ACTA ORNITHOLOGICA
Vol. 37 (2002) No. 2

Differences between the spring and autumn migration of the Red-backed Shrike *Lanius collurio*: record from the Eilat stopover (Israel)

Piotr TRYJANOWSKI[1] & Reuven YOSEF[2]

[1]Department of Avian Biology and Ecology, Adam Mickiewicz University, Fredry 10, 61–701 Poznań, POLAND, e-mail: ptasiek@main.amu.edu.pl
[2]International Birding and Research Centre in Eilat, P. O. Box 774, Eilat 88000, ISRAEL, e-mail: ryosef@eilatcity.co.il

Tryjanowski P., Yosef R. 2002. Differences between the spring and autumn migration of the Red-backed Shrike *Lanius collurio*: record from the Eilat stopover (Israel). Acta Ornithol. 37: 85–90.

Abstract. Migratory Red-backed Shrikes were mist-netted during the spring and autumn migrations (n = 1031 individuals) from 1984 to 2001 in Eilat (Israel). In a similar pattern of trapping, more than four times as many shrikes were caught during autumn than in spring. Males migrated significantly earlier than females in spring but not during the autumn migration, which suggests that in males there is a stronger drive to reach their breeding territories early. In both seasons and between both sexes we did not find any significant relations between the body measurements of individuals and the time of passage. The spring migration was much shorter time than the autumn migration. This was expressed by the minimum stopover duration, as well as by the time when Red-backed Shrike occurred in Eilat. There are significant differences between wing chord length, body mass and fat scores between seasons. In autumn males had longer wings, and both sexes were heavier and in better condition than in spring. The data suggest that the differences are an adaptation to their having to cross the Sahara Desert. The birds spend a statistically significantly shorter period of time at the Eilat stopover site in spring than in autumn (median 1 ± 1.5 days vs 5 ± 6.5 days). In autumn, recaptured birds were 6.3% heavier than during the first capture. The change in body mass was significantly correlated to the duration of the stopover period. The results suggest that migration over desert is energetically costly and that Eilat is a very important stopover site for migrating Red-backed Shrikes.

Key words: Red-backed Shrike, *Lanius collurio*, body condition, migration strategy

Received — Oct. 2002, accepted — Nov. 2002

INTRODUCTION

All Eurasian breeding bird populations that winter in sub-Saharan Africa have to cross the Saharan-Saudi Arabian Desert belt. Most passerines cross the desert on a broad front, however with higher densities in the eastern and western parts of the Sahara desert belt (Biebach 1995, Bruderer & Liechti 1995). A great proportion of these birds stop in Israel because it is the last favourable stopover area for migratory birds during autumn, before crossing the Sahara on their way to East Africa (Frumkin et al. 1995, Shirihai 1996). Eilat is the southernmost point in Israel and plays an important role as a stopover place for passerine species and is an important refuelling site for migrants (Safriel 1968, Frumkin et al. 1995, Morgan & Shirihai 1997).

Red-backed Shrike is the most numerous of the shrike species to migrate through the Middle East, as well as to breed in the Western Palearctic. To date, many papers have focused on the density and breeding ecology during the reproductive season (review in van Nieuwenhuyse et al. 1999, Harris & Franklin 2000), as well as in the wintering areas (e.g. Bruderer & Bruderer 1994, Herremans 1997). However, data on migration strategy, stopover sites and behaviour during migration are relatively scarce (review in Harris & Franklin 2000, but see Biebach et al. 1983, Nikolaus 1990). Some theoretical predictions (Sutherland 1996, Webster et al. 2002) and speculations about the Red-backed Shrike (Nikolaus 1990, van Nieuwenhuyse et al. 1999) suggested that migration time could be a critical period for determining the population size, and consequently a period to focus on when developing conservation programs for this declining and endangered species. Therefore, the aim of this study is to provide the basic data on the migration strategy of the Red-backed Shrike. We analyzed data of birds trapped at the ringing station of the International Birding and Research Centre in Eilat (IBRCE), Israel, just before and after their transition of the Sahara desert belt. We hypothesised that during the spring migration, when in transition from their wintering grounds in sub-Saharan Africa, Red-backed Shrike must stage at Eilat prior to accomplishing the second half of their migrations to their breeding grounds to the north.

