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Orientation of Chiffchaff (*Phylloscopus collybita*), Blackcap (*Sylvia atricapilla*) and Lesser White-throat (*S. curruca*) on spring migration at Eilat, Israel

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Abstract: Ożarowska, A, Yosef, R & Busse, P. (2004): Orientation of Chiffchaff (*Phylloscopus collybita*), Blackcap (*Sylvia atricapilla*) and Lesser White-throat (*S. curruca*) on spring migration at Eilat, Israel. Avian Ecol. Behav. 12, 2004: 1-10.

Directional preferences of the three most common Passerine species migrating through Eilat, Israel, were studied in spring 1999. Eilat is located on the Eastern Palearctic Flyway and a large number of birds migrate through the region in spring and autumn. Results of the directional preferences of the studied species showed consistency with the directions suggested by band return data. However, the routes appear to differ from those suggested to date. Also, our study was able to elucidate the previously unknown relative directional preference of several species to the east revealing the relative proportion of Asiatic versus European populations of conspecifics that migrate through Eilat and that to date were inseparable.

Key words: Eilat, orientation, Chiffchaff, Blackcap, Lesser Whitethroat.

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1. Intoduction

Eilat is located on the Eastern Palearctic flyway, a flyway that is not well studied in comparison to the Western flyways at the Straits of Gibraltar and the Straits of Messina (cf. Berthold 1991). There are very few, if any, banding stations in the Levant and Asia to the northeast. Eilat is the only long-term banding station in the Middle East and that has data since 1984. This has resulted in a very low band-recovery rate – 2% for raptors, 0.1% for waders, and 0.01% for Passerines (Yosef 1997). Hence, in order to overcome the lack of banding stations and the resulting problem of very low percentage of band recoveries, we attempted to check our assumptions by conducting a study of the orientation of the most abundant species caught and banded at the International Birding and Research Center in Eilat (IBRCE) banding station. The species included in our study are only long-range migrants i.e., species whose breeding range stretches across the Palearctics. These included the Chiffchaff (*Phylloscopus collybita*), Blackcap (*Sylvia atricapilla*) and Lesser Whitethroat (*S. curruca*) (Harrison 1982; Hagemeijer & Blair 1997; Morgan & Shirihai 1997). The aim of this study was to understand the directional preferences of nocturnal migrants in a place that not only had a massive volume of migrant birds, but also was situated enough to the north on the flyway such that the individuals would be oriented towards their breeding grounds. Further, comparison of the orientation data with previous band recoveries would allow us to establish the validity of the results and to elucidate the bias caused by the lack of banding stations in Asia.

2. Methods

The experiment was conducted during spring 1999 (February – May) at the "Bird Sanctuary" of the IBRCE in Eilat, Israel. Birds were caught with mist-nets while on their spring migration (February – May 1999), banded, measured and placed in the orientation cage.

The design of the orientation cage Busse (1995) resembles that used by other scientists (e.g. Emlen & Emlen 1966) but is simplified and more bird- and user-friendly in the field. The experimental cage consists of a flat cylinder made of two wires connected by 8 vertical wires that divide the sidewall into eight identical sectors. The top is covered with netting that allows the study bird to see the sky. The sidewall is covered with transparent foil (kitchen saran wrap) on which the pecks and scratches are made by the bird in its attempts to escape the cage. The cage is placed in the centre of an open cylinder made of uniformly coloured, solid plastic that prevents the study bird from seeing any landmarks other than the sky. At the end of the experiment, the bird is released and the number of pecks by the beak and scratches by the claws of the feet are counted. The advantage of the method, among others, is that the birds are tested during the day. Busse (1995) and Nowakowski & Malecka (1999) have proved in a typical nocturnal migrant the Robin (*Erithacus rubecula*) that at daytime activity and directionality of the birds was higher than at night. Further Nowakowski & Malecka (1999) found that robins tested at day and night displayed a very similar distribution in their preferred directions. All these prove that the method can be used also in the daytime to study orientation of nocturnal migrants. Testing birds in the day is a great advantage over the previous methods because the birds included in the experiments are not kept for an extended period of time that exceeded 45 minutes before the test, their migration is not truncated because of the needs of the experiment, and the birds are released immediately into a safe environment of the adjacent bushes.

