Augmentation of ringing recovery data by means of field experiments: a new look at migration of nocturnal migrants

By Przemysław Busse

Abstract: Busse, P. (2000): Augmentation of ringing recovery data by means of field experiments: a new look at migration of nocturnal migrants. Vogelwarte 40: 265–270.

Mapping of ringing recoveries gives very impressive migration patterns that are, however, often misleading. Most of people looking at them believe that almost all European Passerines migrate SW to, or through, south-western Europe. But this impression is false for many species because the number of recoveries often depends more on hunting pressure and a level of education of the people living there than on the number of ringed birds migrating or wintering on the area. Detectability of rings is close to null in the eastern and southeastern parts of Europe and, additionally, bird ringing on this area is negligible in relation to the western Europe. Results of other than bird ringing studies (orientation field experiments) suggest that most of birds from this area migrate in southeastern direction. There were pilot studies with a new field method of setting preferred directions of nocturnal migrants carried out in Poland, Estonia, Ukraine, Russia (as far as Kazan to the East) and Israel. The method is very simple and cheap in application – it is possible for one person to do 40 or more experiments at one stand per day. Robins tested at the Polish Baltic coast show preference to directions leading to winter-quarters situated more easterly than Italy in 36–41%, in central Poland 84%, and near Moscow 87%. To get such information out of the ringing needs tens of thousand ringed birds.

Key words: ringing recoveries, recovery rate, migration pattern, field experiments.

Address: Bird Migration Research Station, University of Gdańsk, Przebendowo, 84–210 Choczewo, Poland; e-mail: busse@univ.gda.pl

1. Introduction

Migration patterns of nocturnal migrants are usually analysed using ringing recoveries as a basic source of information. This method shows distribution maps of recovery localities during migration and wintering time. In the classic atlas by Schüz & Weigold (1931) recovery places were connected by lines with ringing places, which gives very impressive pictures of bird migration. Clusters of recoveries and connected with them lines suggest not only main winter-quarters but even migration routes. This method of presentation is a standard one till quite recent publications, as e. g. passerine migration atlas by Zink (1973–1985). However, more and more authors noted that distribution of recoveries can not reflect distribution of ringed birds correctly. The most extensive studies of this aspect of recovery pattern evaluation were presented by Busse & Kania (1977), Busse (1981) and Kania & Busse (1987). As the method proposed to overcome the problem of unequal detectability of rings needed high numbers of recoveries and using additional data on intensity of ringing at different areas, the problem was practically not solved and only in the paper by Busse & Maksalon (1986) it was suggested migration of quite big share of Song Thrushes passing through central part of the southern Baltic coast to winter-quarters at the Balkan Peninsula where ringing recoveries of this species are sparse. From the other hand it is known that at least some species of passerines show migration divided onto two or more migration directions (Busse 1969, Zink 1973–1985). The most known is a case of Blackcap migration extensively discussed recently (Berthold & Terrill 1988, Busse 1992, Fransson & Stolt 1993). The problem is more and more important when eastern populations of different species are studied – in most of central/eastern European populations SE migration can be suspected despite the number of recoveries from the eastern flyway is low. Working on these populations forced looking for additional methods that could allow studying real distribution of directional preferences of nocturnal migrants on these areas. The new method of field experiments (as to cage design and experimental routine – see next chapter) was elaborated and published recently (Busse 1995).

The present paper is intended as a short overview of preliminary results obtained in central/eastern Europe by means of the method that could encourage to using it anywhere on migration routes.

2. Material and method

The main part of presentation is based on data collected for the Robin *(Erithacus rubecula)* during the Operation Baltic work in 1961–1996 (ringing recovery data) and in September 1998 (field experiments). Some of data were in more detail discussed in recent papers (REMISIEWICZ et al. 1997, BUSSE et al. in press). In years 1960–1996 202 489 Robins were ringed and 936 long-distance recoveries obtained (Table). 172 field experiments were done at Polish stations Bukowo-Kopań (46), Mierzeja Wiślana (51) and Wisła (75), while 83 were performed at Zvenigorod Biological Station of the Moscow State University near Moscow.

BUSSE (1995) already published standard description of the field method used to study directional preferences of birds at these stations. Main points of the method are given below:

The equipment contains circular, opaque, uniformly coloured screen, protecting the bird in an experimental cage against visibility of any landmarks, trees, wires etc., and experimental cage – a cylinder cage made of two wire circles connected by eight vertical wires distributed evenly (these define sectors used when counting results). The top surface of the cage is covered with nylon netting. Sidewall is covered by a stripe of ultra thin plastic foil of a kind used for protecting food in refrigerators.

