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Reverse and cross migration of Western Honey Buzzard *Pernis apivorus* at the Apuane Alps watch-site (Tuscany)

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Abstract – The aim of this study is to analyse the migration flow of the Western Honey Buzzard *Pernis apivorus* observed on the western slopes of the Apuane Alps (Capriglia, Pietrasanta, Lucca, Tuscany). In spring, over a 12-day sample period from 9 to 20 May 2012-2014, a total of 738 individuals were recorded (148, 340, 250 respectively). Most Western Honey Buzzards observed (N = 466; 63%) had a reversed direction of spring migration, incoming from NW and heading SE. In autumn, over a 30-day period from 1 to 30 September 2012-2014, a total of 598 individuals were recorded (155, 111, 332 respectively). A proportion of the Western Honey Buzzards observed (N = 173; 29%) had a reversed direction of autumn migration, incoming from SE and heading NW. Autumn data suggest that mainly adults migrated towards NW, while mainly juveniles followed the innate autumn southbound direction. The particular behaviour of some Western Honey Buzzards heading NW and others heading SE creates a "cross migration" among the same species at the Apuane Alps watch-site, with individuals which possibly belong to different populations that cross their flyways, incoming from different directions and outgoing to different destinations at the same time. The regularly observed behaviour of the Western Honey Buzzards heading SE in spring and NW in autumn shows a spring and autumn reverse migration, adopted probably by a portion of the Central Italian population, which most likely performs a deviation from the main western European migration flyway.

Key-words: *Pernis apivorus*, raptor migration, reverse migration, cross migration, coasting, Apuane Alps.

INTRODUCTION

Geography and coastlines are key elements in shaping the migration pathways of migrating raptors (Kerlinger 1989). Strategies adopted by soaring raptors following coastlines to avoid crossing large water surfaces (Kerlinger 1985, 1989, Agostini *et al.* 2005) includes detours (Alerstam 2001, Yamaguchi *et al.* 2008), arched migration (Berthold 2001, Premuda & Baghino 2012) and circuitous migration (Agostini *et al.* 2002a, 2002b, Premuda 2002, 2004, Baghino *et al.* 2007, Premuda *et al.* 2007). In particular cases, crossed flyways can also result (Denac 2010, Panuccio *et al.* 2011, 2013, Premuda & Baghino 2012, Schindler *et al.* 2014). Reverse migration of migratory birds occurs in both spring and in autumn, as responses to adverse weather, as orientation errors, wind drift or overshooting (Newton 2008), as well as a cause of vagrancy (Thorup 2004). Reverse movements occur also at coasts, near large bodies of water (Berthold 2001).

The Western Honey Buzzard *Pernis apivorus* is a complete migrant raptor (Zalles & Bildstein 2000), wintering in Africa, south of the Sahara desert (Cramp & Simmons 1980), and breeding in Italy with 600-1000 estimated pairs, located mainly in the Alps and Northern Apennines (Brichetti & Fracasso 2003).

The main passage of the species during the spring migration in Italy is recorded at the Strait of Messina in Sicily (1989-1998: max 19,744, mean 19,273, Zalles & Bildstein 2000), with the maximum of 38,469 Western Honey Buzzards counted during April-May 2009 (Ricciardi *et al.* 2009).

Arenzano, Mount Conero and Mount San Bartolo are monitored bottlenecks in spring for the species in Central-Northern Italy in coastal areas (Fig. 1), where a total of 1,908, 2,366 and 1,223 Western Honey Buzzards were observed in spring 2013 respectively (Amatiello & Sonet 2013, Baghino 2013, Fusari & Morganti 2013). At Arenzano (Genova, Liguria), only 320 Western Honey Buzzards heading SW were recorded during the period 25 August – 5 September 2014, illustrating that the Ligurian coastline is a major flyway for the species in spring but not in autumn (Gisotti 2015, Baghino *pers. obs.*).