All orientation tests were conducted in the daytime (6 a.m. till noon). We standardized weather conditions by conducting the experiments only on days with clear blue skies and neutralized wind effects and human disturbance by placing the orientation apparatus in a fenced yard. The standardized length of time for each test was 10 minutes. The results of bird activity i.e., scratches and holes made either with claws or beak were counted with a 45° precision (8 sectors) immediately upon removal of the bird from the cage. Such procedure enabled to process up to 6 birds every hour thus giving a large sample size in a relatively short period of time.

The most important assumption and novelty in the data analysis according to the method used in this study is that of multi-vector model of bird behaviour (Busse & Trocinska 1999). This assumption is based on the hypothesis presented earlier (Busse 1992) that an individual that is an inter-population hybrid ("population" in migratory sense) can have two or more navigational programs. Any distribution different from the random one is accepted, that means that each bird could indicate one or more preferred directions, in the latter either axial or multi-vector tendency.

A total of 1,255 tests were conducted in the three study species (Tab. 1). Results of all tests were computerized with program ORIENT (available from the Bird Migration Research Station, University of Gdansk, Poland). The program facilitated the preparation of all data into a standard form that can then be used by different spreadsheet programs. We used Quattro Pro 6.0 for Windows that allowed making radar (circular) graphs. Tests with less then 20 markings per experiment were excluded from the data set. Initially, all data were checked with Chi-square test and all non-significant distributions (random distribution of the signs) were also excluded from further analysis (Tab. 1). The Rayleigh test, that is used to test data distribution, was not applied as it requires unimodality (Zar 1984). The data were then calculated in percents and smoothed. For each individual a simplified distribution of its headings was elaborated according to the procedures suggested by Busse & Trocinska (1999). Data for all individuals of each of the three study species were summed up for the whole season and these data were used to draw radar graphs of distributions of headings for the study species. The above-mentioned procedure results in a presentation of individual vectors and not an average for the group as in other studies (e.g. Wiltschko 1968; Berthold et al. 1990). It is of interest that Phillips (2000) also found that experimentally tested groups of migrants exhibit a very wide range of orientation directions and that one cannot accept the mean direction as being valid while selectively ignoring individual data points from which it is derived.

3. Results

Out of a total of 1,255 tests conducted only 460 (37%) were used for further analysis (Tab. 1) as in the rest of the tests most birds displayed little activity. This is very unusual in comparison to previous studies conducted elsewhere and where the same method was applied (AO, pers. obs. based on ca. 5000 tests that were made in Estonia, Poland, Russia, and Ukraine).