STUDY AREA AND METHODS

Eilat (29°33′N 34°57′E), at the northern tip of the Gulf of Aquaba/Eilat, is an important site because it is located on the northern edge of the Saharan-Arabian desert belt and is critical for many migratory species because birds reach it after a flight of almost 2000 km of continuous desert regions of the Sahel (Safriel 1968). To the northeast there are still 650 km more of the Syrian Desert and to east the vast Arabian Desert. Hence many birds are attracted to land in the green areas that surround Eilat and to rest before (in autumn) or after (in spring) crossing the deserts (Morgan & Shirihai 1997).

Owing to changes in locations of the ringing station within a 5-km radius in the region, a great variation in trapping results between years and between seasons was evident. However, we analysed the data cumulatively for all years, but separately for seasons — spring and autumn — from spring 1984 to autumn 2001 assuming that the changes in location of the ringing station did not affect the results attained pertaining to the migration patterns and the biometrics of the study species.

Birds were mist-netted and each bird was aged and sexed by plumage and ringed. Flattened maximum wing chord and tail were measured using a wing-ruler (± 1mm), and body mass was determined with a Pesola 50 g (± 0.5 g) spring balance. Visible fat was quantified according to the ordinal scale (Fry et al. 1970), and fat scores ranged from 0 (no fat) to 3 (bulging fat). Additionally, a measure of bird condition was used wherein wing-length was taken as an index of body size (Pearson 1971) and factored the effect of size on mass by calculating the mass/wing-length ratio (e.g. Safriel & Lavee 1988). However, biometric data were not available for all individuals, which resulted in a large variation in sample sizes between years. In autumn, we classified the birds into three age and sex classes — adult male, adult female, and juvenile. In spring, due to moult during winter (Jenni & Winkler 1994) birds were classified only into two categories, males and females. Individuals not ascribed to one of the above mentioned classes were not included in the biometric analyses. In order to avoid pseudoreplication only data from the first captures were used to calculate the biometrical characteristics.

Allowing that our migration study point was not designed especially for the estimation of the duration of the stopover period, we computed only the average stopover duration period derived from the ad hoc method (Kaiser 1999). Hence, there was obtained only the minimum stopover period that is usually shorter than the real period established by the new method developed by Kaiser (1999). All retraps were weighed with the same accuracy, and data from the first and the last catching were used in the analyses. Because of insufficient data from spring, we used only the data from autumn for in-depth analyses.

The phenology of the spring and autumn migration was computed using Julian dates. Because migration time, as well as ringing location, differed between seasons, for comparing arrival dates between sexes and age classes we assigned the median date of arrival, defined as the day when 50% of individuals were captured. Standardised day of arrival was established in relation to median date expressed as 0.

Throughout the text, values are reported as means ± SD. Calculations were conducted using the SPSS for Windows package (Norusis 1986). However, since we conducted statistical tests for each age and sex group separately, but addressed a common null hypothesis for the data from all groups (multiple comparisons), we adjusted all p-values with the use of the sequential Bonferroni test to control for group-wide type I error ($\alpha = 5\%$).

RESULTS

During the 18 years of the study period (1984-2001) a total of 1031 Red-backed Shrikes were caught and ringed, yearly 0–204 individuals. Of these 187 (18%) were males and 126 (12%) females. The remaining individuals were birds whose sex was undetermined (n = 36; 3%) or juveniles (n = 682; 66%).

Spring transients were trapped in Eilat between late March and late May. On average, males arrived ten days earlier than females (U-test, U = 2864, df = 174, p = 0.02). In autumn juveniles arrived significantly later than adults of both sexes (Kruskal-Wallis ANOVA, $\chi^2 = 56.7$, df = 2, p < 0.0001, Table 1), but within adults, the differences between sexes was not significant (U = 2213.5, ns).

Table 1. Median capture date (with 95% confidence interval in days, n in parentheses).

