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Body mass and fat scores of Palaearctic migrants at the southern fringe of the Sahara desert in autumn

Migrants in the Western Palaearctic-African migration system have to pass two to three major ecological barriers to reach their winter quarters in tropical Africa. These are 1) the Alps for some of the migrants breeding in northern and central Europe 2) the Mediterranean Sea and 3) the Sahara desert. The strategies migrants use to pass the first two obstacles were summarised by BRUDERER & JENNI (1990) and BRUDERER & LIECHTI (1999). However, the strategies that migrants may use to cope with the largest barrier, the Sahara desert, remain controversial (BIEBACH 1995). Conflicting theories are whether migrants cross the Mediterranean Sea and the Sahara in a non-stop flight, stop regularly during daytime in the Sahara, or use individual strategies depending on internal state (fat reserves, dehydration) or external conditions (availability of shade) (MOREAU 1972, BAIRLEIN 1985, 1992, BIEBACH et al. 1986, 2000, WOOD 1989).

Essential for the understanding of migration strategies and for the development of optimal migration models are field data on the physical condition of migrants collected along their migration route. This has been achieved during the course of the European-African Songbird Migration Network between 1994 and 1996 (BAIRLEIN 1998, SCHAUB & JENNI 2000, 2001) but the available data are mainly from locations north of the Sahara or from the tropical savannas (SMITH 1966, FRY et al. 1970, DOWSETT & FRY 1971, LOSKE 1990, SALEWSKI et al. in press). Few data on body mass and fat scores of migrants are available from earlier studies from oases in the desert (BAIRLEIN 1985, 1992, BIEBACH et al. 1986). There seem to be no data available on the physical condition of migrants from the southern fringe of the Sahara just after the desert crossing. These data would be essential for the assessment of optimal migration strategies because only data collected just behind a barrier can reveal its importance with respect to the amount of energy needed to pass this barrier. Here we present data on mass and fat scores of Palaearctic migrants which we caught over three days in September 2001 in the oasis of Tichit, Mauritania, at the southern fringe of the Sahara desert.

Methods

During a pilot study of the Swiss Ornithological Institute in Mauritania we stayed in the oasis of Tichit (18°26'N, 09°03'W) from 13 September to 15 September 2001. The Sahara desert extents for about 1200 km to the north and only about 150 km to the south, a relatively short distance for migrating birds in good condition. The oasis is surrounded by Date Palm (*Phoenix dactylifera*) plantations. At its western fringe, a small forest (60 x 300 m) of the introduced Mesquite (*Prosopis juliflora*) was planted to protect the oasis from approaching sand dunes.

We mist-netted birds in this forest on three consecutive days, starting in the evening of 13 September continuing throughout the day on 14 and 15 September. During this period, temperatures reached up 50° C in the shade during the day and it was sunny and cloudless with the exception of a short sand storm between about 12.00 h and 13.00 h on 15 September. In total, the nets were operated for 2764 net metre hours (nmh; eleven 9 m nets, two nets closed between about 10.00 h and 16.00 h because of exposure to the sun, all nets closed during a sandstorm). During 1229 nmh on 15 September tape luring was used with a mixture of songs of Palearctic migrants. Mist-netted migrants were measured using standard methods. Body mass was taken to the nearest 0.5 g with a Pesola spring balance. Fat scores were estimated after KAISER (1993) except for European Turtle Dove (*Streptopelia turtur*) where this is impossible .

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Results

Over the three days, 86 individual migrants of 21 species were mist-netted (Table). The most frequent species were Reed Warbler (*Acrocephalus scirpaceus*) and European Turtle Dove. In both species, mass and in Reed Warbler fat score differed not with respect to time of capture (mediantest; Turtle Dove, mass: $\chi^2 = 6.664$, df = 6, p = 0.36; Reed Warbler, mass: $\chi^2 = 6.441$, df = 10, p = 0.78; fat: $\chi^2 = 10.279$, df = 10, p = 0.42). Therefore, we did not correct the values for time of capture. In other species, the number of birds was too low for statistical analysis.

Body mass of birds (Table) was low compared to other studies in Europe or Africa. In Turtle Doves, the mean ± sd was 109.6 g ± 11.4 g. Mean body mass of Reed Warblers was 9.3 g ± 1.2 g.

Table: Numbers, mass [g] and fat scores of Palaearctic migrants mist-netted in Tichit, Mauritania, 13 - 15 Sep 2001. Values are given as median. In parentheses: range when n > 2.

Tabelle: Anzahl, Masse [g] und Fettklassen in Ticht, Mauretanien, gefangener Zugvögel, 13 - 15 Sep 2001. Werte sind als Median angegeben. In Klammern: Streuung wenn n > 2.

Species	n	mass	fat score
Ardea cinerea	1	-	-
Coturnic coturnix	1	55.0	-
Burhinus oedicnemus	1	310.0	-
Streptopelia turtur	19	106 (85.0 – 126.0)	-
Caprimulgus europaeus	1	47.0 0	0
Upupa epops	1	55.0	1
Calandrella brachydactyla	1	17.0	2
Hirundo rustica	1	13.5	1
Luscinia megarhynchos	1	17.5	0
Phoenicurus phoenicurus	1	10.5, 13.5	1, 0
Locustella naevia	1	10,5	2
Acrocephalus scirpaceus	32	9.5 (7.0 – 12.5)	2 (0 - 5)
Hippolais pallida	3	9.5 (8.0 – 10.0)	0 (0 - 3)
Phylloscopus trochilus	2	6.5,6.5	0, 0
Sylvia hortensis	1	19.5	4
Sylvia borin	5	14.25 (13.0 – 16.5)	2 (1 – 4)
Sylvia communis	1	13.5	3
Sylvia cantillans	4	8.0 (6.5 – 9.6)	2.5 (0 – 5)
Ficedula hypoleuca	2	8.0, 9.0	0, 0
Muscicapa striata	3	12.0 (11.5 – 12.0)	1 (0 – 1)
Oriolus oriolus	4	67.0 (57 – 70.0)	3 (2 – 3)

Median and ranges are shown in the Table. The data of other species are difficult to judge because of the low number of individuals caught. However, compared with data from the breeding grounds, some species showed an unusually low body mass, e.g. Garden Warblers (*Sylvia borin*) (mean ± sd: 14.5 g ± 1.5, but see below).

