Wood Warbler

Phylloscopus sibilatrix

Carles Barriocanal & David Robson

Range

The Wood Warbler breeds in the temperate and boreal W Palearctic north of the Mediterranean and the Black Sea, from the British Isles and Scandinavia eastwards to W Siberia (Cramp, 1992). It winters in sub-Saharan Africa from Sierra Leone and S Guinea east to W Uganda and south to *c.* 6°S (Cramp, 1992). It does not breed in the study area.

Migratory route

In spring, this species mainly follows a S-N flight direction, migrating from tropical Africa to Europe through the C Mediterranean (Pilastro et al., 1998; Spina & Volponi, 2009), using a more westerly and direct route than in autumn (Zink, 1973; Glutz von Blotzheim & Bauer, 1991; Cramp, 1992). As expected, the species is much commoner in the study area during spring than in autumn (Clavell, 2002; Thévenot et al., 2003; ICO, 2010), being more abundant further east and particularly so in the Balearics (fig. 2). It is also rather common in NE Morocco, suggesting that some birds must follow more SW-NE routes to European breeding grounds, as indeed is shown by the recoveries discussed here (fig. 1) and others reported by Zink (1973) and Spina & Volponi (2009). These movements may in fact be commonplace given the abundance of this species in Morocco and Algeria during spring (Isenmann & Moali, 2000; Thévenot et al., 2003).

In contrast with the patterns shown by Willow and Western Bonelli's Warblers, the largest relative frequencies and highest raw number of captures are recorded at well-vegetated sites with some forested areas such as L'Albufera d'Es Grau and L'Alcúdia in the Balearics, and Kerbacha in N Morocco (fig. 2). This species thus seems to be much more selective in terms of habitat requirements and less inclined to use isolated and sparsely vegetated islands as provisional or emergency stopover sites. This selectivity may have relevant conservation implications for this declining species (BirdLife International, 2004).

Phenology

Passage begins at the very end of March, with a peak between the end of April and early May (fig. 3). The overall pattern is similar to that reported on the Tyrrhenian islands (Rubolini et al., 2005) and in La Camargue (Blondel & Isenmann 1981). In the Balearics/Els Columbrets captures occur somewhat later than in Catalonia and Morocco (median date *c.* 7 days later). The frequency distribution of third primary lengths clearly depicts a differential migration of sexes: males (distinctly larger; Cramp, 1992) migrate from late March to the second half of April and females mostly from mid-April onwards (fig. a). It is unknown whether this difference is a consequence of males departing earlier or travelling faster, although in the C Mediterranean male Wood Warblers seem to undertake shorter stopovers than females (Holmgren & Engström, 2006). The arrival of males at breeding grounds clearly takes place ahead of females by *c.* one week (Cramp, 1992).

Biometry and physical condition

Mean values for third primary lengths range from 58.4 (dry Balearics) to 59.8 (wet Balearics; only one in S Morocco 60.5; table 1), similar to the values reported from the C Mediterranean (mean 58.7, n = 14,046; Messineo et al., 2001). Mean wing lengths vary from 75.1 (dry Balearics) to 76.8 (Els Columbrets, one in S Morocco 78.0), similar to values reported in spring from C Europe and the C and E Mediterranean (Cramp, 1992; Morgan & Shirihai, 1997; Messineo et al., 2001; Waldenström et al., 2004). The third primary length shows a marked tendency to decrease over time (fig. 6), as is also found in the C Mediterranean (Messineo et al., 2001) and reflects the differential migration of the sexes.

Mean fat score values range between 0.7 (Els Columbrets) and 2.8 (N Morocco). Figures from the Balearics are slightly higher than those recorded on the C Mediterranean islands (overall mean 1.4, n = 13,533; Messineo et al., 2001). Birds trapped in N Morocco have the highest fat loads, apparently similar to those recorded in N Tunisia (Waldenström et al., 2004). Mean fat and physical condition are significantly lower on Els Columbrets than in other areas and is higher in N Morocco than on Els Columbrets and the dry Balearics. Overall, fat shows a slight but significant tendency to increase over time (fig. 9, and is paralleled by an improvement in physical condition (fig. 7). This tendency indicates that birds migrating early (mostly males) are in poorer condition than those migrating later (mainly females). This pattern may reflect the fact that feeding conditions improve as the season progresses or that females, with less of a need to migrate faster and earlier than males, can proceed in a less demanding way (*e.g.* making longer stopovers; Holmgren & Engström, 2006).