	Spring	Autumn
Male adult	1 May ± 14 (110)	14 Sept ± 16 (77)
Female adult	11 May ± 14 (66)	21 Sept ± 15 (60)
Juveniles		29 Sept ± 16 (685)

Differences in wing length and body mass in relation to sex and age

In spring we found no differences in wing chord length (t = -0.65, df = 166, ns, Table 2) and body mass (t = -0.42, df = 164, ns, Table 2) between the sexes. In autumn, significant differences in wing length were found between the three sex- and age-classes (ANOVA, $F_{2,716} = 4.98$, p = 0.007, Table 2) with adult males having longer wings than juveniles (post-hoc Student-Newman-Keuls test, p < 0.05). However, no significant differences in body mass were found between the three age- and sex- classes (ANOVA, $F_{2,771} = 1.56$, ns, Table 2).

Table 2. Wing length (mm) and body mass (g), means ± SD (n).

	Wing length	Body mass
Spring		
Males	92.7 ± 2.8 (106)	23.9 ± 2.9 (105)
Females	92.4 ± 2.1 (62)	22.9 ± 2.4 (61)
Autumn		
Males	94.0 ± 2.7 (75)	28.4 ± 3.8 (75)
Females	93.2 ± 2.4 (60)	27.6 ± 4.3 (60)
Juveniles	93.0 ± 2.6 (584)	27.5 ± 4.0 (639)

Body measurements in relation to date of passage

In spring, wing length, body mass, as well as condition did not change significantly with date of capture for both sexes (correlation analyses, p > 0.15 in all cases). Similarly, in autumn we did not find a correlation between wing length, body mass and body condition for juveniles and females (p > 0.2 in all cases). Among males correlation between arrival date and wing length was also insignificant (p = 0.9), however relationships between date of capture and body mass (r = -0.20, n = 75, p = 0.09) and condition (r = -0.21, n = 74, p = 0.08) approached the significance. This suggests that heavier birds in better condition have a tendency to migrate earlier.

Differences in wing length between seasons

In autumn, males consistently had longer wings than in spring and the difference was 1.3 mm (t = -3.1, df = 179, p = 0.003, Table 2). This tendency was also observed for females, however, the difference was smaller, 0.8 mm, and is statistically insignificant (t = -1.9, df = 120, p = 0.1, Table 2; in both comparisons p-values adjusted by the sequential Bonferroni technique).

Differences in body mass and fat scores between seasons

In spring, birds were lighter than in autumn, and differences in categories varied from 4.7 to 5.3 g (t = -10.72, df=178 and t = -7.38, df = 119; p <

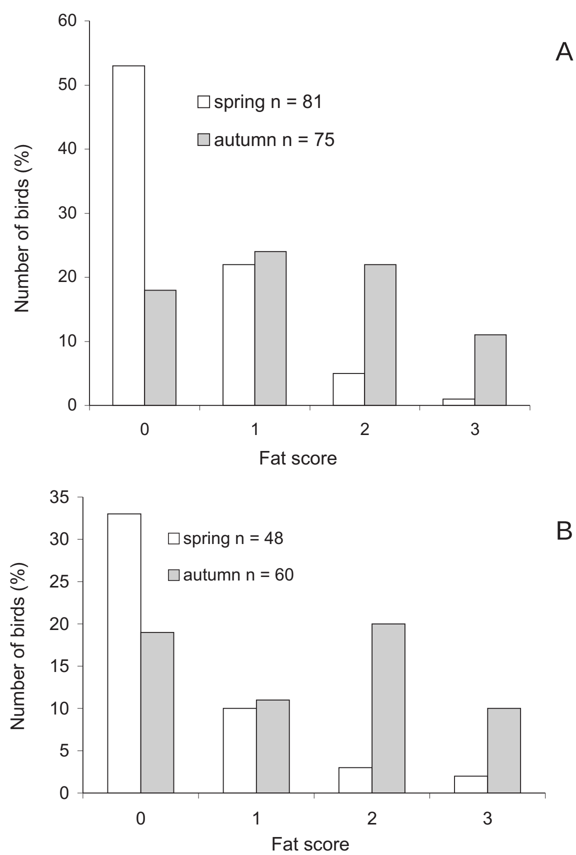

Fig. 1. Fat scores of male (A) and female (B) Red-backed Shrike during spring and autumn migration.

