The study of bird migration across the Western Sahara; a contribution with sound luring

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Report of field research in Mauritania during spring and autumn 2003 in association with the Sahara project of the Swiss Ornithological Institute (Vogelwarte Sempach).

Abstract

During spring and autumn migration 2003, the Swiss Ornithological Institute set up a concerted project in Mauritania to study bird migration across the Sahara (see www.vogelwarte.ch/sahara/). I participated with a side project using artificial induction of landfall with sound luring in an attempt to overcome the potential problem of low sample sizes for random trapping of natural landfall. A comparison with sound lured samples was also expected to provide more insights into the motivation of birds to stop or fly. In total, 9.467 migrants of 55 species were ringed, 590 birds recaptured locally and 49 ringed in Europe were recovered. Sound luring was more effective in autumn, when samples became, however, heavily dominated by Reed Warblers (*Acrocephalus scirpaceus*) and Garden Warblers (*Sylvia borin*). In autumn, adults migrated ahead of juveniles, and in Reed and Garden Warblers, most adults travelled over the interior of the Sahara, while juveniles were concentrated along the coast; no such effect was seen in species that avoided the interior (Nightingale *Luscinia megarhynchos*, Grasshopper Warbler *Locustella naevia*). Local recapture rates were low (6%), particularly inland in autumn (1%), where many more birds (12%) made longer stopovers in spring. In autumn, there were many more birds in poor condition along the coast than inland; birds in poor condition had much higher recapture rates, and birds in good condition (fat score >3, muscle score=3) rarely made a stopover. Grounded birds continued migration as fast as possible, many did so in poor condition. Hence a stopover in the Sahara in autumn was primarily a second chance for dropouts unable to continue. More birds in good condition made longer stopovers in spring. Fat was more quickly restored than flight muscles during stopover, eventually resulting in unusual combinations of good fat stores and poor flight muscles. New arrivals of such birds pointed to birds that experienced a near-fatal dropout earlier on; there were more such birds in spring and along the coast in autumn.

Introduction

During spring and autumn migration 2003, the Swiss Ornithological Institute set up a concerted project in Mauritania to study bird migration across the Sahara (see www.vogelwarte.ch/sahara/). In addition to radar observations of bird migration, there were ground teams capturing birds after natural landfall, conducting bird counts in different habitats, studying foraging behaviour and various aspects of stopover and refuelling ecology. Under some conditions, when natural landfall is sparse, obtaining sufficiently large samples for the ground measurements is a (frustrating) problem. Artificial induction of landfall with sound luring was added as a side project in an attempt to overcome the problem of sample sizes. Comparisons of sound-lured samples with natural landfall nearby and migration aloft as revealed by radar will also help to explain fundamental aspects about sound luring, and what birds are actually attracted under which conditions and why. Sound luring was therefore expected to give also some insights into the motivation of birds to fly or stop, and to provide a link between counts and captures of naturally grounded birds and the radar data.

Study sites and methods

During spring a ringing site was operated from 6 April till 13 May 2003 in a large wadi (dry river bed) just north of Tenlaba village (20° 59.020' N, 11° 40.533' W) ca. 500 km inland in Mauritania. Trapping was with mistnets in natural vegetation (*Acacia, Tamarix, Phyllantus*) and around a small irrigated barley field. This site was flooded in autumn, and the ringing site was moved some 700m further south-west to a Dade palm plantation (20° 58.810' N, 11° 40.766' W), from 29 August to 24 September. Subsequently, from 29 September to 26 October, nets were operated near the coast just north of Nouakchott (18° 07.476'N, 15° 58.208'W), in subsistence vegetable gardens at the sewage dump.

Sound luring involved playing continuously throughout the night and morning a programmed sequence of CD tracks with vocalisations of migrants, but also 'soundscapes' with frogs, insects and running water. Trapped birds were ringed and various data were collected following the ESF songbird migration network manual (http://www.ifv.terramare.de/ESF/manual.pdf).