Mean body mass varies from 8.2 (Els Columbrets) to 9.7 (N Morocco) and shows a slight but significant overall trend to increase during the season (fig. 8), contrary to the tendency observed on the Tyrrhenian islands (Spina et al., 1993). Birds are heavier in the wet Balearics and, especially, in N Morocco. Mean values in the Balearics are higher than those reported from the islands of the C Mediterranean (8.3, n = 14,428; Messineo et al., 2001), where birds show similar mass to Els Columbrets, the most isolated island in our study area. Mean body mass at Kerbacha (NE Morocco) is somewhat higher than in N Tunisia (mean 9.3, n = 53; Waldenström et al., 2004). We trapped only one bird in S Morocco, but good datasets from this same area report means of 8.4 (n = 43; Ash, 1969) and 8.8 (n = 40; Gargallo et al., unpubl.). Spring data from Souss Massa in SW Morocco (mean 8.2, n = 10; D. Robson & E. Durany, unpubl. data) and from S Israel (mean 8.5, n = 51; Morgan & Shirihai, 1997) are also similarly low.

Birds from N Morocco are on average in better condition, being *c.* 9% heavier than in the dry Balearics, *c.* 5% heavier than in Catalonia and *c.* 7-19% heavier than in S Morocco. This result suggests that this species is able to regain part of the energetic reserves lost when crossing the Sahara while in Morocco. The relevance of this region as a reliable stopover area is further supported by the abundance of this species in NW Africa during spring (Isenmann & Moali, 2000; Thévenot et al., 2003). In Catalonia birds are only in slightly poorer body condition than in N Morocco suggesting that once in continental Europe the species is able to regain some mass and continue migration by means of short bouts of flying. Birds passing through Els Columbrets and the Balearics are, however, in distinctly poorer condition, a sign of the effort involved in crossing the sea. Birds trapped in the wet Balearics are significantly heavier and have larger fat reserves than those from more isolated and sparsely vegetated sites (dry Balearics), suggesting that birds stopping at these latter sites include a higher proportion of birds who need to do so for energetic reasons. Birds stopping at wetlands may also gain mass faster and include a larger proportion of birds already on land for a few days (either at the site itself or in surrounding areas), which may also lead to better average body condition (see below also). The higher body mass and fat reserves recorded in the Balearics in comparison to the C Mediterranean islands may reflect differences in the distance travelled over the sea and the Sahara (less distance in the case of birds crossing through the Balearics). These differences are known to influence noticeably the pattern of use and storage of fat reserves in other passerines (*cf.* Rubolini et al., 2002).

Stopover

The frequency of retraps is highest in N Morocco and the wet Balearics, and lowest in dry insular areas (table 2, fig. 5). Mean stopover lengths are rather short at all sites, ranging from *c.* 1.5 to 2.5 days. The few birds that stay in the dry Balearics and on Els Columbrets tend to be in poorer body condition than those that are not retrapped (nearly significantly so in the dry Balearics). This also indicates that this species tries to avoid these particular sites in favour of more forested stopover sites where they can feed. In fact, fuel deposition rates are significantly positive in Catalonia (retraps of more than one day) and the wet Balearics, but are negative on Els Columbrets and in the dry Balearics, although only significantly so in the former area when considering the full sample.