0.001, for both males and females, respectively; p-values adjusted by sequential Bonferroni technique, Table 2). Birds of both sexes had greater fat reserves in autumn than in spring (U = 1461, df = 156, and U = 789, df = 108, for males and females respectively, p < 0.0001 in both cases Fig. 1).

Retraps

Twelve (6.0% of caught birds) and 87 (10.5%) Red-backed Shrikes were retrapped within the spring and autumn seasons at Eilat. However, the difference in the number of retraps between seasons only approached significance ($\chi^2 = 3.07$, df = 1, p = 0.08). Birds stayed for one to 33 days (median values 1 ± 1.5 and 5 ± 6.5 days in spring and autumn, respectively) and the minimum stopover period differed significantly between seasons (U = 295.5, df = 97, p = 0.014). On recapture, birds were heavier than at first capture (27.1 g ± 3.3 vs 25.5 g ± 3.0, respectively, paired samples t-test, t = -5.43, n = 87, p < 0.0001) and differed significantly in body condition (0.275 ± 0.034 vs 0.293 ± 0.038, Wilcoxon matched-pairs test, Z = -5.19, n = 87, p < 0.0001). Consequently, we found correlation between retrap condition and condition at the first capture (Fig. 2). Change in body mass was affected by the duration of time stayed at the stopover site (r = 0.456, n = 87, p < 0.001, Fig. 3). The median gain in body mass per day was 0.3 ± 0.7 g (range: -2.5 to 2.0). A strong correlation we found between changes in body mass of individuals between first capture and subsequent recaptures and initial body mass (r = -0.352, n = 87, p < 0.001) was most probably an statistical artefact (cf. Ruf 2000).

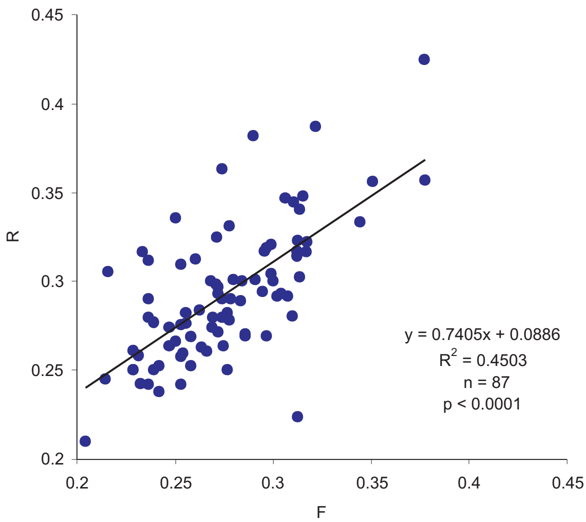

Fig. 2.The relationship in index of body condition between the first capture (F) and recapture (R) in autumn.

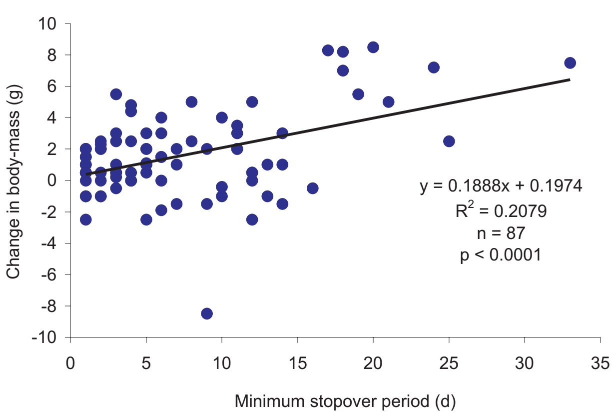

Fig. 3. Changes in body-mass of individual Red-backed Shrikes during their autumn stopover relative to duration time.

DISCUSSION

General migratory pattern

The Red-backed Shrike is a common passage migrant in spring at Eilat, with smaller numbers recorded in spring than in autumn (Morgan & Shirihai 1997, Yosef 1998, this study). However, evidence for the reverse exists for a wide range of species that migrate through Israel in general and Eilat in particular (Frumkin et al. 1995, Shirihai 1996, Morgan & Shirihai 1997). In spring, the Red-backed Shrikes return from Africa to their breeding grounds on a broad front and in autumn the populations (including West European) migrate via the eastern Mediterranean flyways (Biebach et al. 1983).