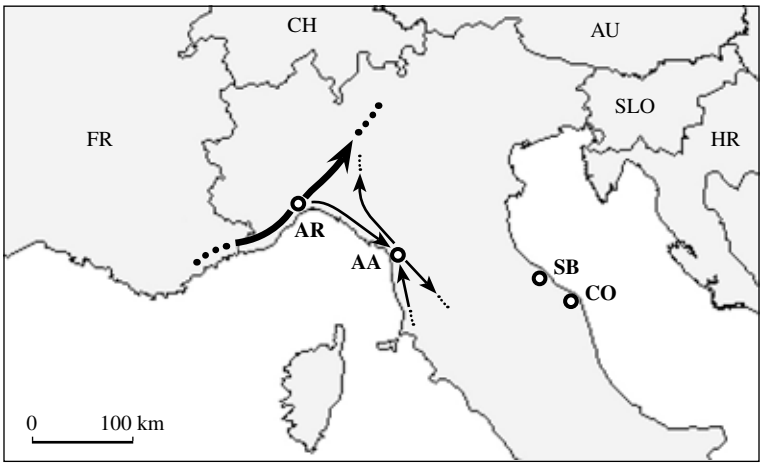

Figure 1. Spring area of study and main bottleneck sites for the Western Honey Buzzard spring migration in coastal areas in Central-Northern Italy (AR = Arenzano, AA = Apuane Alps, SB = San Bartolo, CO = Conero).

Indeed, the main passage of the species during the autumn migration in Italy is recorded at inland sites: Prealpi Trevigiane (TV) (N = 12,515 in 2013) (Mezzavilla *et al.* 2013), Parco del Mincio (MN-BS-VR) (N = 17,669 in 2013) (Gargioni 2013), and Parco Nazionale d'Aspromonte (N = 26,155 in 2013) (Morabito *et al.* 2013).

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). Circuitous and arched migration have been documented at this site for the Short-toed Eagle (Agostini *et al.* 2002a, 2002b, Premuda 2002, 2004), the Booted Eagle *Aquila pennata* (Baghino *et al.* 2007, Premuda *et al.* 2007) and the Black Kite *Milvus migrans* (Premuda & Baghino 2012).

The risk of double counts is very low due to the topography of the site: a bottleneck between a coastline (Versilia) and a mountain chain (Apuane Alps) where birds fly parallel to the coast without attempting the sea crossing (Premuda 2007, Premuda *et al.* 2010) and where raptors can be followed flying for some minutes over a number of kilometers, incoming and outgoing, allowing the observer to verify the migration direction.

The aim of this study is to analyse the spring and autumn migration flow of the Western Honey Buzzard at the Apuane Alps watch-site.

MATERIALS AND METHODS

Observations were concentrated over the main spring peak passage period of the species in May, and over the autumn passage period of both adults and juveniles of the species, which occurs annually mainly in September (Cramp & Simmons 1980).

Visual counts took place on the western slopes of the Apuane Alps (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 over a 12-day sample period from 9 to 20 May 2012-2014, while in autumn observations were performed daily over a 30-day period from 1 to 30 September 2012-2014, from about 09:00 to 17:00 (GMT +1). For each observation, time (hh:mm), species, number of individuals, age (whenever possible), and flight direction of birds (incoming and outgoing) 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 (after about 5 km). 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).

RESULTS

Spring

In spring, observations were carried out for 36 days totalling 300 h and 25 min of observations (mean daily observation effort ± SD = 8.34 ± 1.49 hours).

A total of 738 Western Honey Buzzards were observed in the 12-day sample period over three years (148, 340,

250 respectively), with a seasonal maximum count of 340 individuals in 2013 (Tab. 1).

The migration peak of the species during the study period occurred on 11 May (Fig. 2).

Daily counts comprised between a minimum of two individuals and a maximum of 94 individuals recorded on 11 May 2013 (mean ± SD = 20.50 ± 22.14).

Most Western Honey Buzzards observed (N = 466; 63%) had a reversed direction of spring migration, incoming from NW and heading SE (Tab. 1, Figs 1, 2), flying parallel to the seacoast. The maximum daily count of individuals heading SE occurred on 12 May 2014 with 83 birds, while the maximum daily count of individuals heading NW occurred on 17 May 2012 with 29 birds.

The yearly counts of individuals heading SE at the Apuane watch-site (Tab. 1) represent the 4.7%, 10.8% and 10.0% (mean = 8.5%) of the observations at Arenzano, where 1,463; 1,908 and 1,914 individuals were counted in 2012, 2013 and 2014 respectively (Baghino 2012, 2013, 2014).

Table 1. Spring records of Western Honey Buzzards over the sample period 9-20 May 2012-14 at the Apuane Alps with percentage of individuals incoming from NW and heading SE.

Years	> NW	> SE	Total	% > SE
2012	79	69	148	47%
2013	134	206	340	61%
2014	59	191	250	76%
Total	**272**	**466**	**738**	**63%**

Table 2. Autumn records of Western Honey Buzzards on September 2012-14 at the Apuane Alps with percentage of individuals incoming from SE and heading NW.