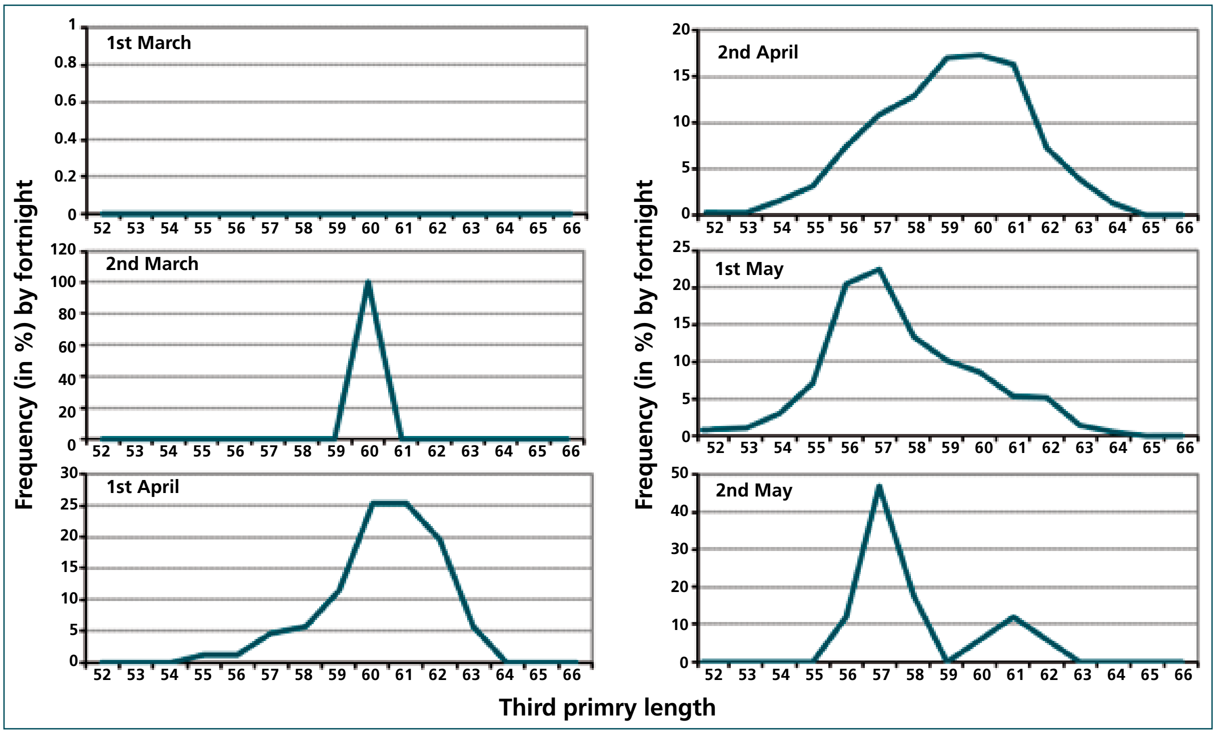


Figure a. Frequency distribution of the third primary length in fortnightly periods.

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

	n	Wing	Third primary	Body mass	Fat score
Catalonia	179	76.3 ± 2.4 (70.5-82.0)	59.6 ± 2.1 (54.0-64.4)	9.2 ± 1.0 (6.9-11.7)	2.2 ± 1.3 (0-5)
Columbrets	123	76.8 ± 3.1 (70.4-82.0)	58.7 ± 2.6 (52.5-64.0)	8.1 ± 0.8 (5.1-10.7)	0.7 ± 0.9 (0-5)
Balearics (dry)	646	75.1 ± 2.7 (69.5-82.0)	58.4 ± 2.3 (51.5-64.5)	8.9 ± 1.1 (6.1-12.5)	1.9 ± 1.2 (0-5)
Balearics (wet)	46	76.4 ± 2.1 (72.0-81.0)	59.8 ± 1.9 (56.0-64.0)	9.5 ± 1.2 (7.5-12.7)	2.4 ± 1.2 (0-5)
Chafarinas	9		59.1 ± 1.8 (57.0-63.0)	9.3 ± 0.9 (7.8-10.3)	2.0 ± 1.0 (1-4)
N Morocco	47	76.0 ± 2.5 (71.5-81.0)	59.3 ± 2.1 (55.5-63.5)	9.7 ± 1.2 (6.5-12.1)	2.8 ± 1.4 (0-6)
S Morocco	1	78.0	60.5	7.5	4.0