The experiment stand should be flat area, top of a hill etc., without trees, wires, poles, which can be visible for bird above the protecting screen.

Tests can be done at any time, both at night and day. The weather limitation in experiments is a rainfall or snow as well as wet fog with a moist condensing on a foil at experiment cage. When strong wind (> 5 °B) experiments are not recommended. Caught birds can be tested just after catching and ringing or handled in opaque bags or cages normally up to two hours.

Preparing the cage for the experiment include covering its vertical sidewall with a stripe of a foil. Then it is located in a centre of the protecting screen with one of wires directed to the North. The bird should be transported to the experimental stand in opaque bag or cage and then put under the experimental cage inside of the screen protecting against visibility of landmarks. The bird lasts in the cage for defined time (the standard used is 10 minutes). During the experimental time the bird should not be disturbed by sudden noises, coming into the range of visibility etc. After end of the test the results of the experiment should be counted. These are dots or scratches made on the foil and they are counted and noted sector by sector. Counted results are then evaluated using circular statistics. The method of evaluation, that pays attention to multimodal distributions, is discussed in the paper by BUSSE & TROCIŃSKA (1999).

The method differs from earlier ones (Kramer's – KRAMER 1949, Sauer's – SAUER 1957 and Emlen's – EMLEN & EMLEN 1966), which based on the same essential principle – directional behaviour of a bird in a round cage, in two important points: time when experiments are performed and the cage construction. In the used method tests were performed during daytime instead of in darkness as earlier researchers did. This simplifies fieldwork, allows performing much more experiments and avoids stressing the birds by longer caging. Agreement of directionalities obtained by diurnal and nocturnal tests was checked by BUSSE (1995) and NOWAKOWSKI & MALECKA (1999). The flat cage design has very clear advantage over a conic construction of Emlen's cage: the bird freely hopes on a flat bottom instead of falling back after every hopping in Emlen's cage. This is important because of falling back is extremely unusual for the free-living bird and it stresses bird very much. This could be a reason why some freshly caught birds behaves as "disoriented" when tested in Emlen's cage. Practical advantage of the new cage is that results of hopping – scratches on the foil counting is much more reliable and very much quicker than on correction paper used in Emlen's method.

3. Results and discussion

Evaluation of effectiveness of the ringing method for estimation of a migration pattern of the species needs setting two main, species-specific parameters: recovery rate and differentiation in detectability of rings within the area of migration and wintering. Total recovery rate tells how much effort must be invested in ringing to obtain enough information, while differentiated detectability of rings could cancel any quantitative estimation.

Generally recovery rate of small passerines is low in comparison with raptors, storks, wildfowl and other big sized and game birds. It is usually below one percent. So, there must be a lot of effort to have number of recoveries sufficient for analyses. A good example is the Robin – one of the most commonly ringed birds at the central European bird stations. Within the Operation Baltic work

Table: Recovery rate of Robins ringed at the Operation Baltic stations in subsequent decades. Regression coefficient R = -0.015 ($p < 0.001$). – Wiederfundrate in aufeinanderfolgenden Dekaden von Rotkehlchen, die auf den Feldstationen der „Operation Baltic" beringt worden waren.

Years	Ringed	Recovered	Recovery rate
1960–1969	71605	419	0.59
1970–1979	54974	286	0.52
1980–1989	44825	134	0.30
1990–1996	31085	97	0.18
Total	202489	936	0.46

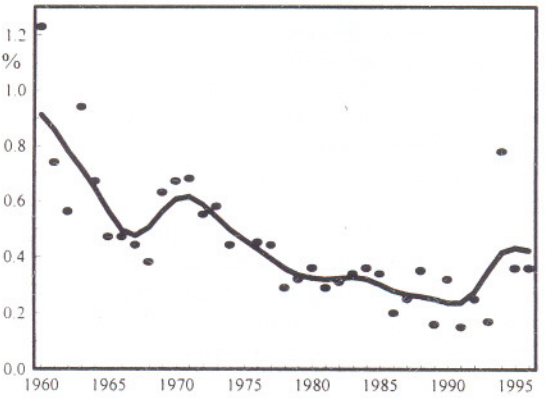

Fig. 1: Recovery rate of Robins ringed at the Operation Baltic in years 1960–1996. Dots – yearly rates, line – smoothed data (5-year moving average). – Wiederfundrate von Rotkehlchen, die von 1960–1996 im Rahmen der „Operation Baltic" beringt worden waren. Punkte = jährliche Wiederfundraten, Linie = geglättete Werte (Fünfjahres-Durchschnittswerte).

over 200 000 individuals were ringed to obtain less than one thousand of long-distance recoveries (Table) – average recovery rate was 0.46 percent. The average recovery rate does not reflect, however, a present effort, which should be invested in collecting of data. Fig. 1 illustrates a continuous process of decrease of recovery rate of Robin during last four decades. Recovery rate for the 90ties is three times lower than in the 60ties (Table). The species was under very strong hunting pressure a few decades ago as it was hunted/caught for food that allowed high recovery rate, while under conditions of much higher protection now naturally dead birds are much less frequently found and reported.

