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Study of nocturnal departures in small passerine migrants: retrapping of ringed birds in high mist-nets

By Casimir V. Bolshakov, Victor N. Bulyuk and Alexandra Sinelschikova

Abstract: Bolshakov, C. V., V. N. Bulyuk & A. Sinelschikova (2000): Study of nocturnal departures in small passerine migrants: retrapping of ringed birds in high mist-nets. Vogelwarte 40: 250–257.

Nocturnal passerine migrants ringed at daytime stopovers can be retrapped at the moment of initiating nocturnal flight by the original method of high mist-nets. This technique was developed and applied at the field site 'Rybachy' where thousands of birds, primarily nocturnal passerine migrants, are annually trapped in a joint research project of the Biological Station and the Vogelwarte Radolfzell. Two lines of high mist-nets (overall length 220 m) are placed on wooden pathways over the tops of bushes and reed ca. 7 m above the ground. Nets are opened daily 2 h before sunset and checked every hour until sunrise. At spring migration in 1998–99 a total of 67 previously ringed individuals of 16 species were trapped by this method. At autumn migration in 1997–98 107 birds of 23 species were trapped. Largest data sets are available for Robins (*Erithacus rubecula*, 49 birds in autumn and 13 in spring) and for Reed Warblers (*Arcocephalus scirpaceus*, 10 and 21 individuals respectively). This method allows to determine (1) stopover length, (2) departure time, and (3) body condition (body mass, fat stores). In each species a very broad variation in departure time and in body condition were recorded. For marked local birds information on date, period of night, body mass, fat stores and moult status at departure for their first migratory flight are obtained.

Key words: nocturnal departure, stopover length, body condition, passerines, migration.

Address: Biological Station Rybachy, Zoological Institute, Russian Academy of Sciences Rybachy 238535, Kaliningrad Region, Russia. E-mail: Rybachy@bioryb.koenig.su

1. An introduction to the problem

In the bulk of passerines migration, apart from crossing ecological barriers, is an alternation of flights and stopovers. The study of stopover ecology and behaviour is an important component of recent research (Bairlein 1985, 1991, Biebach et al. 1986, Moore & Kerlinger 1987, Alerstam 1990, Moore et al. 1990, Moore & Yong 1991, Berthold et al. 1991, Lavee et al. 1991, Kaiser 1992, 1996, Berthold 1993, 1996, Moore & Simons 1992, Yong & Moore 1997, Chernetsov 1998, 1999, Yong et al. 1998). The main objective of stopovers is to replenish fuel stores (Dolnik 1975, 1995, Blem 1980, Alerstam & Lindström 1990) and, probably, to solve orientation tasks (Emlen 1975, Moore 1987, Able & Able 1997, Wiltschko et al. 1998). The study of adaptations to migratory flight itself is no less important. Only combined analysis of both components of avian migratory behaviour is a necessary requirement of understanding their migration strategies. The latter may not only differ in closely related species, but also show intra-specific variation (Berthold 1996).

The bulk of insectivorous passerines are nocturnal migrants. This holds true for species covering varying distances (Hansen 1954, Bolshakov 1977, Martin 1990). The study of migration strategies of passerine nocturnal migrants is probably "least difficult". The diel pattern of their activity includes flights in the darkness and stopovers of varying duration (Kerlinger & Moore 1989). Home ranges of birds at stopovers are usually confined to small areas (Szulc-Oleh 1965, Titov 1999 a, Aborn & Moore 1997). Birds may be repeatedly mist-netted at properly designed trapping stations. This allows to study stopover length, energy condition of birds, rate of mass gain, foraging ecology and other aspects of stopover ecology (Moore & Kerlinger 1987, Kaiser 1992, Yong & Moore 1997, Chernetsov 1998, 1999, Titov 1999 b, Titov & Chernetsov 1999). However, time of nocturnal departures and condition of birds during departures, which are essential to develop theoretical models of bird migration (Alerstam & Lindström 1990, Weber et al. 1994) usually remain not included in the majority of research projects. Some aspects of departure behaviour may be studied by means of radio tracking (COCHRAN et al. 1967, COCHRAN 1987, ÅKESSON et al. 1996, MOORE & ABORN 1996).

In this paper we present a new method of direct control of nocturnal departures from daytime stopovers. This method was developed at the Biological Station Rybachy of the Zoological Institute in 1997. The method allows (1) to determine the time of nocturnal departures, (2) to estimate body mass and fat stores of birds, (3) to study stopover length, and (4) to estimate stopover efficiency from energetic view point.