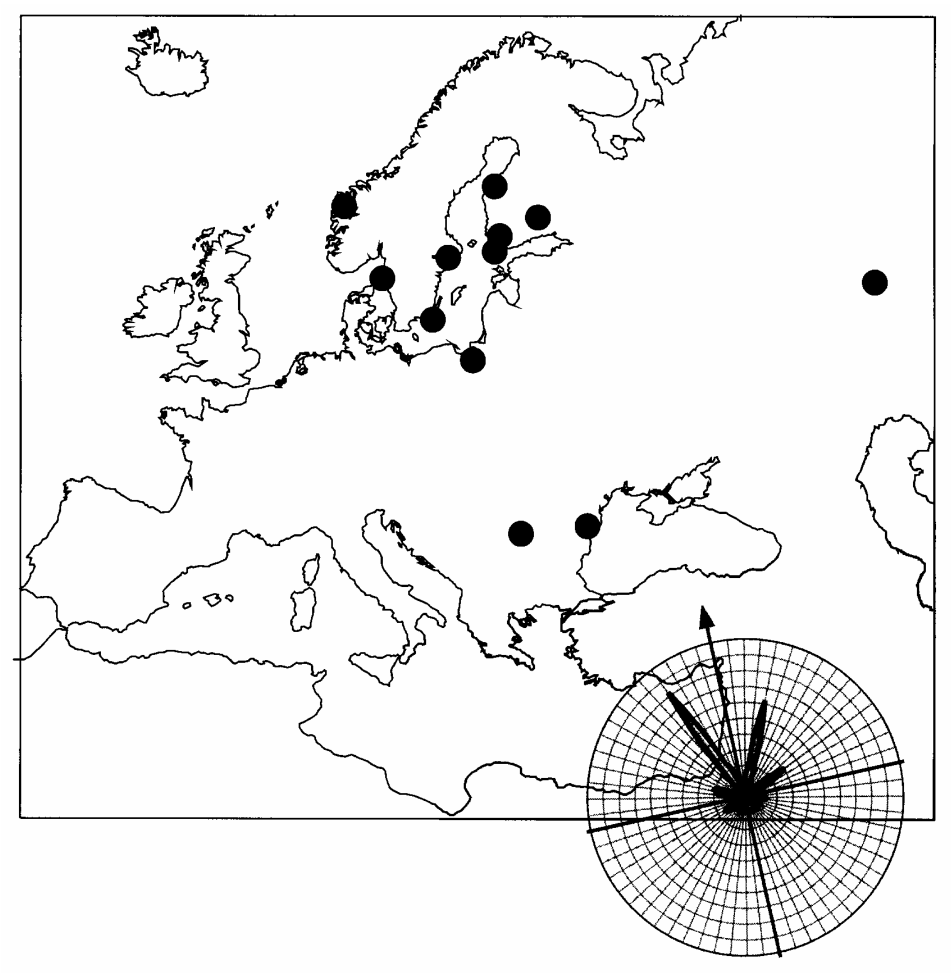

Figure 1. Distribution of headings of the Blackcap (N = 183) tested in the field experiments in Eilat, Israel, spring 1999 and banding/recovery locations of individuals controlled/banded at Eilat and other parts of Israel (banding recoveries after: Yosef 1997; Zink 1973-1985).

Table 1. Number of tests of the studied species used for analysis.

	Tested N	Inactive n_i	Non-signif. n_n	Analysed* n_a
Phylloscopus collybita	256	197	0	59
Sylvia atricapilla	432	235	14	183
Sylvia curruca	567	340	9	218
Total	1255	795	23	460

Note: * Distribution significantly different from random: Chi-square test, 97.4% of tests: $p < 0.01$; 2.6% of tests: $p < 0.05$.