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	0.13 ± 0.26 (19)	-0.25 ± 0.20 (7)	-0.12 ± 0.15 (38)	0.35 ± 0.24 (8)		-0.11 ± 0.27 (7)
Retraps >1 day	0.23 ± 0.17 (9)	-0.02 ± 0.16 (2)	-0.06 ± 0.16 (18)	0.27 ± 0.25 (3)		0.01 ± 0.37 (4)

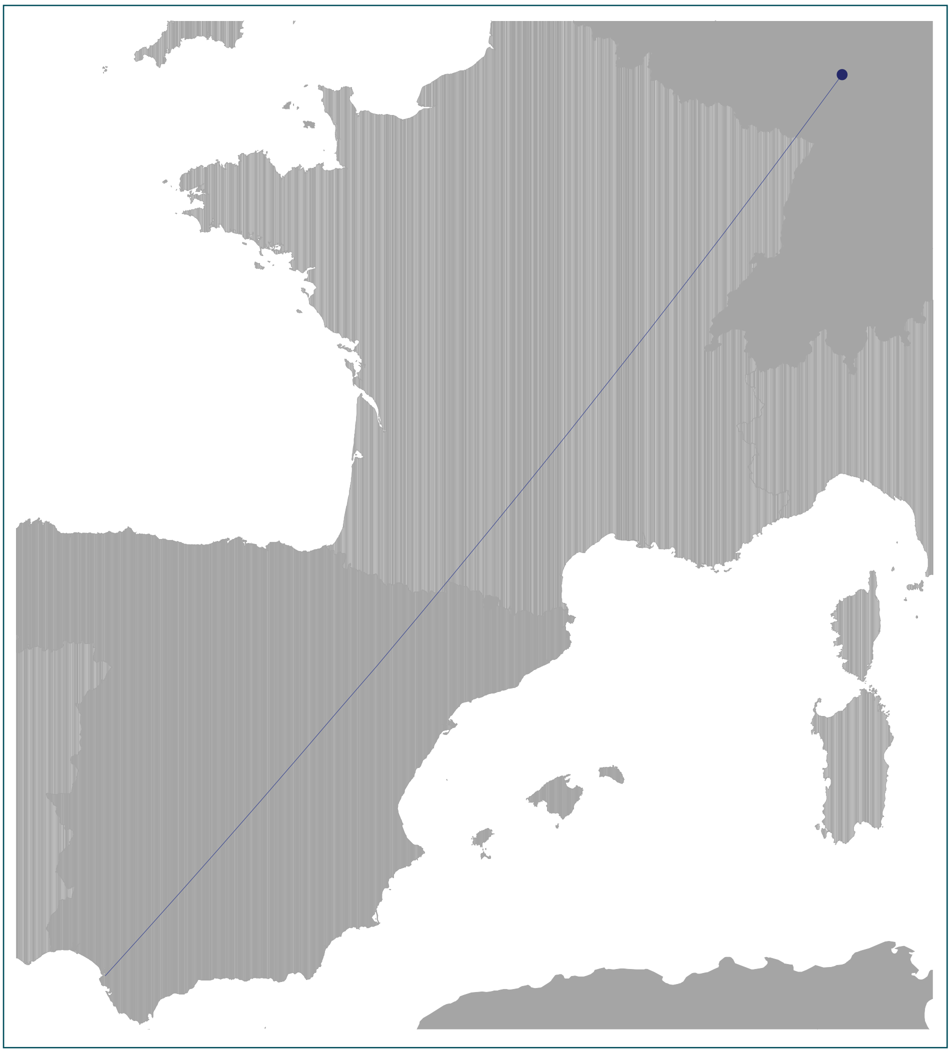


Figure 1. Map of recoveries of birds captured in the study area during the study period (March to May).

