

## Further evidence of cross migration behaviour of Western Honey Buzzard *Pernis apivorus* at the Apuane Alps (Tuscany, Italy) bottleneck

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The Western Honey Buzzard *Pernis apivorus* is breeding in Italy with a current estimate of 600-1,000 pairs, located mainly in the Alps and Northern Apennines (Brichetti & Fracasso 2003). The species is a complete migrant raptor (Zalles & Bildstein 2000), wintering in Africa, South of the Sahara Desert (Cramp & Simmons 1980). The Versilia-Apuane Alps (Tuscany) bottle-neck is an important raptor migration watch-site (Premuda *et al.* 2014), both in spring and autumn (Premuda 2007, Premuda *et al.* 2010), due to the topography of the area as a bottle-neck between a coastline (Versilia) and a mountain chain (Apuane Alps), where the potential for double counts is very limited (Premuda *et al.* 2015).

Migration strategies involving raptors moving toward different directions have been documented at the site for the Short-toed Eagle *Circaetus gallicus* (Agostini *et al.* 2002a, Premuda 2002), Booted Eagle *Hieraaetus pennatus* (Baghino *et al.* 2007, Premuda *et al.* 2007a), and Black Kite *Milvus migrans* (Premuda & Baghino 2012). In addition, migrating Western Honey Buzzards were seen heading toward different directions and showing a cross migration behaviour (Clarke 1912, Dixon 1895, Schüz *et al.* 1971, Roney Drennan 1981) with the regular passage of a number of individuals heading SE in spring and NW in autumn (Premuda *et al.* 2015).

The aim of this research is to confirm the results of a previous survey and to describe flows and behavior of the Western Honey Buzzard at the Versilia-Apuane Alps watch-site as well as to verify that the previously reported behavior was not an anomaly but a consistent pattern in seasonal migration at the site. The larger monitoring effort (six months across three years) made during spring and autumn migration can also help to assess the species' breeding population in Central Italy.

Observations were made over the main spring peak

passage period of the Western Honey Buzzard in May, and over the autumn passage period of both adults and juveniles of the species, which occurs mainly in September (Cramp & Simmons 1980).

Visual counts took place on the western slopes of the Apuane Alps (Versilia, Tuscany). The main observation point used was Capriglia (Pietrasanta, Lucca), located about 5 km inland of the Tyrrhenian seacoast (43°58'2.6"N - 10°14'22.8" E, 378 m a.s.l.). In spring, observations were carried out from 1<sup>st</sup> to 31<sup>st</sup> May 2016-2018, while in autumn observations were performed from 1<sup>st</sup> to 30<sup>th</sup> September 2016-2018, from approximately 09:00 to 17:00 (GMT +1). For each observation, time (hh:mm), species, number of individuals, estimated age (whenever possible), and flight direction of birds (northward or southward) were recorded. To avoid double-counts and to determine the right migration direction, incoming raptors were detected at long distance and followed during the passage at the bottleneck area until they disappeared from view. The observations were aided with binoculars and telescopes. Diagnostic characters used to identify the species and the age of birds are those provided by Forsman (1999, 2016).

### Spring

Observations were carried out for 93 days totalling 644 h and 25 min (mean daily observation effort  $\pm$  SD = 6.93  $\pm$  2.28 hours) during May 2016, 2017, 2018 (212.35, 200.35, 231.15 hours respectively).