Another explanation of the differences in number of birds between seasons is migration speed. Drost (1934) showed, that in spring, a Red-backed Shrike ringed at Helgoland (Germany) was retrapped 700 kilometres to the north after 20 hours. Also, our analysis of data from retrapped birds showed that in spring Red-backed Shrike stayed at Eilat on average four days shorter than in autumn. On the other hand, the stopover period may be related to the variation in food supplies, and consequently in opportunities to obtain sufficient food need just after (in spring) or before (in autumn) crossing the Saharan-Arabian deserts. Moreover, the two spring and autumn seasons could differ in capture probability of birds, which strongly influenced the average stopover duration (Schaub et al. 2001).

In spring the Red-backed Shrike males arrived on average 10 days before females. This concurs with data for island males in Italy (Spina et al. 1994) as well as for sex differences of arrival time to the breeding grounds in Poland (Tryjanowski & Sparks 2001).

In autumn the adults of both sexes arrived at Eilat significantly earlier than juveniles. Morgan & Shirihai (1997) also found that in autumn adults pass earlier than juvenile Red-backed Shrike. We speculate that there are two possible factors that may account for this pattern. First, younger males may remain on their natal territories for a longer period of time in order to learn its properties for future use. Second, and not mutually exclusive, explanation is that later passages of juvenile birds represent a strategy to avoid competition with adults. However, a more detailed comparison of our results with data outside of Israel is impossible owing to the scarcity of information (cf. Harris & Franklin 2000). Moreover, on the breeding grounds juvenile have to perform at least a partial post-juvenile moult before they start the autumn migration.

Differences in measurements and condition

Older birds did not have significantly longer wings than juveniles which is a well-established phenomenon in many bird species (Alatalo et al. 1984), including the Red-backed Shrike (Jakober & Stauber 1989). Lack of age-related differences in wing length in our study may be connected to the fact that the Eilat is a bottleneck region, where birds from different geographical populations and/or subspecies are known to concentrate. Hence, differences between birds of the different age-classes may be masked by the inter-population variability. Interestingly, males had significant longer wing length in autumn than in spring. This is surprising because wing moult occurs on the wintering grounds in Africa (Jenni & Winkler 1994, Harris & Franklin 2000) and we expected the birds to have longer wings in spring, with fresh, unworn primaries. However, after moulting on the wintering grounds, first-year and adults cannot be separated in spring and the data were lumped into one category. This should not account for this result however, as the adults in younger age-classes are included among autumn adults as well. Hence, we speculate that it is possible that population(s) that migrate through Eilat in spring is different from the population(s) in autumn (e.g. birds from subspecies *L. c. collurio* and *L. c. pallidirostris*). Unfortunately, no Red-backed Shrike ringed in Israel in general, and at Eilat in particular, has been recovered on the breeding grounds.

The significant differences in body mass and fat scores between the spring and autumn seasons can be explained by the differences in hardships of the migration flyway. The pattern found at Eilat, that birds are heavier and have larger amounts of fat in autumn than in spring is probably the result of the necessity to accumulate sufficient nutrient reserves that are used for crossing the inhospitable expanses of the Sahara and Sinai deserts. These results corroborate the findings of other studies that have described a similar situation for other passerines (Baierlein 1995, Biebach 1995), including differences in the body mass in Red-backed Shrike (Moreau 1969).

At Eilat, the Red-backed Shrikes, in line with the situation found in other passerine birds at stopover sites, improved their body condition and gained mass. Changes in body mass were linked to the minimum stopover period. The pattern of improvement in body condition during autumn stopover time was very similar to that described for other passerines (e.g. Bairlein 1995). Shrikes gained on average 6% of its body mass during this short stay at Eilat and accumulated a relatively large amount of fat prior to their attempting the desert crossing.

ACKNOWLEDGEMENTS

We are grateful to all ringers (Hadoram Shirihai, John Morgan and Reuben Solomon) for their years of work at the IBRCE ringing station, and to Przemysław Chylarecki, Lukas Jenni, and Nikita Chernetsov. This study was accomplished with help from the National Aviary in Pittsburgh, WWF-International, Earthwatch Institute and Swarovski Optics.