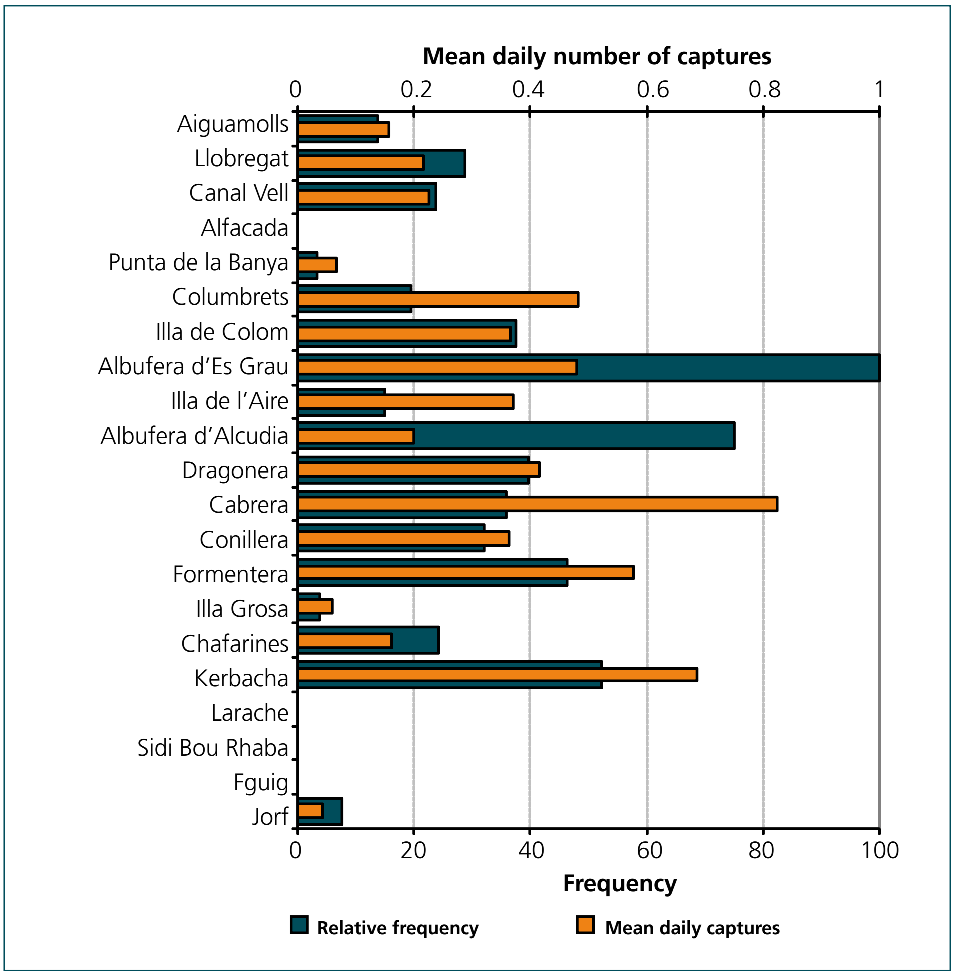


Figure 2. Relative frequency of captures and mean daily numbers according to site during the standard period (16 April to 15 May).