2. Method

A prerequisite for the use of this method is the presence of a large number of previously ringed birds at a study site. This is possible at trapping stations where regular trapping and ringing of passerine nocturnal migrants is done at daytime, and where many birds are retrapped. Birds that depart for nocturnal flights are practically never trapped in standard mist-nets. One reason for this is that birds take-off from tops of trees and bushes. Another reason is that in darkness birds take-off at large angles to the ground, often nearly vertically (HEBRARD 1971; BOLSHAKOV & BULYUK 1999). In practice, passerine migrants that depart from stopovers in the darkness, may be trapped only in nets put above the vegetation.

The method of trapping departing nocturnal migrants in high nets was developed and applied at the field site "Rybachy" where thousands of birds, primarily passerine nocturnal migrants, are annually trapped in a joint 10-year research project of the Biological Station and Vogelwarte Radolfzell. At the site where trapping is done in 511 m of standard mist-nets, an extra 220 m of high nets were erected (Fig.1). They are placed in two net lines on metal poles put on wooden pathways. In a working position, all nets are above the tops of bushes and reeds. The upper edge of nets is 7 m above the ground.

High nets are opened 2 hours before sunset and closed at sunrise. Nets are checked every hour by a torch with narrow, well-defined beam. During the first hour after sunset nets are checked twice, 45 and 65 min after sunset. At dawn nets are also checked twice, 70 and 30 min before sunrise. During twilight and darkness no cases of flushing birds into the nets were recorded, as researchers check the nets carefully. This allows to assume that net rounds do not induce nocturnal departures. Nocturnal trapping in high nets is done simultaneously with the standard trapping.

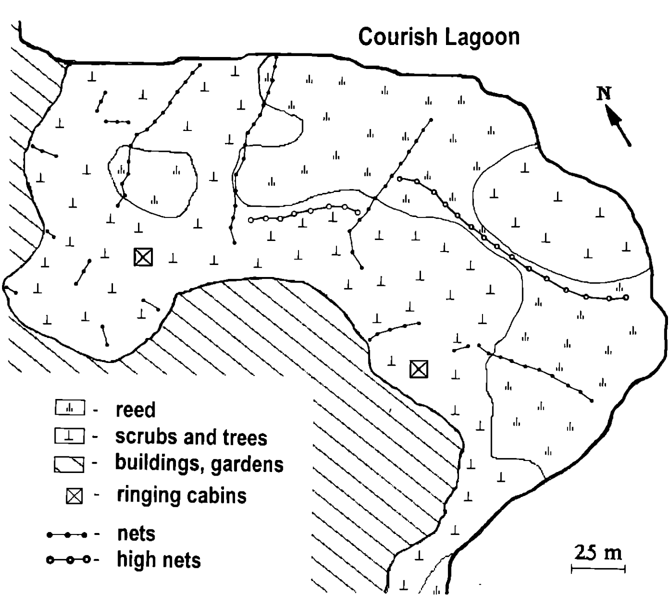

Fig. 1: Map of the study site. – Karte des Untersuchungsgebietes.

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3. Preliminary data and discussion

3.1. Specific composition of passerine nocturnal migrants

As shown in the Table, over 4 seasons we trapped 174 ringed individuals of 26 passerine species during nocturnal departures. Until now, large data sets are available for Reed Warbler and Robin.

Table: Species composition and numbers of ringed passerine migrants trapped at the moment of nocturnal departure. – Zusammenstellung über erfaßte Zugvogel-Arten und Anzahl beringter Individuen, die zum Zeitpunkt des nächtlichen Aufbruchs gefangen wurden.

Species	Spring migration (1998 – 1999)	Autumn migration (1997 – 1998)	Total
Long-distance migrants (19 species)			
Great Reed Warbler (*Acrocepalus arundinaceus*)	2		2
Marsh Warbler (*A. palustris*)	5	1	6
Reed Warbler (*A. scirpaceus*)	21	10	31
Sedge Warbler (*A. schoenobaenus*)	6	2	8
Scarlet Rosefinch (*Carpodacus erythrinus*)	1	3	4
Pied Flycatcher (*Ficedula hypoleuca*)	1	1	2
Red-breasted Flycatcher (*F. parva*)		1	1
Red-backed Shrike (*Lanius collurio*)		2	2
Savi's Warbler (*Locustella luscinioides*)		1	1
Grasshopper Warbler (*L. naevia*)	1		1
Spotted Flycatcher (*Muscicapa striata*)		1	1
Redstart (*Phoenicurus phoenicurus*)	2	3	5
Chiffchaff (*Phylloscopus collybita*)	1	1	2
Willow Warbler (*Ph. trochilus*)		2	2
Whinchat (*Saxicola rubetra*)		1	1
Blackcap (*Sylvia atricapilla*)	3	5	8
Garden Warbler (*S. borin*)	2	2	4
Whitethroat (*S. communis*)		2	2
Lesser Whitethroat (*S. curruca*)	2	2	4
Middle- and short-distance migrants (7 species)			
Treecreeper (*Certhia familiaris*)		1	1
Robin (*Erithacus rubecula*)	13	49	62
Wren (*Troglodytes troglodytes*)	4	4	8
Goldcrest (*Regulus regulus*)		8	8
Redwing (*Turdus iliacus*)	1		1
Blackbird (*T. merula*)	2	3	5
Song Thrush (*T. philomelos*)		2	2
Total : species	16	23	26
birds	67	107	174