Results

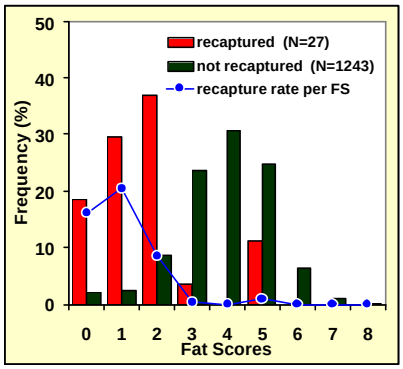
Captures

In spring, 2.191 migrants of 43 species were ringed in 38 days (median 55/day, max 138). In autumn, 2.543 migrants of 26 species were ringed in 27 days at Tenlaba (median 75/day, max 366), and 4.733 of 41 species in 29 days at Nouakchott (median 115/day, max ca. 1000). Species composition and abundance ranking were very different between spring and autumn: eight *Sylvia*, *Hippolais*, *Phylloscopus* and *Acrocephalus* species had totals between 100-350 in spring, but totals in autumn were dramatically dominated by Reed Warblers (3.573) and Garden Warblers (1.844) (see full lists in annex 1). There were more species and considerably more birds at the coast than inland in autumn (or in any case many more were prepared to stop at the coast). Several species that were common inland in spring remained very sparse on the ground there in autumn (e.g. Whitethroat *Sylvia communis*, Orphean Warbler *Sylvia hortensis*, Melodious Warbler *Hippolais polyglotta* and Whoodchat Shrike *Lanius senator*). Many more birds were in poor condition at the coast than inland.

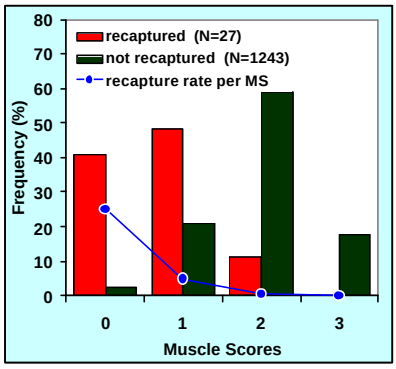
In autumn, far more adult than young Reed and Garden Warblers crossed the interior of the Sahara: unexpectedly few young were caught inland (12% and 26%, respectively), while much higher proportions of young occurred at the coast (83 and 81%). Adults migrated ahead of juveniles, but not enough to account for the above site differences. For species that relatively avoided the interior (i.e. few ringed), this difference was more marginal: Nightingale 35% young inland *versus* 55% at the coast, Grasshopper Warbler 40% inland *versus* 57% at the coast. There were three complete moon cycles in the project and each time the week following full moon produced many more birds than the week before (3.8x, 3.6x and 2x more, respectively).

Recaptures

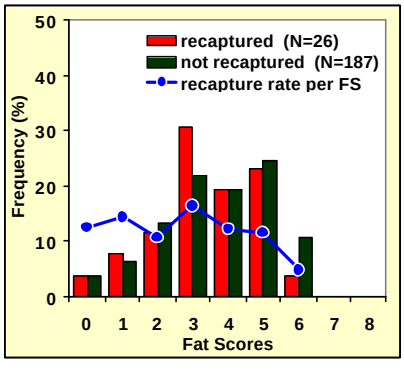
In spring, there were 424 retraps of birds ringed locally, involving 252 birds (recapture rate 12%), and only one recovery from Europe (a Reed Warbler). In autumn, there were only 59 local retraps at Tenlaba, involving 35 birds (recapture rate a mere 1.4%), but there were 22 recoveries from Europe. At the coast, there were 443 local retraps of 303 birds (recapture rate 6.4%), and a further 26 foreign recoveries (annex 2). Two birds had travelled fast: a Reed Warbler caught at Nouakchott had been ringed in Sweden 27 days previously (4.933 km) and a Sedge Warbler (*Acrocephalus schoenobaenus*) in France only 13 days before (3.284 km). None of the birds ringed in spring was recaptured in autumn (no recurrence). In autumn, recapture rates were much higher for lean birds and particularly for birds with poor flight muscles, indicating that stopover birds were essentially dropouts unable to continue (e.g. Figs 1-2 for Reed Warblers at Tenlaba in autumn).



