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Spring weights of some Palaearctic passerines in Ethiopia and Kenya: evidence for important migration staging areas in eastern Ethiopia

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Summary

Palaearctic migrants were trapped in late April and early May at a passage site near Jijiga in eastern Ethiopia. Willow Warblers *Phylloscopus trochilus* and Spotted Flycatchers *Muscicapa striata* were predominant, while Red-backed Shrikes *Lanius collurio*, Sedge Warblers *Acrocephalus schoenobaenus*, Reed Warblers *A. scirpaceus*, Garden Warblers *Sylvia borin* and Common Whitethroats *S. communis* also featured prominently. Weights were high in all species, and over 70% of the birds caught were extremely fat. Spring weights and fat scores at Jijiga were compared with those found in the same species in Kenya, and the difference was striking. In Kenya, most species had mean spring weights 10–20% above lean weight; at Jijiga, species' mean weights ranged from 30% to 55% above lean weight. Whereas the reserves of most migrants departing from Kenya would have supported flights only as far as Ethiopia, the fat loads of birds at Jijiga indicated a potential for crossing Arabia with little need to feed. This suggests important staging and fattening grounds between these two areas, perhaps in the *Acacia–Commiphora* bushlands drained by the upper Juba and Shebelle rivers and their tributaries.

Introduction

Each year hundreds of millions of migrant passerines must set off from the Horn of Africa in April and early May on a crossing of the Arabian Peninsula (Moreau 1972). These are bound ultimately for Palaearctic breeding grounds distributed from Western Europe to Siberia and central Asia. They include birds which have wintered in northeast or east Africa as well as others which have already travelled thousands of kilometres from wintering grounds in southern parts of the continent. Many species cross Arabia rapidly in late April and May, and although desert conditions may be ameliorated locally by limited spring rainfall, this must present energy demands comparable with those of birds facing a spring crossing of the Sahara (e.g. Fry *et al.* 1970, Wood 1982), and require extensive pre-migratory fattening. Some high spring weights have been noted in Ethiopia (Ash 1993, 1994, Yohannes *et al.* 2009) but there have been no reports of concentrations of fat migrants preparing for take-off from The Horn. Further south, in Kenya, wintering departures and passage take place mainly in April, within a period of just three to four weeks (Pearson 1990, 1992). A few species, such as Sedge Warbler *Acrocephalus schoenobaenus* (Pearson *et al.* 1979) and Great Reed Warbler *A. arundinaceus*, sometimes accumulate large fat loads at these equatorial latitudes, but the great majority of departing or passing migrants carry only sufficient reserves to take them to refuelling areas in north-east Africa. Where are these important fattening grounds?

Numbers of passerine migrants on the coasts of Sudan and Eritrea during April-May appear to be unremarkable (e.g. Smith 1960, GN unpubl.). In Ethiopia, Ash (1980) noted some impressive concentrations of Willow Warblers *Phylloscopus trochilus* in late March–early April in the central Rift Valley, and *Sylvia* warblers trapped in April in southern and central parts of the Rift have included some very heavy birds (Ash 1994, and *in litt.*). But major spring transit areas probably lie further east. One likely clue to this was the discovery by Ash (1980, 1993) of mid–April concentrations of migrants in southeast Ethiopia, in an area of thorn bush southeast of Negelle at about 5° N, 40–41° E. The few birds that he trapped here included some Great Reed Warblers and Willow Warblers with high weights, but the proportion of heavy birds present was not large, suggesting that most needed to stay longer or move on quickly to fattening areas elsewhere. In late April 1995, HB, GN and DP joined John Ash in a search for Palaearctic migrants further north in eastern Ethiopia. Surveys near Aseita, in the Lake Awash area, proved disappointing, but 100 km to the southeast, near Jijiga, JA discovered a substantial passage and trapped fat migrants of several species.

In 1998, HB, GN and EY returned to the Jijiga site on 21 April and mist-netted continuously there until 3 May. A heavy passage of Palaearctic passerines was confirmed, and most birds trapped were found to have very high weights. Here we report the composition of this catch and give details of weights and fat scores. These are compared with spring data for the same species collected mainly by DP from passage sites in central and southeast Kenya.