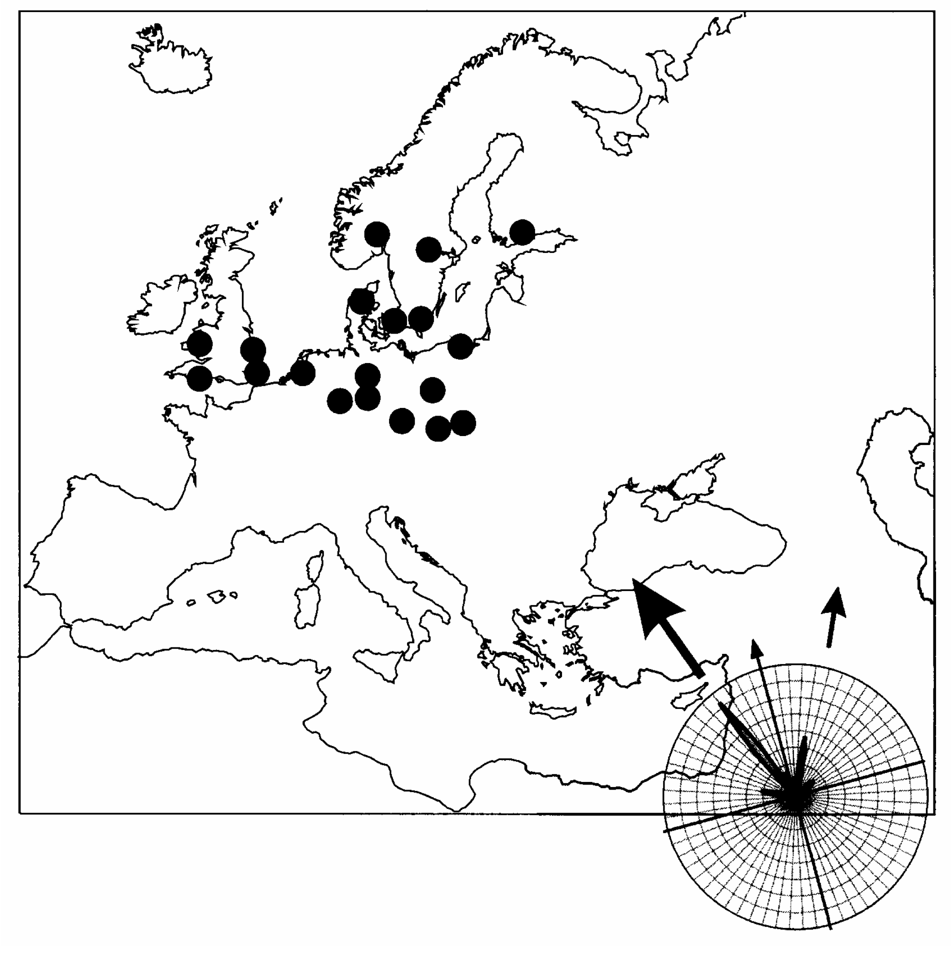

Figure 2. Distribution of headings of the Lesser Whitethroat (N = 218) tested in the field experiments in Eilat, Israel, spring 1999 and banding/recovery locations of individuals controlled/banded at Eilat (banding recoveries after Yosef 1997).

All species displayed variations of the preferred directions, but usually there was one direction that dominated over all others. In the Blackcap there appear to be at least two dominant directions, north-northwest (55%) and north-northeast (30%) (Fig. 1) and the majority of the Lesser Whitethroat oriented to the north-northwest (49%) (Fig. 2). The Chiffchaff displayed extreme persistent orientation to the north-northeast (38%) and northeast (43%) and only a very small vector pointed towards north-northwest (13%) (Fig. 3).