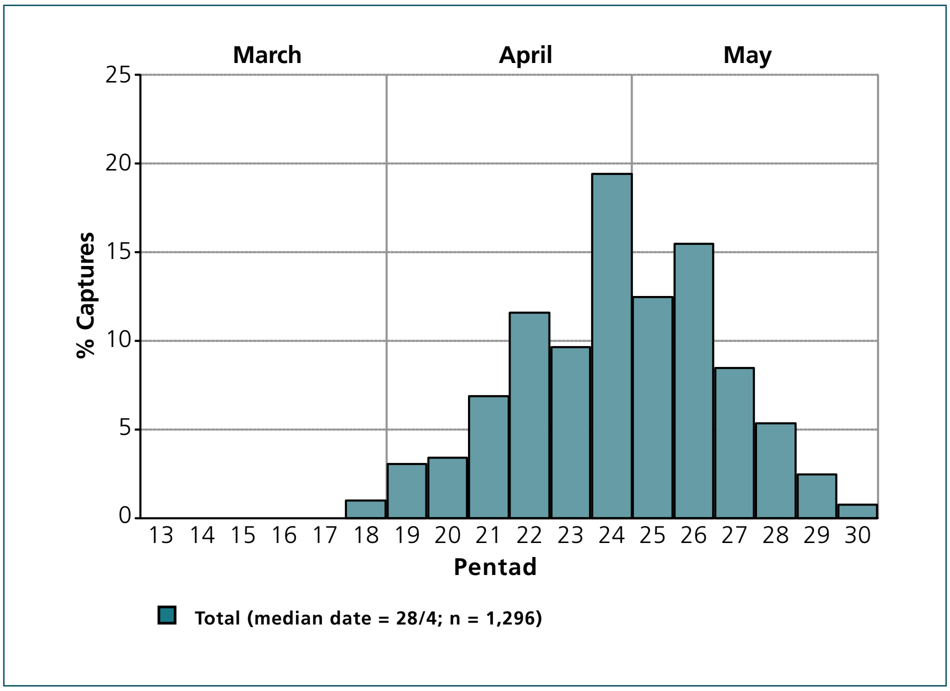


Figure 3. Frequency of captures during the study period.

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

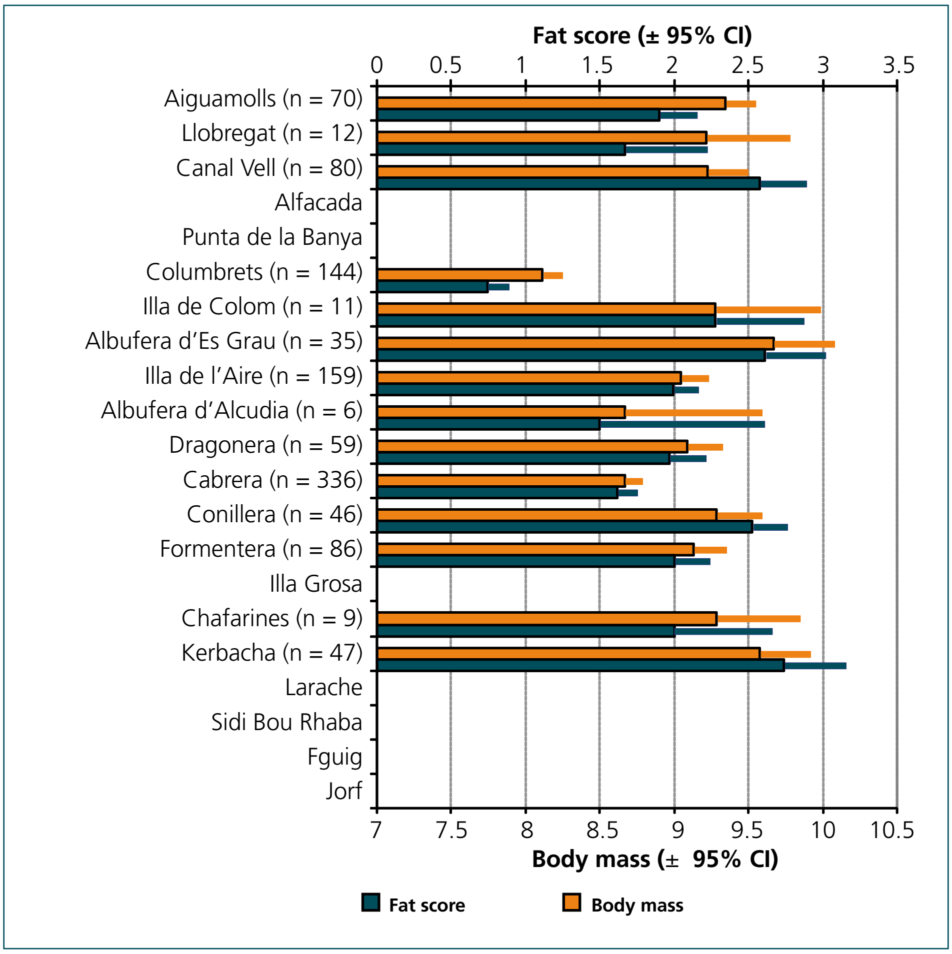
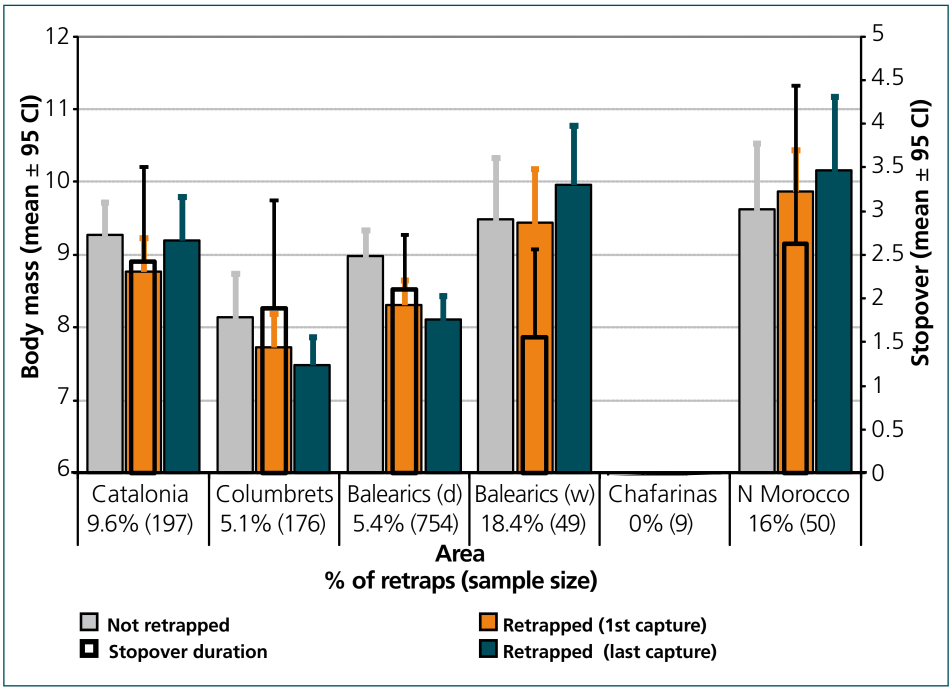