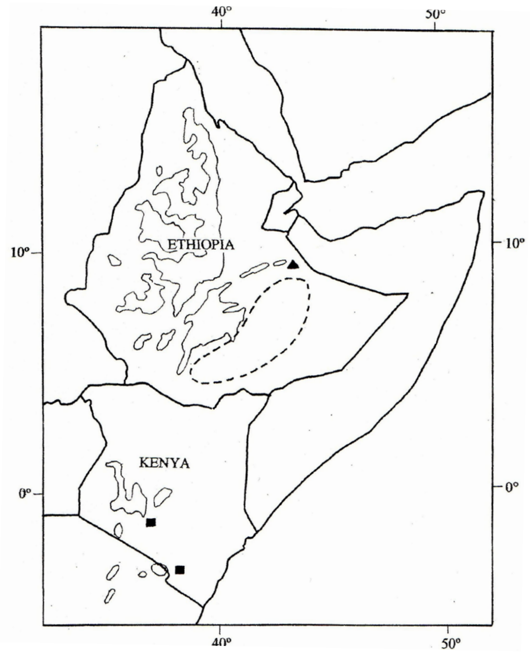

Figure 1. The Horn of Africa showing the location of the Jijiga ringing site (▲) and ringing areas in central and southeast Kenya (■). High ground over 2100 m is indicated. The likely Ethiopian fattening area is marked by a dashed line.

Methods and ringing sites

Jijiga (9°22′ N, 42°51′ E, 1600 m) is located in semi-arid country in eastern Ethiopia, to the north of the Ogaden region (Fig. 1). The study site was located about 15 km southeast of the town in an area of sparse bushy vegetation and acacia trees. Birds were mist-netted from early morning (05:00) until sunset. All were weighed to the nearest 0.1 g immediately after capture, using a digital pan balance, and were scored for visible fat following the procedure and 0–8 scale of Kaiser (1993).

The Kenya spring data given here were collected in April–early May from the Nairobi area and in April from Tsavo West National Park. Near Nairobi, birds were mist-netted in dry *Lantana–Acacia* scrub at Kariobangi (1°15´S, 36°50´E, 1600 m) on the eastern outskirts of the city, and also in scrub, bush and ditches 25 km to the southeast at Athi River (1500 m). In Tsavo, birds were caught in semi-arid bush at Ngulia Lodge (3°00´S, 38°13´E, 900 m), mostly after attraction to lights at night. Birds were weighed to the nearest 0.1 g using a Pesola spring balance. Visible subcutaneous fat was scored on a 0–4 scale according to the appearance of the furcular pit. A score of *0* here (fat absent from the furcular pit) corresponds to *0* on the Kaiser scale; a score of *4* (furcular pit filled with fat and bulging) corresponds to *5* or above on the Kaiser scale, and is translated as such in Table 3 and the comparisons made below.

Species, weights and fat scores at Jijiga

A total of 647 Palaearctic migrants of 23 species was caught over the 12–day spring ringing session. Table 1 shows the composition of this catch.

Table 1. Numbers of each Palaearctic species caught, and numbers retrapped, at Jijiga, Ethiopia, 21 April–3 May 1998.

	New captures	Retraps
Hoopoe *Upupa epops epops*	4	0
Red-backed Shrike *Lanius collurio*	45	4
Eurasian Golden Oriole *Oriolus oriolus*	5	0
River Warbler *Locustella fluviatilis*	2	1
Great Reed Warbler *Acrocephalus arundinaceus*	11	3
Sedge Warbler *A. schoenobaenus*	24	2
Marsh Warbler *A. palustris*	11	0
Eurasian Reed Warbler *A. scirpaceus*	38	4
Icterine Warbler *Hippolais icterina*	2	0
Upcher's Warbler *H. languida*	1	0
Willow Warbler *Phylloscopus trochilus*	303	19
Blackcap *Sylvia atricapilla*	1	0
Garden Warbler *S. borin*	26	1
Common Whitethroat *S. communis*	31	3
Thrush Nightingale *Luscinia luscinia*	15	5
Common Nightingale *L. megarhynchos*	2	0
White-throated Robin *Irania gutturalis*	5	0
Common Redstart *Phoenicurus phoenicurus*	7	0
Whinchat *Saxicola rubetra*	1	0
Common Rock Thrush *Monticola saxatilis*	1	0
Spotted Flycatcher *Muscicapa striata*	109	12
Yellow Wagtail *Motacilla flava*	2	0
Tree Pipit *Anthus trivialis*	2	0

Willow Warbler and Spotted Flycatcher dominated throughout. Red-backed Shrikes, Sedge Warblers, Reed Warblers, Garden Warblers and Common Whitethroats also featured prominently, while Great Reed Warblers, Marsh Warblers and Thrush Nightingales gave smaller but informative weight samples. Birds appeared to be moving quickly through the site for there were rather few retraps. The weights and visible fat scores of the ten main species are detailed in Table 2.