Individual fat scores (Table) showed that in Reed Warblers a relatively high number of birds (19 %) was lean (score 0). The same was the case in Olivaceous Warbler (*Hippolais olivaceus*), Subalpine Warbler (*Sylvia cantillans*) and Spotted Flycatcher (*Muscicapa striata*) with 2, 1 and 1 individuals showing score 0, respectively. Additionally, score 0 was found exclusively in some species caught in low numbers (Table). In contrast, birds with fat scores of 4 and 5 were rare and were found in only two (6 %) Reed Warblers and one Subalpine Warbler. An exception was Garden Warbler with two out of five birds showing fat score 4. The single Orphean Warbler (*Sylvia hortensis*) also had fat score 4.

Discussion

Many individuals of migrant birds in the oasis of Tichit showed unusually low body mass and fat scores compared to the values from other stopover sites (for Turtle Dove: GLUTZ v. BLOTZHEIM & BAUER 1980, MOREL 1986; for Reed Warbler: BAIRLEIN 1988, GLUTZ v. BLOTZHEIM & BAUER 1991, BAIRLEIN & GIESSING 1997) or compared to body mass on the breeding grounds (GLUTZ v. BLOTZHEIM & BAUER 1980, 1991). Mean mass recorded for Reed Warblers after crossing the Sahara in autumn was also higher in Chad (DOWSETT & FRY 1971), Cape Timirist, Mauritania, and in Senegal (MOREL 1987) compared to the results of our study.

However, the situation in Tichit is not comparable to most other ringing stations, as those are mostly not situated directly behind an ecological barrier without any possibility of foraging prior to arrival at the site. This is also the case when ringing results in spring from sites in Morocco or southern Europe are taken into account. In most cases, spring mass in Morocco (Defilia, c. 32°07'N) was slightly higher than our data for most species with the exception of Reed Warbler (ASH 1969). On a Mediterranean island, mean spring mass of migrants was also higher than in our study (PILASTRO & SPINA 1997) indicating that, on arrival at Tichit, migrating passerines may have used up more of their protein reserves or are more dehydrated compared to after crossing of the Mediterranean Sea. Additionally, birds in our study had lower mass than in oases in the central Sahara (BAIRLEIN 1985).

The exceptional condition of many individuals was also indicated by their behaviour. Some individuals of Turtle Doves and Reed Warblers used humans in order to rest in their shade or as perches to catch flies, a behaviour not unknown in the desert (MOREAU 1972 HAAS & BECK 1979). The threat of starvation was confirmed by the fact that in a 1 hr survey 24 dead birds (19 Turtle Doves, 1 European Bee Eater (*Merops apiaster*) , 1 Barn Swallow, 1 Common Redstart, 1 Garden Warbler, 1 Pied Flycatcher) were found in the forest; most of them had died relatively recently. Although the cause of death could not be determined, we assume that most of these birds had died of exhaustion or starvation.

Summarising our observations, it appears that many exhausted migrants arrive in Tichit after a trans-Saharan flight that brings them to their physiological limits. Some die, but probably many more are able to accumulate fat reserves for the ongoing migration.

Zusammenfassung

Masse und Fettklassen paläarktischer Zugvögel am Südrand der Sahara im Herbst.

Masse und Fettklassen paläarktischer Transsaharazieher sind in den Brutgebieten sowie auf den Zugrouten nördlich der Sahara bekannt, und gleiches gilt z.T. für ihre Überwinterungsgebiete. Vom Südrand der Sahara liegen jedoch keine Daten vor. Doch wären entsprechende Befunde für die Diskussion optimaler Zugstrategien von Bedeutung, da nur nach einem Hindernis gesammelte Daten Aufschluss über die Bedeutung desselben im Hinblick auf den dafür benötigten Energieverbrauch geben können. Wir untersuchten Masse und Fettklassen

paläarktischer Zugvögel in einem künstlich angelegten Wald bei der Oase Tichit, Mauretanien, in drei aufeinanderfolgenden Tagen im September 2001. Die am häufigsten gefangenen Arten waren Turteltaube (*Streptopelia turtur*) und Teichrohrsänger (*Acrocephalus scirpaceus*). Beide Arten wiesen niedrigste Körpermassen und Fettklassen im Vergleich zu Literaturdaten auf. Die anderen untersuchten Arten bestätigten diesen Trend, doch wurden sie nur in geringer Anzahl gefangen. Im Untersuchungsgebiet wurden zudem viele tote Vögel gefunden und einige Individuen zeigten bei der Suche nach Nahrung oder Schatten wenig Scheu vor Menschen. Die Daten zur Kondition der Vögel zusammen mit ihrem Verhalten weisen darauf hin, dass das Überqueren der Wüste ein Hindernis für Zugvögel ist, welches sie an ihre physiologischen Grenzen bringt.

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