Figure 5. Variation in body mass by trapping status, minimum stopover length and frequency of retraps according to area.



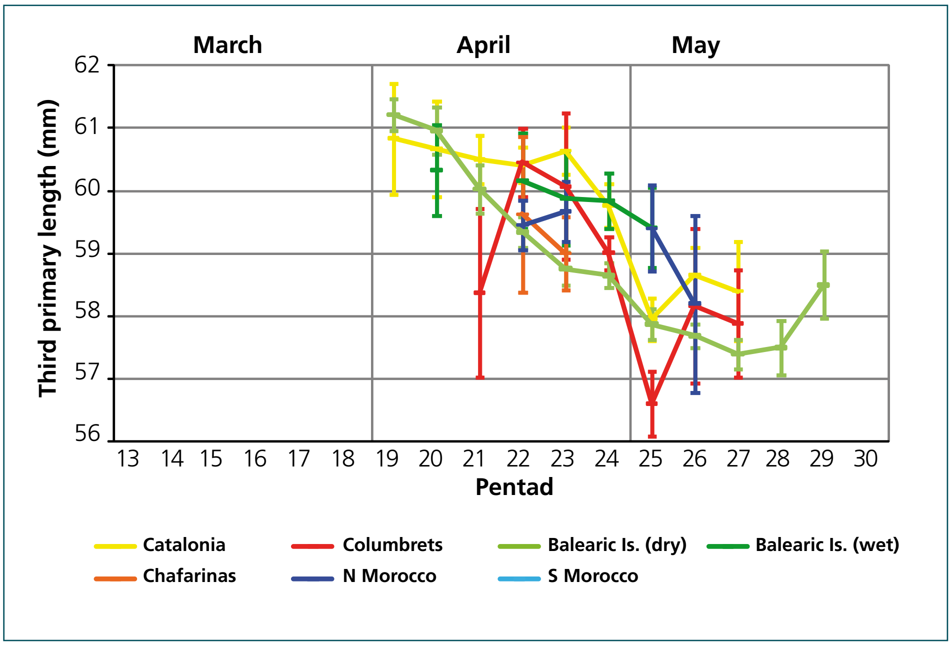


Figure 6. Temporal variation of third primary length according to area.

