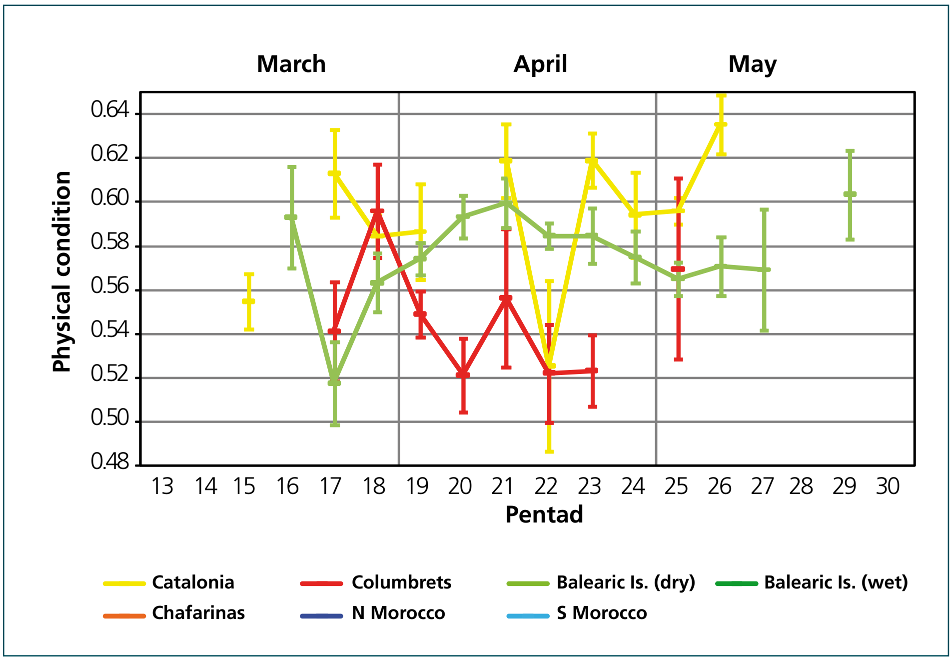


Figure 7. Temporal variation of physical condition according to area.

Figure 8. Temporal variation in body mass according to area.

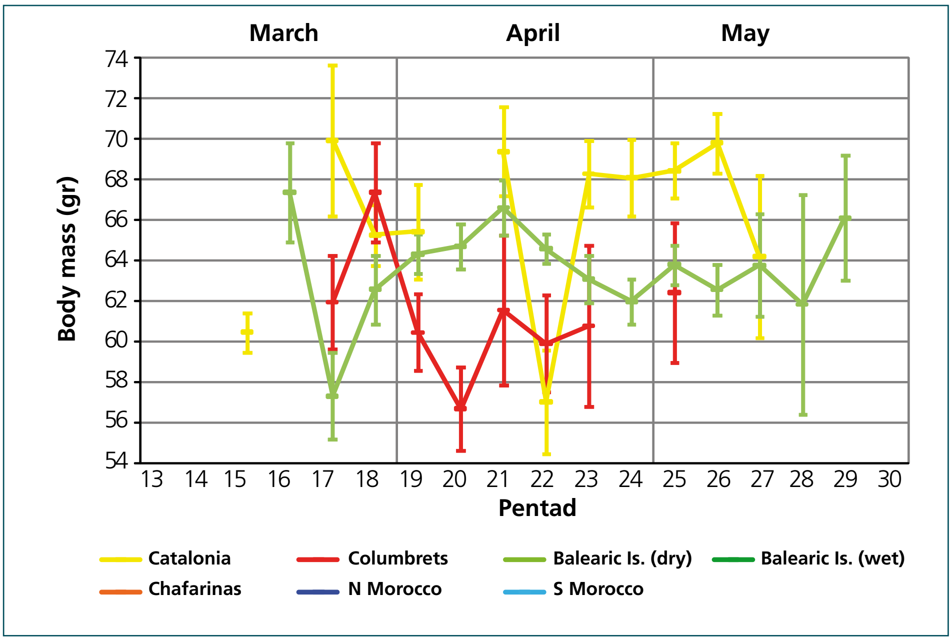


Figure 9. Temporal variation in fat score according to area.