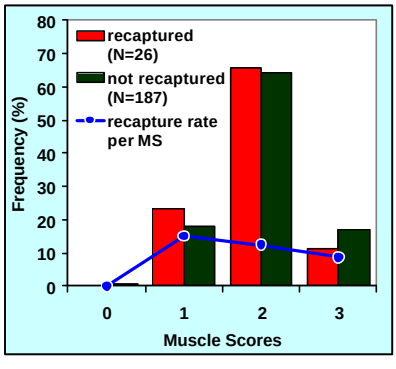
Fat scores (left) and muscle scores (right) at first capture for Reed Warblers that were later recaptured (red) and those never seen again (dark).
(low scores are'thin' birds)
(overall recapture rate 2%)



In spring, initial body condition of birds later recaptured matched more closely that of birds never seen again (see Figs 3-4 for Orphean Warbler at Tenlaba in spring), except for species with very high proportions of transient birds, i.e. with low recapture rates (e.g. Willow *Phylloscopus trochilus* and Melodious Warblers).



Fat scores (left) and muscle scores (right) at first capture for Orphean Warblers that were later recaptured (red) and those never seen again (dark).
(low scores are'thin' birds)
(overall recapture rate 12%)



Stopover strategies

In general, recapture rates were low (Annex 1), indicating that most birds left as soon as possible, but there were more birds making a stopover in spring than in autumn (higher retrap rates). Furthermore, crude stopover duration (time between first and last capture) was longer in spring (Table 1). In autumn, more birds made a stopover along the coast, and they also stayed longer than inland (see Reed Warbler in Table 1). In spring, most Reed and Melodious Warblers, species with the lowest recapture rates and a short median stopover, lost weight during their short stop.

Table 1: recapture rate, median stopover duration (# nights), and weight gain of recaptured birds (for selected species)

A) spring	**locality**	**sample N**	**retraps** % of total	**stopover nights**	**weight gain** g/day	%/day
Whitethroat	Tenlaba	86	24	4 (max 17)	0,14	1,0
Common Redstart	Tenlaba	16	18	6 (max 18)	0,24	1,9
Tree Pipit	Tenlaba	12	63	5 (max 10)	0,61	2,8
Garden Warbler	Tenlaba	11	7	4 (max 9)	0,12	0,6
Reed Warbler	Tenlaba	8	6	1 (max 5)	-0,62	-5,6
Grasshopper Warbler	Tenlaba	4	29	4 (max 7)	0,16	1,5
Ortolan Bunting	Tenlaba	1	33	8	0,25	1,1
Melodious Warbler	Tenlaba	6	2	2 (max 10)	-0,31	-2,7
B) autumn						
Whitethroat	Nouakchott	2	3	1 (max 1)	0,25	2,5
Common Redstart	Nouakchott	3	3	1 (max 3)	0,58	5,0
Tree Pipit	Nouakchott	4	16	1 (max 6)	0,58	3,4
Garden Warbler	(Nouakchott)	37	2	3 (max 11)	0,08	0,6
Reed Warbler	Tenlaba	29	2	2 (max 6)	0,10	1,1
Reed Warbler	Nouakchott	190	9	3 (max15)	0,17	1,8
Grasshopper Warbler	(Nouakchott)	15	8	3 (max 11)	0,25	3,0
Ortolan Bunting	Nouakchott	9	25	2 (max 6)	0,31	1,6

Taxonomy and faunistics

All 70 Chiffchaffs caught between early April and late October were Iberian Chiffchaffs (*Phylloscopus ibericus*), a taxon recently raised to species rank. This confirms recent opinion (*Svensson 2001: Bull. B.O.C. 121:281-296*) that this taxon indeed mainly migrates to tropical Africa, and it appears to be the principle Chiffchaff taxon doing so. Two vagrants, a Lesser Whitethroat (*Sylvia curruca*) and a Red-backed Shrike (*Lanius collurio*), normally migrating along the east Mediterranean flyway, were caught at Nouakchott. At Tenlaba three observations were made of Verreaux' Eagles (*Aquila verreauxii*), a species apparently new to the Western Sahara.