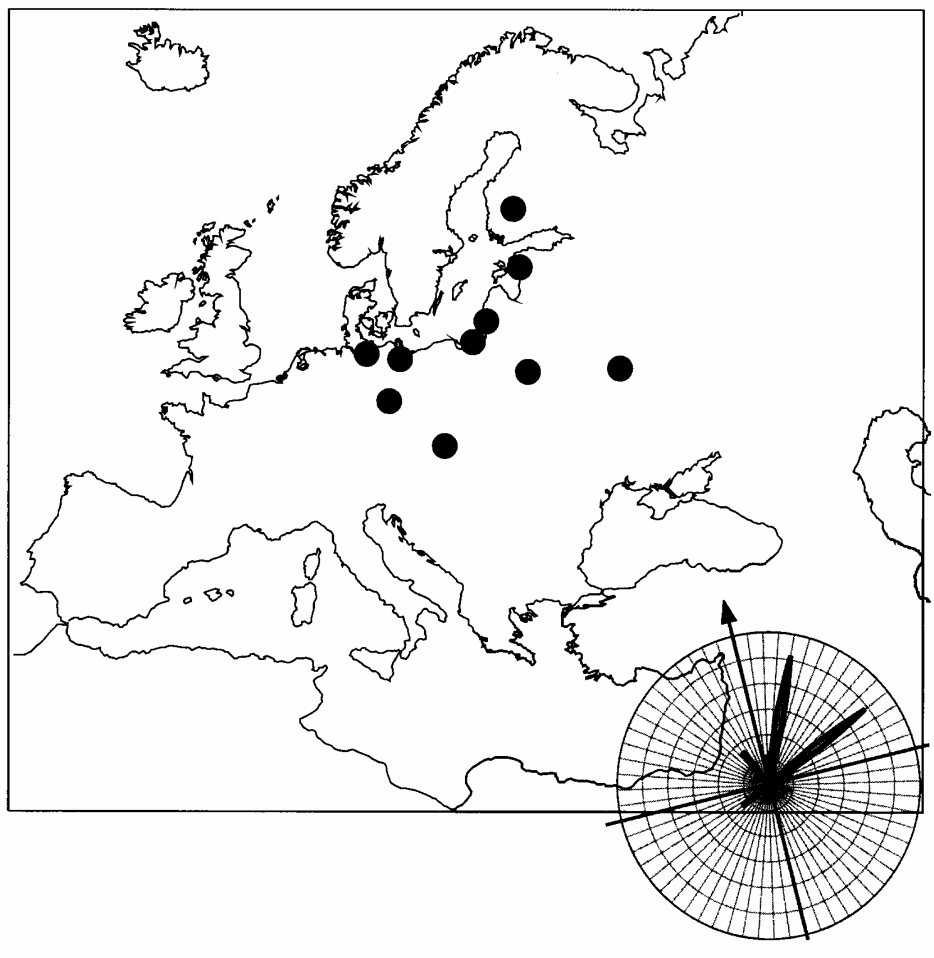

Figure 3. Distribution of headings of the Chiffchaff (N = 59) tested in the field experiments in Eilat, Israel, spring 1999 and banding/recovery locations of individuals controlled/ banded at Eilat (banding recoveries after Yosef 1997).

Discussion

The species included in our study are all long-range migrants, with a very widespread breeding range. Moreover the Lesser Whitethroat is a locally quite common breeding summer visitor in northern Israel, with a few in the central parts. The Blackcap is a very irregular breeder in the north, while the Chiffchaff is only abundant passage migrant and common winter visitor throughout the country. Both the Lesser Whitethroat and Blackcap are fairly common autumn and abundant spring passage migrants throughout the country, but are very rare winter visitors (Shirihai 1996). In all of the studied species there are either subspecies known or there are different populations migrating to different breeding grounds by separate flyways (Glutz & Bauer 1991; Hagemeijer & Blair 1997).

The orientation experiments allowed us to verify previous assumptions that in the Eilat region the spring migration "is directed north or north-east, in the shortest route to their Palearctic (estimated 46% of migrants) and Holarctic (14%) breeding grounds" (Yosef 1997). Further, we could elucidate if indeed birds fly along the coastline of the Red Sea and when they reach Eilat they follow either north or northeast directions (Yom-Tov 1988).

The large variance of the preferred directions shown by species could be a result of geographically different populations of the same species passing through Eilat. Morgan & Shirihai (1997), who summarized ten-years of bird banding at Eilat, state that in many of the species banded in large numbers and studied in detail to the subspecific level, birds are of different populations. An example of this is the Blackcap. They suggested that two, probably unrelated, populations of this species migrate through the Eilat region in a sequential manner.

Results of the tests were compared with available data on banding/recovery locations of birds recovered/banded at Eilat (Yosef 1997). Such data were scarce for the Blackcap, thus were supplemented with data from other parts of Israel from Zink (1973-1985). Distribution of banding recoveries and directional preferences are consistent in this species (Fig. 1) and support the hypothesis mentioned above. A smaller vector to the north-northeast and an even smaller one to the northeast, suggests that at least three different geographically distinct populations of the species migrate through Eilat. A hint to the existence of the latter two existed in the form of a single recovery from western Russia. This concurs with Morgan & Shirihai (1997) who found that there are two distinct peaks of migration, one in mid-April and second in early May, of Blackcaps at Eilat and that the birds in the second wave have grayer plumage and longer wing chord.

In the Lesser Whitethroat, orientation vectors of the studied birds were very similar to the recovery data (Fig. 2). Contrary to most European Passerine species, in autumn the Lesser Whitethroat migrates from Europe in a southeasterly direction to the Levant and then in a southwesterly direction to its wintering grounds (Glutz & Bauer 1991; Hagemeijer & Blair 1997; Shirihai 1996). In the spring the birds are assumed to return in the same manner. Morgan & Shirihai

(1997) suggested that the large spring passage of this species in Eilat was a result of the fact that the majority of the West European populations all pass through the Levant in autumn and spring. Our results support this suggestion because in our study the Lesser Whitethroat also showed predominance towards the west (49% of total). These authors also noted that numbers of individuals of the eastern subspecies: *S. c. halimodendri* (steppes from Volga to Altai) and *blythi* (most of Siberia and steppes south to N. Transcaspia, Kirghiz, Altai) (Glutz & Bauer 1991; Svensson 1992) were relatively small. This is also evident in our data wherein although the majority of the vectors were to the northwest, there were a smaller proportion of birds that displayed a tendency towards the north-northeast (20%) (Fig. 2). We can only assume that these relate to the two aforementioned Asiatic subspecies of the Lesser Whitethroat.