REFERENCES

Alatalo R. V., Gustafsson L., Lundberg A. 1984. Why do young passerine birds have shorter wings than older birds? Ibis 126: 410–415.

Baierlein F. 1995. Recent prospects on trans-Saharan migration of songbirds. Ibis 134, Suppl.: 41–46.

Biebach H. 1995. Stopover of migrating flying across the Mediterranean Sea and the Sahara. Isr. J. Zool. 41: 387–392.

Biebach H., Dallmann M., Schuy W., Siebenrock K.-H. 1983. Die Herbstzugrichtung von Neuntötern (*Lanius collurio*) auf Karpathos (Griechenland). J. Ornithol. 124: 251–257.

Bruderer B., Bruderer H. 1994. Numbers of Redbacked Shrikes *Lanius collurio* in different habitats of South Africa. Bull. Brit. Ornithol. Club 114: 192–202.

Bruderer B., Liechti F. 1995. Variation in density and height distribution of nocturnal migration in the south of Israel. Isr. J. Zoool. 41: 477–487.

Drost R. 1934. Welchen Weg nehmen die auf Helgoland durchziehenden Neuntöter *Lanius collurio collurio*. Die Vogelzug 5: 190–191.

Fry C. H., Ash J. S., Ferguson-Lees I. J. 1970. Spring weights of some Palearctic migrants at Lake Chad. Ibis 112: 58–82.

Frumkin R., Pinshow B., Kleinhaus S. 1995. A review of bird migration over Israel. J. Ornithol. 136: 127–147.

Harris T., Franklin K. 2000. Shrikes and Bush-shrikes. Christopher Helm, London.

Herremans M. 1997. Habitat segregation of male and female Red-backed Shrikes *Lanius collurio* and Lesser Grey Shrikes *Lanius minor* in the Kalahari basin, Botswana. J. Avian Biol. 28: 240–248.

Jakober H., Stauber W. 1989. Beeinflussen und Alter dei Ortstreue des Neuntöters (*Lanius collurio*)? Vogelwarte 35: 32–36.

Jenni L., Winkler R. 1994. Moult and Ageing of European Passerines. Academic Press, London.

Kaiser A. 1999. Stopover strategies in birds: a review of methods for estimating stopover length. Bird Study 46, Suppl.: 299–308.

Moreau R. E. 1969. Comparative weights of some trans-Saharian migrants at intermediate points. Ibis 111: 621–624.

Morgan J. H., Shirihai H. 1997. Passerines and passerine migration in Eilat. Int. Birdw. Cent. Eilat Tech. Publ. Vol 6.

Nikolaus G. 1990. Shrikes, *Laniidae*, feeding on Marsh Warblers *Acrocephalus palustris* during migration. Scopus 14: 26–28.

Norusis M. 1986. SPSS PC+. Advanced statistics. SPSS Inc.

Pearson D. J. 1971. Weights of some Palearctic migrants in Uganda. Ibis 113: 173–184.

Ruf T. 2000. Mass-dependent mass loss: how to get the null hypothesis wrong. Oikos 90: 413–416.

Safriel U. 1968. Bird migration at Elat, Israel. Ibis 110: 283–320.

Safriel U. N., Lavee D. 1988. Weight changes of cross-desert migrants at an oasis. Do energetic considerations alone determine the length of stopover? Oecologia 76: 611–619.

Schaub M., Pradel R., Jenni L., Lebreton J.-D. 2001. Migrating birds stop over longer than usually thought: an improved capture-recapture analysis. Ecology 82: 852–859.

Shirihai H. 1996. The birds of Israel. Academic Press, London.

Spina F., Massi A., Montemaggiori A. 1994. Back from Africa: Who's running ahead? Aspects of differential migration of sex and age classes in Palearctic-African spring migrants. Ostrich 65: 137–150.

Sutherland W. J. 1996. Predicting the consequences of habitat loss for migratory populations. Proc. R. Soc. London B Biol. Sci. 263: 1325–1327.