Distribution of recoveries of Robins ringed at the Polish Baltic coast and recovered in Europe and in northern Africa

Fig. 2: Recoveries of Robins ringed at the Operation Baltic stations after REMISIEWICZ et al. 1997). – Wiederfunde von Rotkehlchen, die auf den Stationen von „Operation Baltic" beringt worden waren (nach REMISIEWICZ et al. 1997).

is very unequal (Fig. 2). Breeding time recoveries are limited to Scandinavia, Finland and the Baltic countries, while from more eastern areas they are very sparse. Recoveries from a migration time and wintering are highly concentrated in western Europe, while eastern half of Europe is nearly empty of them. This recovery pattern convinces many people that Robins do not migrate in south-easterly direction. As an argument against low detectability explanation they give examples of Blackcap and Lesser Whitethroat. For these species a lot of recoveries from the SE flyway are reported. However, in this arguing a very important detail is overlooked: recoveries are concentrated on Cyprus and in Lebanon, where hunting for these birds causes very high recovery rate. Robins do not reach these areas and for this reason they are not reported. It is worth to stress that within Balkan Peninsula long-distance migrants to eastern part of Africa are reported less frequently too and mainly on seacoasts, where tourists report them from holiday's time in early autumn. Late migrants, as e. g. Robins and thrushes, are much less reported there.

Since first field experiments done while testing the method (BUSSE 1995) it was found that several of tested Robins show tendency to point at NW-SE axis of movement rather than NE-SW one as it could be expected from ringing recoveries. Further experiments (data combined for Bukowo/Kopań and Mierzeja Wiślana stations) confirmed this pattern – around half of vectors shown by tested Robins point at an azimuth NNW and NW to SSE and SE in autumn.

The method of field experiments gives estimation of directional preferences in a defined locality where experiments are performed. It is very tempting to extrapolate obtained directions as far as to winter-quarters basing on direction-time theory of bird navigation (e.g. BERTHOLD 1984), however, no one can be sure that the birds, even immatures, migrate along straight lines: for nocturnal migrants it was demonstrated that they can change direction of movement both in the nature (e.g. Robin on the western flyways – REMISIEWICZ et al. 1997) and in orientation experiments with caged birds (e.g. HELBIG et al. 1989). Caution in extrapolations suggests augmenting local studies by experiments carried out in many places on the area of migration. Organisation of scientific networks of the bird stations makes possible performing standardised studies in many localities simultaneously, then to compare results and build a wide area migration patterns. The example of such collaboration within the SEEN network (SE European Bird Migration Network) is a pilot study of directional preferences of Robins performed in September 1998 (BUSSE et al. in press). Experiments were carried out at four localities – Bukowo/Kopań and Mierzeja Wiślana at the Polish Baltic coast (Operation Baltic stations), Wisła (Operation Vistula) in central Poland and Zvenigorod Biological Station near Moscow, Russia. Results are presented at Fig. 3. There are shown both differentiation of distributions at different localities and high degree of agreement in documenta-

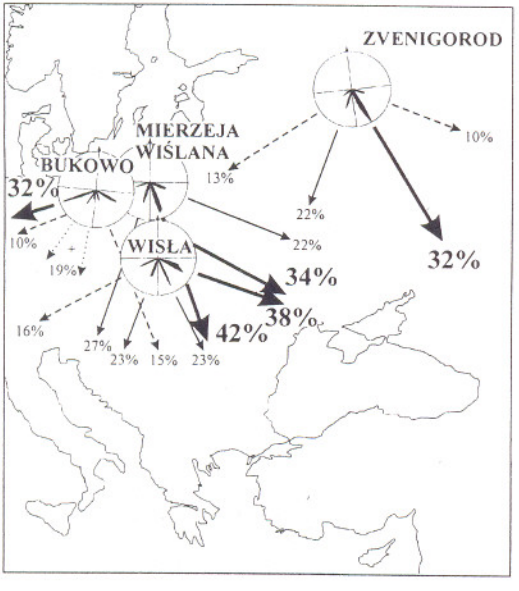

Fig. 3: Simplified distribution of headings of Robins tested in the field experiments at different bird stations (after BUSSE et al. in press). – Vereinfachte Darstellung zur Richtungsbevorzugung im Orientierungskäfig nach Feldexperimenten mit Rotkehlchen an verschiedenen Stationen ($N_{B.} = 46$, $N_{M.} = 51$, $N_{W.} = 75$, $W_{Z.} = 83$).