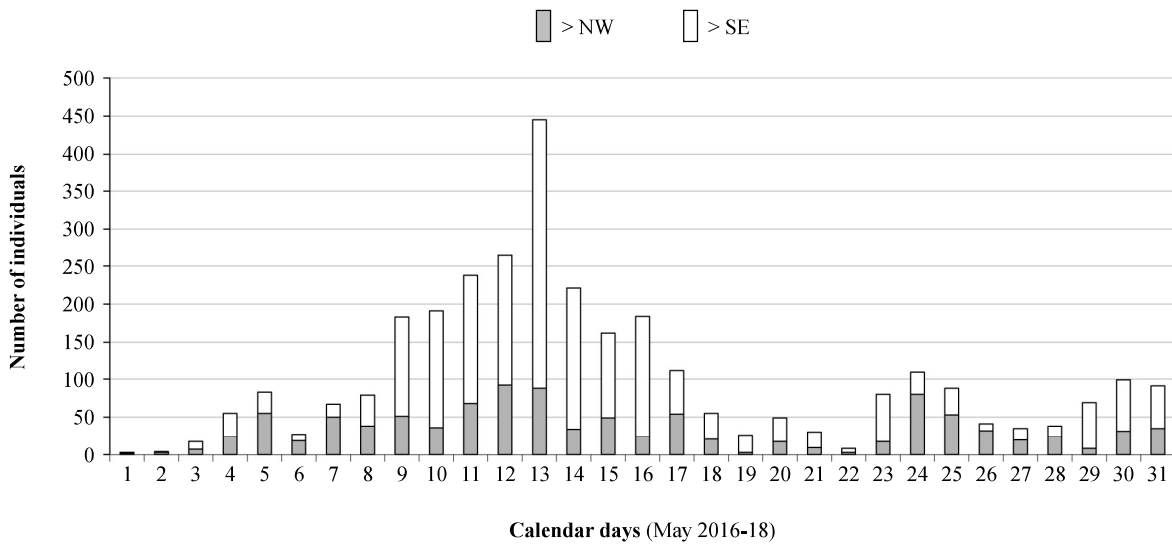
A total of 3152 Western Honey Buzzards were observed over three years (1436, 345 and 1371, respectively; yearly mean:  $x = 1051$ ), with a seasonal maximum count of 1436 individuals in 2016. Most Western Honey Buzzards observed ( $N = 2108$ ; 67%) had a reversed direction of spring migration (1018, 250, 840 respectively), incoming from NW and heading SE (Fig. 1), flying parallel to

the seacoast. Daily counts comprised between a minimum of zero individuals and a maximum of 376 individuals recorded on 13 May 2016 (mean  $\pm$  SD = 34.40  $\pm$  53.58).

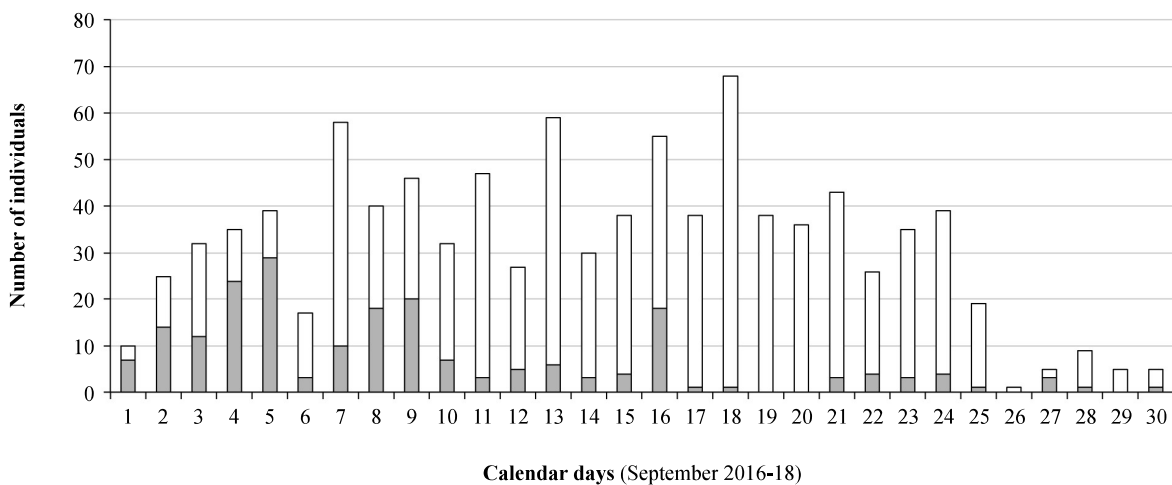
The maximum daily count of individuals heading SE occurred on 13 May 2016 with 310 birds, while the maximum daily count of individuals heading NW occurred on 24 May 2018 with 73 birds. The overall migration peak of the species during the study period occurred on 13 May (Fig. 1), as well as for birds heading SE, while it was recorded on 12 May for birds heading NW. The overall median date of passage of the species occurred on 13 May, including birds heading NW, and birds heading SE.