Table 2. Weights and fat scores of the main migrants trapped at Jijiga, April–May 1998.

Species	Weight				Fat score			
	n	mean	sd	range	n	mean	sd	% ≥ f5
Red-backed Shrike	40	33.3	4.9	23.1–41.7	41	4.5	1.8	86
Great Reed Warbler	11	37.6	4.9	32.0–46.2	11	6.3	1.3	91
Sedge Warbler	18	13.2	2.5	10.4–17.2	19	5.0	2.6	58
Marsh Warbler	11	16.2	2.2	10.8–18.7	11	6.4	1.8	91
Eurasian Reed Warbler	38	13.7	2.1	9.8–18.3	37	5.5	2.0	84
Willow Warbler	298	10.6	1.2	7.4–13.9	279	5.1	1.0	89
Garden Warbler	25	21.4	1.8	18.2–26.5	25	4.1	1.7	44
Common Whitethroat	31	19.1	1.9	14.0–22.2	30	5.9	1.1	87
Thrush Nightingale	15	32.9	3.9	22.5–38.3	15	6.3	1.4	93
Spotted Flycatcher	109	17.6	2.0	13.5–22.4	109	3.4	1.2	17

Mean weights and maximum weights were high in all these species (for comparisons see e.g. Cramp 1988, 1992, Cramp & Perrins 1993). The majority of birds were very fat. Seven of the ten species usually scored *fat 5–7* on the Kaiser scale. Only in Sedge Warbler, Garden Warbler, and most notably Spotted Flycatcher, were scores below *fat 5* commonly recorded. The high weights of some of the scarcer Jijiga species also deserve mention: 2 River Warblers, 22.7 and 27.0 g; 2 Icterine Warblers, 15.2 and 15.4 g; 2 Common Nightingales, 29.6 and 30.0 g; 7 Common Redstarts, 12.7–19.9 g (mean 15.8) and 1 Whinchat, 19.2 g.

Spring weights and lean weights in Kenya

For the ten main species above, Table 3 summarizes spring weights from central and southeast Kenya, and gives the percentage of birds at or above *fat 5* (Kaiser scale) for the sample sizes indicated. Some significant (mostly small) differences in spring fattening pattern have been found in Kenya between different sites and with different weather situations (see e.g. Pearson *et al.* 1979, Pearson 1992). However, the broad combined samples in Table 3 serve as a useful comparison with the Jijiga birds.

Table 3. Weights and prevalence of fat birds (score ≥5) in central and southeast Kenya, April–early May. N, data mainly or entirely from Nairobi/Athi River; T, data mainly from Tsavo; NT, data from both areas.

Species		Weight				Fat	
		n	mean	sd	range	n	% ≥f5
Red-backed Shrike	NT	57	28.8	3.2	24.0–39.8	42	7
Great Reed Warbler	NT	84	32.0	5.1	24.6–45.7	65	12
Sedge Warbler	NT	643	11.9	1.8	9.1–21.0	321	8
Marsh Warbler	T	94	11.1	0.9	9.1–13.2	93	0
Eurasian Reed Warbler	N	537	11.1	1.1	8.5–15.8	331	2
Willow Warbler	NT	869	8.5	1.0	6.2–14.6	475	2
Garden Warbler	N	191	21.1	2.6	15.4–28.7	159	28
Common Whitethroat	NT	475	15.2	2.0	11.3–22.3	158	13
Thrush Nightingale	NT	87	24.9	3.1	18.8–36.8	66	5
Spotted Flycatcher	N	11	14.3	1.2	12.8–17.2	11	0

Some high maximum weights are shown, and the heaviest Great Reed Warblers, Sedge Warblers and Willow Warblers were about double the lean weight given in Table 4. But the proportion of Kenya spring birds with these massive fat loads was small. Moderate reserves were commonly carried (Kaiser *fat 3–4*), but many birds were quite lean. With the exception of Garden Warbler (28%), the proportion of each species scoring *fat 5* or above in these samples ranged from just 0 to 13%.