Fig. 4: Simplified distribution of headings of Lesser Whitethroat (N_t = 218) tested in field experiments in Eilat, Israel, spring 1999 and ringing/recovery localities of individuals recovered/ringed at Eilat (N_r = 15), after TROCIŃSKA et al. in press b. – Vereinfachte Darstellung zur Richtungsbevorzugung im Orientierungskäfig getesteter Klappergrasmücken (N = 218) nach Feldexperimenten in Eilat/Israel im Frühjahr 1999 und Beringungs-/Wiederfundorte von in Eilat wiedergefundenen/beringten Individuen (N = 15), nach TROCIŃSKA et al. in press b.

tion of the SE flyway existing in the eastern part of Europe. Similar picture was presented by BUSSE et al. (op. cit.) for BLACKCAP (*Sylvia atricapilla*) and TROCIŃSKA et al. (in press a) for Reed and Sedge Warblers (*Acrocephalus scirpaceus* and *A. schoenobaenus*). These patterns encourage much to continuing the study in more extensive way using the study network SEEN covering a wide area from Scandinavia to Israel and Egypt (TROCIŃSKA 1998).

Comparison of ringing recoveries distribution and results of the field experiments could be very important for evaluation of the method. The results can be clear when through the locality where experiments are performed birds are migrating which are breeding within an area of good detectability of ringed birds and/or number of birds ringed during breeding time is enough high. TROCIŃSKA et al. (in press b) shows such example: recoveries of Lesser Whitethroat (*Sylvia curruca*) shown in a paper by YOSEF (1997) and results of experiments conducted in spring 1999 (218 individuals tested) give the same migratory pattern (Fig. 4). Distribution of vectors obtained by experiments suggests, however, an additional group of birds migrating much to the East, in relation to known recoveries, to the areas where detectability of rings is low.

4. Conclusion

Because of low and decreasing recovery rate of small passerines and very high differentiation of reporting rate in different parts of Europe and Africa, augmentation of these data in evaluation of migration patterns of populations, especially those living in central/eastern Europe, is necessary. The discussed method of field experiments can be useful for augmentation of ringing if applied in many localities dispersed along the migratory routes.

Zusammenfassung

Vermehrung der aus Ringwiederfunden gewonnenen Erkenntnisse durch Feldexperimente: ein neuer Blick auf die Migration von Nachtziehern.

Die Kartierung von Ring-Wiederfunden gibt sehr eindrucksvolle Migrationsmuster, die jedoch oft irreführend sind. Die meisten hiermit befaßten Personen nehmen an, daß fast alle migrierenden europäischen Passeriformes in SW-Richtung nach oder durch Südwest-Europa wandern. Aber dieser Eindruck ist für viele Arten falsch, weil die Zahl der Wiederfunde oft mehr vom Jagddruck und dem Ausmaß der Bevölkerungsaufklärung abhängt als

von der Anzahl ein Gebiet durchziehender oder überwinternder Vögel. Die Rückmelderate von Ringen ist in den östlichen und südöstlichen Teilen Europas nahezu Null und die Vogelberingung ist außerdem in diesen Regionen im Vergleich zum westlichen Europa gering. Andere Methoden (Feld-Orientierungsversuche) deuten darauf hin, daß die meisten Vögel dieser Gebiete in südöstlicher Richtung abwandern. Mit einer neuen Feldmethode wurden in Polen, Estland, der Ukraine, Rußland (bis nach Kazan im Osten) und Israel erste Orientierungsversuche zu den bevorzugten Zugrichtungen von Nachtziehern durchgeführt. Die Methode ist sehr einfach und preiswert in der Anwendung – für eine Person ist es an einem Standort möglich, vierzig oder mehr Versuche pro Tag durchzuführen. Rotkehlchen, die im Bereich der polnischen Ostseeküste getestet wurden, bevorzugten in 36–41% der Fälle Richtungen zu Winterquartieren, die sich östlich von Italien befinden, bei den im polnischen Binnenland getesteten traf dies für 84% und bei den nahe Moskau getesteten Vögeln für 87% zu. Um solche Informationen mit Hilfe der Beringung zu erhalten, bedarf es zehntausender markierter Individuen.

5. References

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