**Autumn**

Observations were carried out for 90 days totaling 733.30 h of observations (daily mean  $\pm$  SD = 8.15  $\pm$  2.23) during September 2016, 2017, 2018 (218.10, 252.40, 262.40 hours respectively). A total of 957 Western Honey Buzzards were recorded in the 30-day period over three years (190, 186 and 581, respectively; yearly mean:  $x = 319$ ), with a seasonal maximum count of 581 individuals in 2018. A number of the raptors observed ( $N = 205$ ; 21%) had a 'reversed' direction of autumn migration, incoming from SE and heading NW (Fig. 2), flying parallel to the seacoast. Considering only the individuals observed over



**Figure 1.** Daily records during May 2016-2018 of migrating Western Honey Buzzards at the Apuane Alps, heading NW and heading SE.



**Figure 2.** Daily records during September 2016-2018 of migrating Western Honey Buzzards at the Apuane Alps, heading SE and heading NW.

the ten-day period between 1 and 10 September ( $N = 334$ ), 144 (43%) were heading NW, while 190 (57%) were heading SE (Fig. 2). Daily counts comprised between a minimum of zero and a maximum of 58 individuals recorded on 18 September 2018 (mean  $\pm$  SD =  $11.26 \pm 12.16$ ). The maximum daily count of individuals heading NW occurred on 5 September 2018 with 22 birds, while the maximum daily count of individuals heading SE occurred on 18 September 2018 with 57 birds. The overall migration peak of the species during the study period occurred on 18 September (Fig. 2), as well as for birds heading SE, while it was recorded on 5 September for birds heading NW. The overall median date of passage of the species occurred on 14 September, while it occurred on 8 September for birds heading NW and on 16 September for birds heading SE. Among the Western Honey Buzzards whose ages were estimated ( $N = 343$ , 36%), 87 (25%) were adults and 256 (75%) were juveniles. Among the birds heading NW ( $N = 94$ , 27%), 74 (79%) were adults and 20 (21%) were juveniles, while among the birds heading SE ( $N = 249$ , 73%), only 13 (5%) were adults and 236 (95%) were juveniles.

Reported data confirm the results of a previous survey (Premuda *et al.* 2015) showing the occurrence of 'reverse' and 'cross' migration of the Honey Buzzard, visible at the Versilia-Apuane Alps bottle-neck. It is confirmed that the movements of some Western Honey Buzzards heading SE and others heading NW create a "cross migration" among the same species at the Apuane Alps watch-site, with individuals incoming from different directions and outgoing to different destinations at the same time (Premuda *et al.* 2015).

In spring, the regularly observed 'reversed' migration is performed by a significant portion of the Central Italian population very likely incoming from the western European migration flyway, and which, in the study area, follows the coastline heading SE probably to reach Central Italy as a breeding or summering destination. In autumn, the observed behavior of the Western Honey Buzzards heading NW at the Apuane Alps watch-site shows an autumn northward migration direction, adopted by a limited portion of the Central Italian population which probably joins the main western European migration flyway, passing throughout the arched Ligurian coastline, France and Spain (Premuda *et al.* 2015).

In autumn, the different and shifted peak and median date of passage, as well as the flight directions of the samples of adults and young birds, suggest that individuals flying towards NW were mostly adults, while juveniles, which migrate later than the adults (Cramp & Simmons 1980), mostly followed the innate southbound direction of the species' autumn migration (Premuda *et al.* 2015). The

reduced counts in spring 2017 can be hardly explained just with a reduced count effort (only 12 hours less than 2016), or bad weather (only six afternoons), or birds not detected (about 1,000 less), and therefore is likely due to a different route used: the Central Mediterranean flyway across Sicily, instead of the western European flyway across Spain. Overall, research with satellite tracking would be useful to identify the breeding and wintering areas of the individuals that cross the Italian Peninsula, potentially belonging to a wide geographical range, and to delineate the migration pathways used both in spring and in autumn.

With regard to the spring records, for birds heading NW the destination is unknown but for the Western Honey Buzzards entering the Italian Peninsula from NW and heading SE, the destination breeding area is most probably Central Italy. In particular, considering the number of individuals recorded in spring 2016 ( $N = 1,018$ ), about 400 breeding pairs can be estimated (considering a number of floaters, potentially compensated by not detected birds and individuals reaching Central Italian Peninsula from South), as the species performs its first migration back to Europe when adult (Cramp & Simmons 1980, Forsman 2016). Thus, the suggestion is to update the Western Honey Buzzard estimated breeding pairs in Italy to 1,200-1,800, considering that they are known to be present mainly in the Alps and Northern Apennines (Brichetti & Fracasso 2003).

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