3.2. Stopover length

In an ideal case, a bird may be trapped when landing after a nocturnal flight, and then departing for the next one. In spring minimum stopover length is similar in different long-distance migrants from 1 to 6 days. However, 85% of birds leave stopovers on the first night upon arrival. In Reed Warblers stopover length of 17 out of 20 marked birds was 1 day.

In spring middle-distance migrants make slightly longer stopovers, with 44% of Robins stopping over for 3 to 7 days, one-half of birds however depart from the stopover site on the first or second night after arrival.

We suggest that short stopovers in spring refer to the general migration strategy of various passerine nocturnal migrants, and not to peculiarities of Rossitten Cape on the Courish Spit.

3.3. Efficiency of stopovers

It may be estimated by comparing body mass during arrival, to be more correct, during first capture, and during nocturnal departure. In the Reed Warbler in spring, average mass change over very short stopover was positive, +0.40 g (3.2% of initial mass). Mass loss was recorded in only 3 birds out of 20.

In the Robin which migrates earlier in the season and makes longer stopovers, energy balance is also positive. During the stopover, average mass gain is + 0.38 g (2.5 % of initial mass), some birds gaining up to 2.2 g. However, in contrast to the Reed Warbler, about 44% of Robins lose 0.2–1.0 g during stopover.

3.4. Time of nocturnal departures

The method of high nets allows the determination of the time of nocturnal departures with an accuracy of 30–60 min.

As shown in Fig. 2, the time of nocturnal departure in spring in long-distance migrants is not fixed and varies between the end of the first hour after sunset, and the fifth hour. About 81% of birds depart during the first and the second hour, and 19% during third to the fifth hour after sunset. Reed Warbler spring departures occur between the first and fourth hours, 81% of birds departing during the first and second hour.

Robins migrate earlier in spring during longer nights. The time of departures from stopover site varies between first and seventh hour after sunset. As shown in Fig. 3, 77% of Robins started

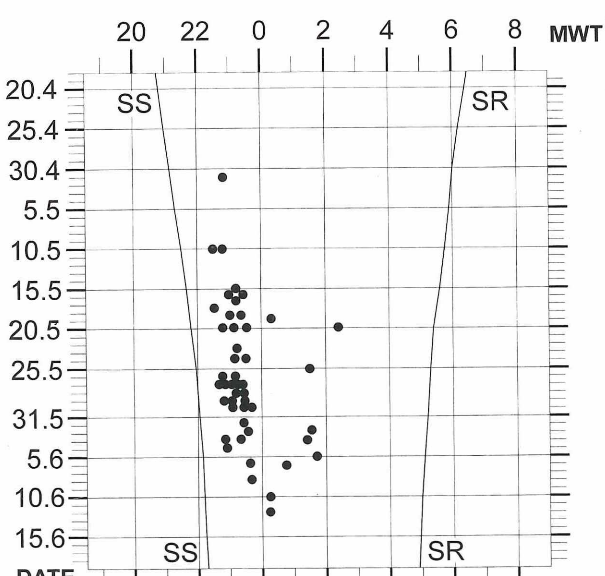

Fig. 2: Time of nocturnal departures in ringed long-distance migrants in spring (11 species). SS – sunset, SR – sunrise, MWT – Moscow winter time. – Zeitpunkt des nächtlichen Aufbruches beringter Langstreckenzieher im Frühjahr (11 Arten). SS = Sonnenuntergang, SR = Sonnenaufgang, MWT = Moskau Winterzeit.