Tryjanowski P., Sparks T. 2001. Is the detection of the first arrival date of migrating birds influenced by population size? A case study of the red-backed shrike *Lanius collurio*. Int. J. Biometeorol.: 217–219.

van Nieuwenhuyse D., Nollet F., Evans A. 1999. The ecology and conservation of the Red-backed Shrike *Lanius collurio* breeding in Europe. Aves 36: 179–192.

Webster M. S., Marra P. P., Haig S. M., Bensch S., Holmes R. T. 2002. Links between worlds: unravelling migratory connectivity. Trends Ecol. Evol. 17: 76–83.

Yosef R. 1998. Migration of Red-backed (*Lanius collurio*) Masked (*L. nubicus*) and Woodchat shrikes (*L. senator*) at Eilat Israel. IBCE Tech. Publ. 7: 5–8.

STRESZCZENIE

[Migracje gąsiorka na obrzeżach pustyń: badania w Eilat, Izrael]

Badania wędrówek gąsiorka prowadzono w latach 1984–2001 w punkcie obrączkowania ptaków w Eilat, leżącym w Izraelu, nad Morzem Czerwonym. Jest to duża oaza oferująca wędrującym ptakom możliwość zatrzymania się i uzupełnienia materiałów energetycznych tuż po (wiosna) i tuż przed (jesień) przekroczeniem pasa pustyń w drodze na zimowiska w Afryce. Wędrujące gąsiorki łapano w sieci, obrączkowano, ustalano poziom zapasów tłuszczowych, ważono i mierzono (n = 1031 osobników). Ponieważ część ptaków łapała się kilkakrotnie, celem uniknięcia pseudoreplikacji do analizy włączano tylko informacje z pierwszych złowień. Ponadto wykonano dodatkowe analizy dla retrapów, których celem była ocena jakości lokalnego miejsca zatrzymywania dla wędrujących gąsiorków. Rocznie łapano 0–204 osobniki, a aż dwie-trzecie wszystkich ptaków stanowiły osobniki młode. Wiosną samce przylatywały wcześniej od samic (Tab. 1), a jesienią ptaki dorosłe wcześniej od młodych (Tab. 1). Stwierdzono istotne różnice wiekowe i płciowe w długości skrzydła, natomiast przypadku masy ciała różnice te nie były istotne (Tab. 2). Wiosną nie stwierdzono spodziewanych istotnych negatywnych korelacji pomiędzy terminem wędrówki, a długością skrzydła i masą ciała dla żadnej z wyróżnionych grup wiekowo-płciowych. Jesienią te korelacje też nie były istotne, choć zauważono marginalnie istotne trendy sugerujące, że ptaki w lepszej kondycji mają tendencję do wcześniejszej wędrówki na zimowiska.

Szersza analiza i dyskusja różnic (a właściwie ich braku) pomiędzy grupami wiekowo-płciowymi jest bardzo utrudniona, gdyż przez badany punkt przelatują gąsiorki z wielu populacji i co najmniej dwóch podgatunków *L. c. collurio* and *L. c. pallidirostris*, co skutecznie może maskować różnice, mające wynikać z płci czy wieku (np. to, że starsze samce z dłuższym skrzydłem, jak to się dzieje u wielu innych wróblowych, wiosną powinny migrować wcześniej).

Znacznie lepiej zarysowane są różnice sezonowe w masie ciała i zapasach tłuszczowych. Wiosną ptaki są wyraźnie lżejsze i w mają słabiej odłożony tłuszcz niż jesienią (Fig. 1, Tab. 2). Jest to konsekwencją wyczerpującej wędrówki wiosennej przez pas pustyń, a jesienią przygotowaniem się do jej podjęcia.

Gąsiorki wiosną zatrzymują się w Eilat na 1, a jesienią na 5 dni. Analizując dane jesienne (z wiosny są one zbyt ubogie) stwierdzono, że poprawienie masy ciała (przeciętnie 0.3 g dziennie) koreluje z długością czasu postoju. Znaczy to, że zapewnienie gąsiorkom odpowiednich warunków na miejscach postoju w czasie wędrówki może być ważne dla ochrony tego gatunku.