Inversely to the other two study species, the Chiffchaff showed a strong directionality to the east with a very small proportion, of only 13%, towards the northwest. This, although all of the recoveries from birds banded at Eilat or recovered to date are from western and central Europe (Yosef 1997). Though it has to be stressed that one of the smaller vectors shows the direction given by all the recoveries, it appears that the majority of the Chiffchaffs banded in Eilat are of Asiatic origins (Fig. 3). It is of interest to note that two very prominent vectors are evident to the northeast and east-northeast. If placed on a map of the region it is evident that the strongest vector points directly towards the land-bridge between the Caspian and Black seas suggesting that these are birds of Eastern Europe – Western Asiatic populations (Fig. 3). The other almost equally strong vector points to the south of the Caspian Sea and suggests that these are probably birds that are of central, or maybe even eastern, Asiatic populations. We assume that this large proportion of Chiffchaffs are of Asiatic origin and was not previously known because of the lack of banding activity in western and central Asia. Conversely, the comparatively large number of banding stations across Europe has resulted in a disproportionately large number of recoveries. This is a very obvious case wherein without the insight accorded by the orientation experiments our conceptions of the migratory habits and origins of this species would be extremely biased and result in wrong conservation measures being implemented.

In this study, in a comparatively large number (63%) of tests the birds showed very little activity. We hypothesize that this could be a result of the fact that many of the birds were in varying conditions of migratory staging in the "Bird Sanctuary" and at the time of their study were not yet ready for their northward passage to the breeding grounds. An example in point is that of an adult female Blackcap (T86728) that was trapped and placed in the orientation cage on three consecutive occasions between 22 and 27 April 1999. On 22 April the bird had a body mass of 13.6 g, a fat score of 0 and made no moves at all in the orientation cage. On 25 April, the same bird had increased its body mass to

14.5 g, had a fat score of 2 and exhibited migratory restlessness by making 55 scratches which, however, did not show any specific directional preference. However, an extreme change was evident when the bird was retrapped a third time on 27 April. Although the individual had not increased weight or the fat score considerably, 14.7 g and 2 resp., the bird made a total of 75 scratches and displayed a very unidirectional orientation to the north-north-west. This marked increase in directionality and restlessness clearly suggested that on 22 April the bird had just accomplished a crossing of the deserts from the south, staged at Eilat for a week and then exhibited its readiness for the onward migration by the large number of scratches which resulted from its hyper-activity and its desired direction by attempting to escape in the same direction for the full 10 minutes that it was placed in the orientation cage. The lack of activity also suggests that Eilat is an important staging area for all three of the study species and that it is important because it is reached immediately after the crossing of the Sahel, Sahara and Sinai deserts to the south.

In conclusion, the results of the directional preference experiments of the three Passerine species migrating through Eilat were consistent with the directions found by previous band recovery data. However, all three species indicated that their orientations are also in previously undocumented directions of the large landmass of Eurasia. Evaluation of the large sample sizes at a predetermined time of the known migratory waves of the different species will allow us to further elucidate the relative proportions of the sub-species/geographic races that avail of the Eilat region to reach their breeding grounds.

The results are consistent with existing knowledge of bird migration from the wintering grounds in Africa to the Palearctics, but we have also shown that there is a previously unidentified, and hitherto unquantified, proportion of birds that are from the east – areas that lack banding stations and are still not well studied. Further, our study has shown that although earlier hypothesis stressed that most of the migratory species circum-navigate the Mediterranean Sea by following the land mass, that there is a large proportion that orient towards Cyprus and Greece suggesting a short sea-crossing. These results stress the urgent need to study the eastern migratory flyway of the Western Palearctic in order to fully understand the intercontinental movements of the migratory populations involved. In the immediate future we hope to conduct additional orientation experiments to the north of Eilat and to compare the results with those of this study. It will also be of interest to analyse the results on the passage phenology of the geographically different subspecies or populations of many of the species banded at Eilat. We think that similar efforts should be made to test the directional preferences of avian migrants along every possible point of this very important global flyway. We consider this important because the conservation implications are far-reaching. In recent decades research has proved that this flyway conducts a very large proportion of Europe's birds back to their breeding grounds in the spring of each year and continued development by humans of their critically located staging habitats could endanger the survival of the dependent subspecies, or even the species themselves.

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