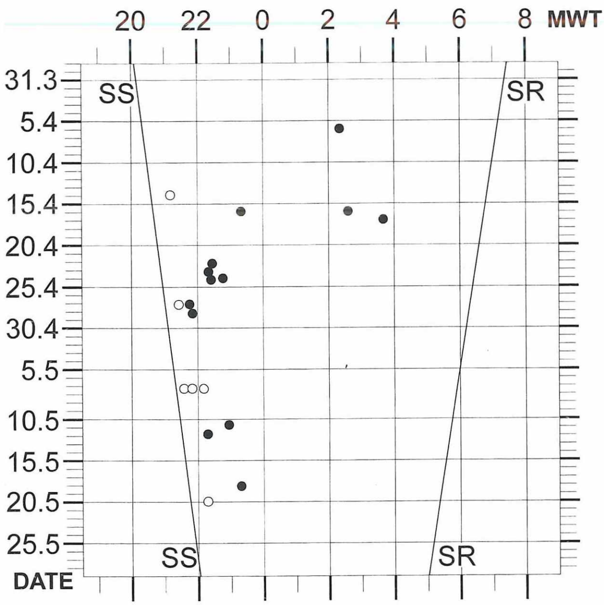

Fig. 3: Time of nocturnal departures in ringed Robins in spring. Filled circles – departures in darkness, open circles – take-offs before 45 min. after sunset. Other notations as in Fig.2. – Zeitpunkt des nächtlichen Aufbruchs beringter Rotkehlchen im Frühjahr. Ausgefüllte Kreise – Abzug bei Dunkelheit, nicht ausgefüllte Kreise – Aufbruch bis 45 min nach Sonnenuntergang. Abkürzungen wie in Abb. 2.

flight in spring in the first to the third hour after sunset. However the bulk of data refers to the second half of the migratory season of this species on the Courish Spit.

3.5. Body mass and fat stores

In Fig. 4 the temporal distribution of captures of Reed Warblers with and without rings is presented. Birds without rings may be divided into two groups. Those captured in the beginning of the night are obviously departing. Those trapped 2–3 hours before sunrise are without doubt ceasing flight.

The mass of 40 departing birds varied from 11.2 to 14.6 g, mean value being 12.85 ± 0.54 g. The mass of birds ceasing flight varied from 10.5 to 12.4 g, the mean being 11.46 ± 0.46 g ($n = 8$). Body mass of landing birds appears significantly to be 1.4 g less than that of taking-off ($p < 0.001$). This value may be an estimate of fat expenditure for a single migratory flight in Reed Warblers in spring in our part of the migratory route. Further, body mass of Reed Warblers ceasing flight exceeds the lean body mass for an average of 1 g, in some birds up to 2 g.

On the basis of captures of marked birds in high nets, we estimated energy stores of Reed Warblers at nocturnal departure. We assumed that in transit individuals difference between observed and lean body mass may be attributed to fat, and that energetic cost of flight is approx. 12 BMR (Dolnik 1995, Berthold 1996). BMR in the Reed Warblers was assumed to be 19.5 kJ·day^{-1} [the average of two measurements available (Gavrilov & Dolnik 1985, Lindström & Kvist 1995)]. Fat stores in birds departing from our stopover site vary between 0.7 and 4.1 g, being 7 to 39% of lean body mass. This is enough for flying during 2.8 – 16.4 hours.

3.6. Juvenile dispersal at night

In spite of a small number of captures of previously marked birds, the method of high nets has already allowed the establishment of some new and interesting facts. Nocturnal take-offs in juvenile Reed Warblers, belonging to the local population, were recorded in July and August 2–3 hours before sunrise. All birds were in heavy moult, two of them, ringed as pulli, had the age of 36 and 40 days, respectively. These take-offs are very likely to refer to juvenile dispersal that in this species may be occur at the end of the night (Herremans 1990, Chernetsov & Mukhin 2000). Timing of departure and energy condition of birds in the middle of moult suggest the movement distance to not exceed several dozens of km. Nocturnal departures of juvenile Reed Warblers that have completed moult, occurred in the first to the third hour after sunset.