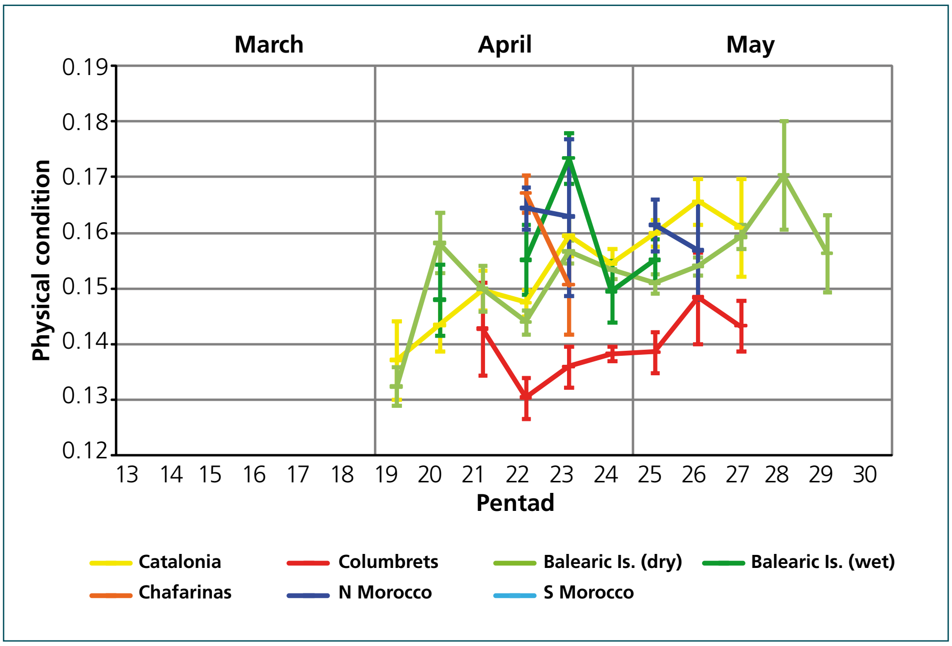


Figure 7. Temporal variation of physical condition according to area.

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

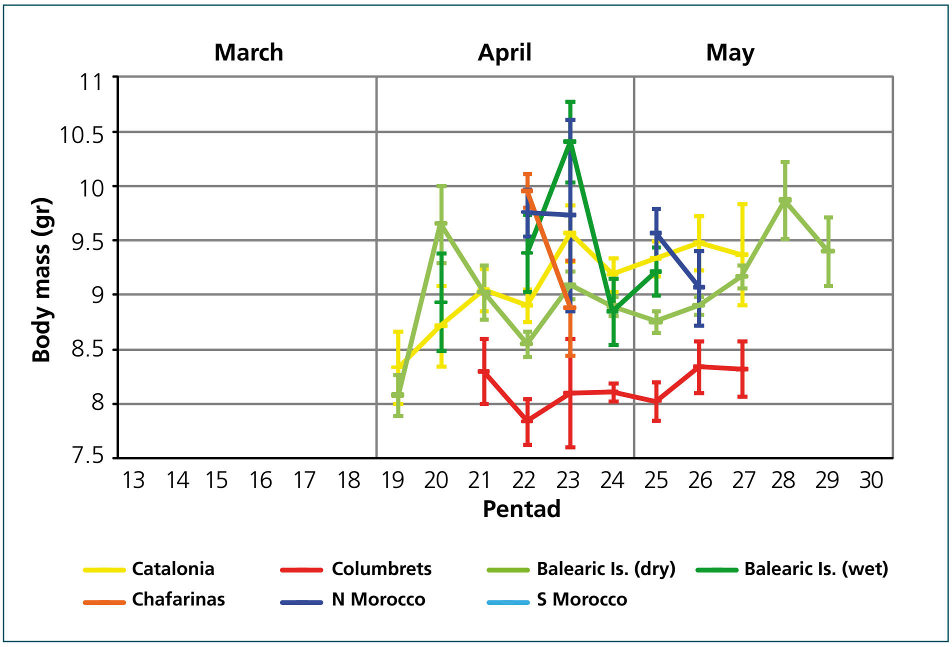


Figure 9. Temporal variation in fat score according to area.