Table 4 lists mean weights (with number in sample and standard deviation) of birds caught in Kenya between November and April with a fat score of 0. These are taken as the 'lean weight' of the species concerned.

Table 4. Lean weights.

	(birds scoring f0, Kenya, Nov–Apr)		
	n	Mean	sd
Red-backed Shrike	407	24.6	1.6
Great Reed Warbler	15	26.8	2.2
Sedge Warbler	146	10.2	0.7
Marsh Warbler	2267	10.4	0.6
Eurasian Reed Warbler	51	10.1	0.5
Willow Warbler	384	7.7	0.7
Garden Warbler	105	16.9	1.1
Common Whitethroat	653	13.1	1.0
Thrush Nightingale	954	21.3	1.5
Spotted Flycatcher	315	13.3	0.9

Spring birds from Jijiga and Kenya compared

In all ten species the mean weight of birds at Jijiga was higher than that in Kenya. The difference ranged from just 0.3 g in Garden Warbler up to 8 g in Thrush Nightingale (Table 5). In all species except Garden Warbler and Sedge Warbler the difference was highly significant (p<0.1%).

Table 5. Differences of mean spring weight between Jijiga and Kenya and corresponding values of the t-statistic and probability level p.

	Difference ± SD	t	p
Red-backed Shrike	4.5 ± 0.88	5.1	<0.001
Great Reed Warbler	5.6 ± 1.57	3.6	<0.001
Sedge Warbler	1.3 ± 0.59	2.2	0.03
Marsh Warbler	5.1 ± 0.67	7.6	<0.001
Eurasian Reed Warbler	2.6 ± 0.34	7.6	<0.001
Willow Warbler	2.1 ± 0.08	27.3	<0.001
Garden Warbler	0.3 ± 0.41	0.7	0.47
Common Whitethroat	3.9 ± 0.35	11.1	<0.001
Thrush Nightingale	8.0 ± 1.07	7.5	<0.001
Spotted Flycatcher	3.3 ± 0.41	8.0	<0.001

At Jijiga, mean weights ranged from 30% above lean weight in Sedge Warbler to well over 50% higher in Thrush Nightingale and Marsh Warbler. In Kenya, by contrast, mean spring weights ranged between 7% above lean weight in Spotted Flycatcher and 24% in Garden Warbler.

Differences in visible fat levels between the two areas are even more striking. While 72% of the Jijiga birds scored *fat 5* or above (all ten species combined), the corresponding figure for the Kenya sample was just 7%. In all species except Garden Warbler and Spotted Flycatcher the higher proportion of these very fat birds at Jijiga was highly significant ($p < 0.1\%$).

Discussion

Migrant passerines setting off from wintering sites or spring transit sites in central or southern Kenya typically do so with low or moderate reserves of fat fuel. Some are close to lean weight on departure and perhaps proceed north via a series of short flights, with frequent pauses to feed. Many, however, are 20–30% above lean weight, with sufficient reserves to support 30–40 h of flight (for estimates see e.g. Pennycuick 1975, Alerstam 1990). This might involve three to four nights flying with little need to feed during daytime resting. Assuming a speed of 30–40 km/h (in still air) this should take them to fattening and staging areas 1000–1500 km further north.

The majority of spring passage birds caught at Jijiga were 30–60% above lean weight. This corresponds to a flight potential of 50–70 h, or, in still air, a flight range of 1500–3000 km. Such fat reserves should therefore be sufficient to take many of these birds across the Arabian desert with little or no need to feed. These high fat loads are similar to those recorded in migratory passerines preparing to cross the Sahara in West Africa (e.g. Smith 1966, Fry *et al.* 1970, Wood 1982). Despite high weights Spotted Flycatchers tended to record lower fat scores at Jijiga than other species. They may well tend to use a strategy of intermittent feeding on the crossing of Arabia, as they would appear to do on the southern autumn crossing of the Egyptian Sahara (Biebach 1985).