Discussion

In terms of improving the numbers of birds caught, sound luring was successful, but the difference with the trapping success of naturally grounded birds was smaller in spring (5x more with sound luring) than in autumn, when the difference was furthermore larger inland (39x) than along the coast (13x). Sound luring therefore was most useful exactly when and where it was most needed: inland in autumn, when few birds were landing naturally (thus 2.543 ringed with *versus* 65 without sound luring). The poorer results in spring were expected, and probably relate to the great altitude (2-5 km) at which birds then fly to benefit from tailwinds above the wind-shear. The species composition of the samples is obviously biased by the responsiveness to the sound luring (possibly in interaction with the habitat), but there is so far (further research pending) no obvious indication that birds grounded with sound did something very different from what birds in the same body condition would have done after a natural stop. When many birds are naturally prepared to stop, most of the success of sound luring comes from concentrating such birds at one spot (e.g. in spring). In autumn, sound luring convinced many more transient birds to stop, possibly because most passage was at lower altitudes, with tail-winds below the wind-shear. It remains to be investigated if the effect of higher catches just after full moon is due to moon-dependent variations in migration intensity. In the absence of such variation, an alternative explanation is that more birds are more easily convinced to stop following full moon, when the habitat is brightly moon-lit (hence more easy to assess) during the second part of the night, when most stop-or-fly decisions have to be taken. Therefore, it appears that when visual and auditive stimuli (i.e. moon-lit oasis and bird sound) match, more birds can be convinced to interrupt flight.

Some of the differences in species composition between spring and autumn (species missing inland in autumn) reflect differences in routes or migratory strategies (in terms of speed and preparedness to stop)

between the seasons. The very different numbers of Reed and Sedge Warblers (two species responding well to sound luring in Europe) suggest different migratory strategies over the Sahara, Reed Warblers being prepared to stop almost anywhere, Sedge Warblers hardly so. The average loss of weight during the short stops in the few stopping Reed and Melodious Warblers in spring could indicate that birds, which experience difficulties in foraging efficiently, leave as soon as possible. Alternatively, and more likely, birds programmed to travel as fast as possible without stopping over, may not forage efficiently and accept to loose weight during short forced stops (e.g. by weather conditions).

In spring, and in autumn along the coast, several birds had unusual combinations of fat and muscle conditions, i.e. carrying substantial amounts of fat while the flight muscles were much reduced. Retrap histories indicate that exhausted birds may regain fat relatively easily, but flight muscle restoration was much slower. Unbalanced combinations of fat and muscles therefore indicate migration dropouts that managed to survive and refuel. New arrivals of such birds point to birds that experienced a near-fatal dropout earlier during migration; there were more such birds in spring, and along the coast in autumn.

Conditions were exceptionally wet in the Sahara during autumn: repeated and heavy rain caused devastating flash floods and persistent surface water, and generated widespread very green habitats. However, there is no indication that migrants to any significant extent opportunistically cashed in on this. To the contrary, few birds stopped over and grounded birds mostly left again the next night, many despite low fuel loads and poor flight muscle condition. In contrast, during spring at the end of the dry winter, fewer transient birds were grounded and more birds in good condition made longer stopovers.

Comparisons of the various datasets from the different teams in future is likely to assist in the further unravelling of the more complex patterns and phenomena.