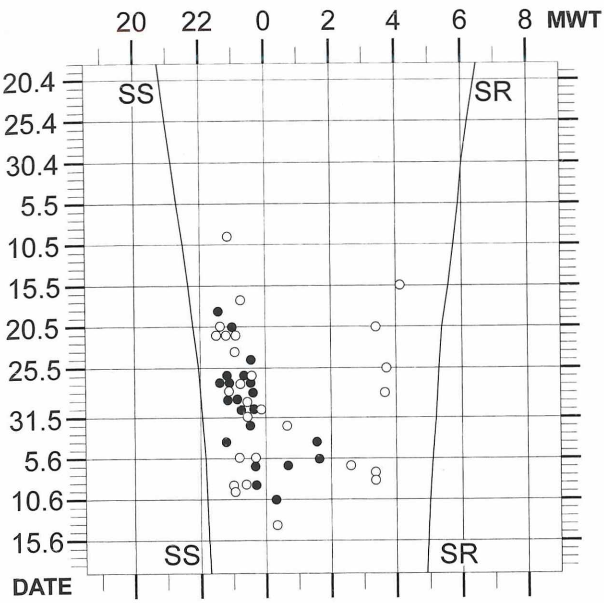

Fig. 4: Temporal distribution of captures of Reed Warblers with (filled circles) and without (open circles) rings in spring. Other notations as in Fig. 2. – Zeitliche Verteilung der Teichrohrsänger-Fänge im Frühjahr, ausgefüllte Kreise = Fang beringter Vögel, nicht ausgefüllte Kreise = Fang unberingter Vögel. Abkürzungen wie in Abb. 2.

3.7. Complicated forms of stopover behaviour

The method of high nets allowed to establish another interesting fact referring to migratory behaviour of birds. Marked Robins at stopover sites in autumn display a peculiar behaviour during sunset and sunrise. Around sunset some birds probably fly to the tops of highest trees. Otherwise, it is difficult to explain why marked birds are trapped in nets placed about 7 m above the ground and over the top of usual vegetation. As shown by direct visual observations, in autumn this activity does not refer to the onset of nocturnal flight. Until 30–40 min after sunset a proportion of birds obviously climb down to the lower scrub layer. According to direct visual observations, at the end of the spring migratory season during short nights, moving to tops of trees and even short-term take-offs often directly precede the onset of migratory flights (Bolshakov & Rezvyi 1972, 1982).

In the morning such short-range movements occur since the beginning of the civil twilight (Sun 6° under the horizon). They were recorded in different passerine species and even in moulting birds. During pre-migratory period and during stopovers many marked individuals were trapped during the morning twilight several times. We suggest that these local movements, confined to sunset and sunrise refer to some orientation behaviour of birds.

4. Conclusion

At properly designed trapping stations in long-term projects using, the method of high nets allows to trap birds to study departure time and physiological condition in departing nocturnal passerine migrants of different species. This method may also be used for the study of the temporal pattern of the landing behaviour and condition of nocturnal passerine migrants when interrupting flight in varying weather conditions.

Zusammenfassung

Untersuchungen über den Zeitpunkt des nächtlichen Aufbruchs ziehender Kleinvögel: Wiederfang beringter Vögel mit Hilfe von Hochnetzen.

Nächtlich ziehende Kleinvögel, die tagsüber am Rastplatz beringt wurden, konnten beim nächtlichen Zug-Aufbruch mit Hilfe von Hochnetzen wiedergefangen werden. Die Methode wurde auf den Fangstationen von „Rybachy“ entwickelt und angewandt, wo alljährlich Tausende von Individuen – vor allem nächtlich ziehende Kleinvögel – im Rahmen eines Gemeinschaftsprojektes der Biologischen Station und der Vogelwarte Radolfzell

gefangen werden. Die auf Holzstegen errichteten Hochnetze (2 Reihen von insgesamt 220 m Länge) befinden sich ca. 7 m über dem Boden (Netzoberkante) und überragen damit die Spitzen der Büsche und das Ried. Die Netze werden täglich 2 Std. vor Sonnenuntergang fängisch gestellt und bis zum Sonnenaufgang stündlich kontrolliert. In den Jahren 1998 und 1999 wurden während des Frühjahrs mit dieser Methode 67 zuvor beringte Individuen von 16 Arten gefangen. Während des Herbstzuges der Jahre 1997 und 1998 waren es 107 Vögel von 23 Arten. Die meisten Daten stammen von Rothkehlchen (*Erithacus rubecula*, Herbst 49 Individuen und Frühjahr 13) und Teichrohrsängern (*Acrocephalus scirpaceus*, 10 bzw. 21 Vögel). Mit Hilfe dieser Methode kann 1) die Rastdauer, 2) der Abzugszeitpunkt und 3) die Kondition der Vögel (Körpermasse, Fettvorrat) erfaßt werden. Bei allen Arten wurde eine starke Variabilität bezüglich Abzugszeit und Körper-Kondition festgestellt. Für individuell markierte Vögel der lokalen Population konnten – auf den Startzeitpunkt ihrer Migration bezogen – Informationen über Datum, Uhrzeit, Körpermasse, Fettvorrat und Mauserstadium gewonnen werden.

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