Years	> NW	> SE	Total	% > NW
2012	26	129	155	17%
2013	32	79	111	29%
2014	115	217	332	35%
Total	**173**	**425**	**598**	**29%**

Autumn

In autumn, observations were carried out for 90 days totaling 768 h of observations (daily mean ± SD = 8.53 ± 1.79).

A total of 598 Western Honey Buzzards were recorded in the 30-day period over three years (155, 111, 332 respectively), with a seasonal maximum count of 332 individuals in 2014 (Tab. 2).

A number of the Western Honey Buzzards observed (N = 173; 29%) had a reversed direction of autumn migration, incoming from SE and heading NW (Tab. 2, Figs 3, 4), flying parallel to the seacoast. Considering only the individuals observed over the ten-day period 1-10 September (N = 206), 120 (58%) were heading NW, while 86 (42%) were heading SE (Fig. 4).

Daily counts comprised between a minimum of zero and a maximum of 43 individuals recorded on 11 September 2014 (mean ± SD = 6.64 ± 8.42).

The maximum daily count of individuals heading NW occurred on 6 September 2014 with 18 birds, while the maximum daily count of individuals heading SE occurred on 22 September 2014 with 36 birds.

The overall migration peak of the species during the study period occurred on 11 September (Fig. 4), while it was recorded on 6 September for birds heading NW and on 22 September for birds heading SE.

The overall median date of passage of the species occurred on 13 September, while it occurred on 7 September for birds heading NW and on 16 September for birds heading SE.

Among the Western Honey Buzzards whose ages were

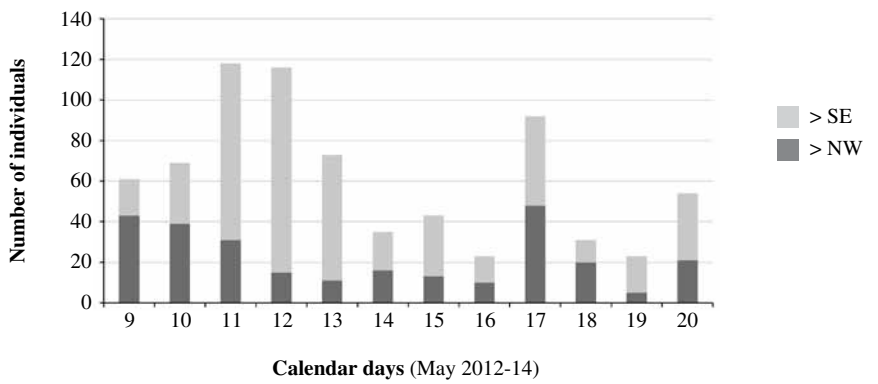

Figure 2. Daily records during May 2012-14 of migrating Western Honey Buzzards at the Apuane Alps, heading NW and heading SE.

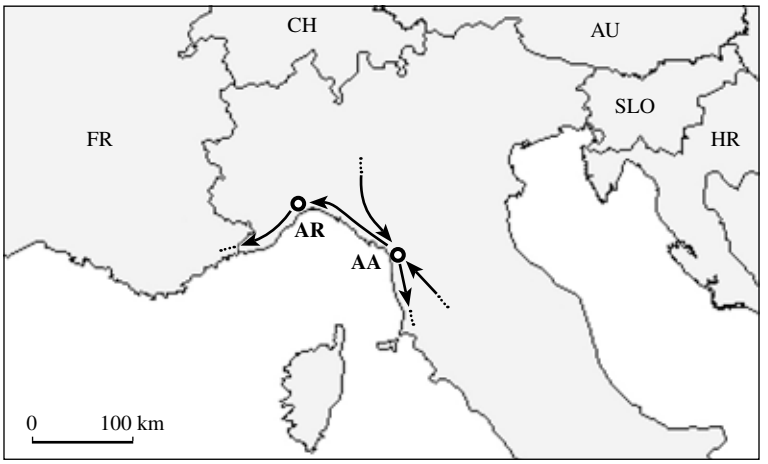

Figure 3. Autumn area of study in western Central-Northern Italy and watch-sites of the Western Honey Buzzard autumn migration (AR = Arenzano, AA = Apuane Alps).