Acknowledgements

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Annex 2: origins of birds ringed abroad and recaptured with sound luring in Mauritania

(for full details see www.vogelwarte.ch/Sahara/ follow “diaries” & “recoveries”)

39 Reed Warblers *Acrocephalus scirpaceus:*

Belgium 9	**England 4**	**Estonia 3**	**Croatia 2**	**Czechia 1**
	France 4	**Germany 3**	**The Netherlands 2**	**Russia 1**
		Slovenia 3	**Sweden 2**	
		Spain 3	**Switzerland 2**	

4 Garden Warblers *Sylvia borin:*

Czechia 1 **Germany 1** **Spain 1** **Switzerland 1**

2 Sedge Warblers *Acrocephalus schoenobaenus:*

France 1 **England 1**

1 Great Reed Warbler *Acrocephalus arundinaceus:*

Spain

1 Willow Warbler *Phylloscopus trochilus:*

Norway

1 Blackcap *Sylvia atricapilla:*

England

1 Orphean Warbler *Sylvia hortensis:*

Italy

Annex 1: summary of captures	TENLABA spring			TENLABA autumn			NOUAKCHOTT autumn			Total
	ringed	recaptured	(%)	ringed	recaptured	(%)	ringed	recaptured	(%)	ringed
Acrocephalus arundinaceus				5	1	20				5
Acrocephalus schoenobaenus	1			12			23	7	30	36
Acrocephalus scirpaceus	140	8	6	1550	29	2	2023	190	9	3713
Actitis hypoleucos							3			3
Anthus campestris	1	1								1
Anthus trivialis	19	12	63				25	4	16	44
Caprimulgus europaeus	1									1
Caprimulgus ruficollis	1									1
Cercotrichas galactotes	22	6	27	5			2			29
Coturnix coturnix				5	1	20	1			6
Cuculus canorus							1	1		1
Cyanosylvia svecica							52	6	12	52
Delichon urbica	1									1
Emberiza hortulana	3	1	33				36	9	25	39
Ficedula hypoleuca	2			5			93	6	6	100
Hippolais (pallida) opaca	91	2	2	33			2			126
Hippolais (pallida) reiseri	117	5	4	21						138
Hippolais polyglotta	271	6	2	5			3			279
Hirundo daurica	8									8
Hirundo rustica	28			1						29
Jynx torquilla	1			2			63	1	2	66
Lanius collurio							1			1
Lanius senator badius							1			1
Lanius senator senator	53	10	19				15	1	7	68
Locustella luscinioides				1						1
Locustella naevia	14	4	29	5	1	20	185	15	8	204
Luscinia megarhynchos	17			20	1	5	374	9	2	411
Merops apiaster	1									1
Merops persicus	6						7	1		13
Monticola saxatilis	1						1			2
Monticola solitarius	1						3			4
Motacilla alba							8			8
Motacilla flava	35	11	31				8	1	13	43
Muscicapa striata	7			12			14			33
Oenanthe hispanica	6	2	33	1						7
Oenanthe oenanthe	3						5			8
Oriolus oriolus	2			1			1			4
Otus scops	1						8	2	25	9
Phoenicurus phoenicurus	88	16	18	10			88	3	3	186
Phylloscopus bonelli	19									19
Phylloscopus ibericus	3			6			61	2	3	70
Phylloscopus trochilus	234	10	4	134			102			470
Riparia riparia	3									3
Saxicola rubetra	2			4			11	3	27	17
Streptopelia turtur	13			2			6			21
Sylvia atricapilla	63	12	19				117	2	2	180
Sylvia borin	160	11	7	618	2	0,3	1226	35	3	2004
Sylvia cantillans	183	23	13	47			30			260
Sylvia communis	353	86	24	28			70	2	3	451
Sylvia conspicillata	2									2
Sylvia curruca							1			1
Sylvia hortensis	212	26	12	10			39	1	3	261
Sylvia melanocephala							10	1	10	10
Tringa nebularia							1			1
Tringa totanus							1			1
Upupa epops	2						12	1	8	14
totals	**2191**	252	12	**2543**	35	1	**4733**	303	6	**9467**