Most migrants heading north from Kenya must replenish their reserves in Ethiopia. At Jijiga, however, passage birds had already fattened extensively, nearby or to the south. This indicates important staging areas in eastern Ethiopia, which should probably be looked for east of the Bale Mountains (see Fig. 1). These may well lie in the *Acacia-Commiphora* bushlands drained by the upper Juba and Shebelle rivers and their tributaries. This region usually receives the bulk of its annual rainfall during March–May (Griffiths 1972; see also the online accessible resources of The World Bank Climate Change Knowledge Portal (http://sdwebx.worldbank.org/climate portal/ index.cfm), and the flourishing of vegetation there typically coincides with the spring passage of Palaearctic migrants. Its likely importance has been underlined in recent experiments in which Red-backed Shrikes and Thrush Nightingales were tracked with light level geolocators. Birds paused for some days during their northward migration through eastern Africa, most apparently in southeast Ethiopia (Tøttrup *et al.* 2012).

Stopover and staging areas in north-east Africa appear to be utilized by most of the global population of some Palaearctic passerine species en route to and from their southern African winter quarters. The spring staging area indicated here is well separated from the autumn stopover area identified in eastern Sudan and/or western Ethiopia (Pearson *et al.* 1988), apparently a reflection of a geographic difference in seasonal rainfall pattern. In both seasons these areas are evidently more spatially restricted than many southern African wintering ranges. Their location and conservation should therefore be a priority in the protection of the migration routes and strategies of the species involved.

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References

Alerstam, T. 1990. *Bird migration*. Cambridge: Cambridge University Press.

Ash, J.S. 1980. Migrational status of Palaearctic birds in Ethiopia. *Proceedings of the 4th Pan-African Ornithological Congress*: 199–208.

Ash, J.S. 1993. Migration of Palaearctic birds inland in Ethiopia. *Scopus* 17: 19–25.

Ash, J.S. 1994. Weights of migrant Palaearctic *Sylvia* warblers in Ethiopia. *Scopus* 17: 119–123.

Biebach, H. 1985. Sahara stopover in migratory Flycatchers: fat and food affect the time program. *Experientia* 41: 695–697.

Cramp, S. 1988. *The birds of the western Palearctic* Vol. V. Oxford: Oxford University Press.

Cramp, S. 1992. *The birds of the western Palearctic.* Vol. VI. Oxford: Oxford University Press.

Cramp, S. & Perrins, C.M. 1993. *The birds of the western Palearctic.* Vol. VII. Oxford: Oxford University Press.

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

Griffiths, J.F. 1972. *Climates of Africa*. Vol. 10. World Survey of Climatology. Amsterdam: Elsevier.

Moreau, R.E. 1972. *The Palearctic-African bird migration system*. London & New York: Academic Press.

Pearson, D.J. 1990. Palaearctic passerine migrants in Kenya and Uganda: temporal and spatial patterns of their movements. Pp 41–59 in Gwinner E. (Ed) *Bird Migration, Physiology and Ecophysiology*. Berlin: Springer-Verlag.

Pearson, D.J. 1992. Northward passage of Palearctic songbirds through Kenya. *Proceedings of the 7th Pan-African Ornithological Congress*: 113–124.

Pearson, D.J., Backhurst, G.C. & Backhurst, D.E.G. 1979. Spring weights and passage of Sedge Warblers *Acrocephalus schoenobaenus* in central Kenya. *Ibis* 121: 8–19.

Pearson, D.J., Nikolaus, G., & Ash, J.S. 1988. The southward migration of Palaearctic passerine through northeast and east tropical Africa: A review. *Proceedings of the 6th Pan-African Ornithological Congress*: 243–262.

Pennycuick, C.J. 1975. Mechanics of flight. Pp. 1–75 in Farner, D.S. & King, J.R. (Eds) *Avian Biology*. New York: Academic Press.

Smith, K.D. 1960. The passage of Palaearctic migrants through Eritrea. *Ibis* 102: 536–544.

Smith, V.W. 1966. Autumn and spring weights of some Palaearctic migrants in central Nigeria. *Ibis* 108: 492–512.

Tøttrup, A.P., Klaassen, R.H.G., Kristensen, M.W., Strandberg, R., Vardanis, Y., Lindström, Å., Rahbek, C. & Alerstam, T. 2012. Drought in Africa caused delayed arrival of European songbirds. *Science* 338: 1307.

Wood, B. 1982. The trans-Saharan spring migration of Yellow Wagtails (*Motacilla flava*). *Journal of Zoology* 107: 267–283.

Yohannes, E., Ash, J., Biebach, H., Nikolaus, G. & Pearson, D.J. 2009. Passerine migration strategies and body mass variation along geographic sectors across Europe, East Africa, the Middle East and Arabia Peninsula. *Journal of Ornithology* 150: 369–381.

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