estimated (N = 205, 34%), 50 (24%) were adults and 155 (76%) were juveniles. Among the individuals heading NW (N = 31, 15%), 20 (65%) were adults and 11 (35%) were juveniles, while among the birds heading SE (N = 174, 85%), 30 (17%) were adults and 144 (83%) were juveniles. In addition to the records of the autumn study period, during five days of sporadic sample observations at Capriglia, from 26 August to 5 September 2005-8, twenty-eight Western Honey Buzzards were flying heading NW and only one towards SE (Premuda *et al.* 2010, S. Donello *pers. comm.).*

DISCUSSION

The particular behaviour of some Western Honey Buzzards heading SE and others heading NW both in spring and in autumn creates a "cross migration" (Dixon 1895, Schüz *et al.* 1971, Roney Drennan 1981, Clarke 2014) among the same species at the Capriglia watch-site. It is likely that individuals which are part of different populations cross their flyways, incoming from different directions and outgoing to different destinations at the same time (Figs 1, 3). The coasting behaviour of the individuals heading NW and heading SE, might have been adopted to avoid the direct crossing of the Apuane Alps and the sea crossing, hence reducing energy expenditure in both cases (Figs 1, 3).

In spring, the regularly observed reversed migration direction of the Western Honey Buzzards at the Apuane Alps watch-site is probably performed by a portion of the Central Italian population (possibly mainly Tuscany), incoming from the western migration flyway passing through Liguria (Arenzano), which follows the coastline to reach their territories in Central Italy as a breeding destination (Fig. 1).

In autumn, the different and shifted peak and median date of passage, as well as the flight directions of the sample of birds whose age was estimated, suggest that mainly experienced individuals (adults) were flying towards NW, while mostly juveniles, which migrate later than the adults (Cramp & Simmons 1980), followed the innate southbound direction of the autumn migration of the species (Fig. 4).

The observed behaviour of the Western Honey Buzzards heading NW at the Apuane Alps watch-site shows an autumn reverse migration, adopted possibly by a portion of the Central Italian population (probably mainly from Tuscany). This should represent a diversion from the expected southbound migration, through which Honey Buzzards from Tuscany eventually join the main western European migration flyway, passing throughout the arched Ligurian coastline, Mediterranean France, Spain and the Strait of Gibraltar, to finally reach the western wintering areas in Central Africa (Fig. 3).

Despite the fact that the Western Honey Buzzards is very capable of flying for long distances over water (Agostini *et al.* 2005), the hypothesis that the reversed movements observed are part of a precise learnt circuitous migration strategy cannot be dismissed. This is performed backwards in autumn following the same spring pathway, to avoid the sea crossing, thus saving energy and reducing the risks associated with flying over water.

In any case, a high learning and navigation ability of the species is evident.

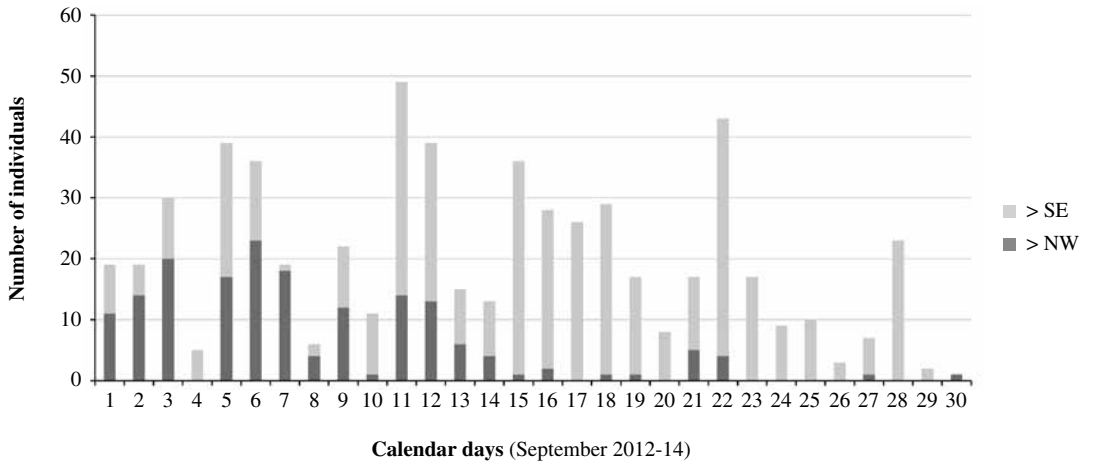

Figure 4. Daily records during September 2012-14 of migrating Western Honey Buzzards at the Apuane Alps, heading SE and heading NW.

Future research with satellite tracking could be useful to delineate the breeding and wintering areas of the individuals which perform the reverse migration and to support or not the above mentioned hypothesis.

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