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Phenology of Western Olivaceous Warbler *Hippolais opaca* and Eastern Olivaceous Warbler *Hippolais pallida reiseri* on stopover sites in Mauritania

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Due to the problems of identifying the recently-split Western Olivaceous Warbler *Hippolais opaca* and Eastern Olivaceous Warbler *H pallida reiseri* in the field, the migration phenology, passage routes and wintering areas of the two species remain unknown. Both species were mist-netted regularly during autumn and spring migration on Mauritania and the migration phenology of the species in the western Sahara is described here for the first time. Autumn migration of Western Olivaceous Warblers through central Mauritania lasts from early August to early October. Passage at the coast started later and occurred during a shorter time period. The species does not seem to winter in central Mauritania. During spring migration, Western Olivaceous Warblers occurred from early March to early May. No birds were mist-netted in spring at the coast although some were present. The Eastern Olivaceous Warbler was mist-netted at the inland sites only. Only a few birds were mist-netted on autumn migration, which was between late August and early October. The species does not seem to winter in central Mauritania. During spring migration, Eastern Olivaceous Warblers were mist-netted from mid March until early May. There were no indications that the species breeds in central Mauritania.

The Olivaceous Warbler was recently split into Western Olivaceous Warbler *Hippolais opaca* and Eastern Olivaceous Warbler *H pallida* with the subspecies *pallida, reiseri, elaeica* and *laeneni* (Cramp 1992, Helbig & Seibold 1999, Svensson 2001, Parkin *et al* 2004). Field identification of *H opaca* and *H pallida* is challenging, so migration data for *H opaca* are difficult to interpret in Africa because of marked regional overlap with *H p reiseri* and *H p laeneni* (Cramp 1992). The separation between the subspecies of *H pallida* is even more difficult, so, for example, the exact wintering range of *H p reiseri* is unknown because of its similarity to *H p laeneni* and *H p pallida* (Svensson 2001).

H opaca arrives on its North African breeding grounds in late March/early April, whereas it tends to reach its European breeding grounds later, on about 10 May (Svensson 2001). In Mauritania, southward passage starts in August and lasts until mid September (Lamarche 1988). The wintering range is from Senegal to northern Cameroon (Baker 1997, Svensson 2001). In general, the species occurs south of 17°N from November until the end of April; some remain that far south until June (Lamarche 1988) and July when pairs and singing birds were observed near Nouakchott (18° 6'N 15° 57'W), Mauritania's capital city (Browne 1981). During the northern summer some birds stay in the Sahel region but breeding south of the Sahara has not yet been confirmed (Urban *et al* 1997).

Information about the breeding range of Eastern Olivaceous Warbler *H p reiseri* is unclear. Distribution maps in Svensson (2001) and Parkin *et al* (2004) suggest eastern Morocco, Algeria, Tunisia and Libya but the texts of the latter and other authors suggest that only breeding sites in Algeria have been confirmed. There are, however, recent breeding records from Tunisia (Jiguet 2003) and Morocco (Dally 2003). It is not clear whether the records for Mauritania in Baker (1997) and Urban *et al* (1997) refer to a breeding population or cite Lamarche (1988) who supposed *H p reiseri* to be rare, with only two records from Nouakchott.

H p reiseri is resident in its southern breeding range in Algeria (Baker 1997, Svensson 2001). Further north it is migratory and arrives in early March and reaches breeding grounds in southeast Morocco (possibly this taxon) in late March/early April (reviewed by Cramp 1992). According to Baker (1997), northern populations winter further south within the breeding range of the species, but northern populations migrate to Senegal, Niger and Nigeria according to Svensson (2001).

In Mauritania, *H opaca* and *H p reiseri* occur (Lamarche 1988) but data on migration phenology in

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the country are scarce. Between February 2003 and May 2004 the Swiss Ornithological Institute's project on bird migration across the Sahara ran a number of mist-netting sites at various localities in Mauritania during the migration seasons. Both Western Olivaceous Warblers and Eastern Olivaceous Warblers were mist-netted regularly at most sites. This paper describes the phenology of both species in the western Sahara based on mist-netted birds with the aim of discussing timing of migration, possible migration routes and the status (migrant versus resident) of Western Olivaceous Warbler and Eastern Olivaceous Warbler in Mauritania.

METHODS

Study sites

Mist-netting effort in Mauritania was concentrated at several sites. PK28 (17° 43'N 16° 02'W) is a village situated approximately 40 km south of Nouakchott: a netting site was placed between bushes of *Tamarix senegalensis* approximately 3 km south of the village in autumn 2003. Iouîk is a village in the Bank d'Arguin National Park: a mist-netting station was established approximately 5 km west-northwest (19° 53'N 16° 18'W) of the village. Nets were placed at the coast between *Tamarix senegalensis* bushes and operated in spring 2003. Tenlaba (20° 59'N 11° 41'W) is situated approximately 14 km northwest of Ouadâne in the Adrar: mist nets were operated in a garden and a Date Palm (*Phoenix dactylifera*) plantation in spring 2003, in a Date Palm plantation in autumn 2003 and in a Date Palm plantation and between bushes in a dry riverbed in spring 2004. In both seasons in 2003, sound-luring was used each night and morning from 2200 hrs till 0900 hrs. Thirty-second sequences of songs of various Palaearctic migrants (including *Hippolais pallida*) were repeated. In 2004, sound-luring was only used at three-day intervals, interrupted by three days without sound-luring. Car booster-amplifiers of 100 watts theoretical power were used. Ouadâne (20° 54'N 11° 35'W) is an oasis surrounded mainly by stony desert. Dry wadis and gorges support larger trees many kilometres away from the oasis. Birds were mist-netted between *Acacia tortilis*, *Balanites aegyptiaca* and *Maerua crassifolia* trees fringing a dry riverbed in spring and autumn 2003 and in spring 2004. Tichît (18° 28'N 09° 30'W) is also an oasis surrounded by stone and sand desert, but with higher vegetation of Date Palm plantation around the oasis. Mist-netting took place between 13 August and 24 September 2003 in a *Prosopis juliflora* (introduced from America) wood. Akmakam (21° 12'N 11° 53'W) is an oasis situated at the base of a rocky escarpment. Mist nets were placed next to a small open water body among reeds *Phragmites australis* and between *Acacia tortilis* and *Balanites aegyptiaca* trees in the vicinity of the water. The site was operated from 7 March to 8 May 2003. Tenadi (17° 52'N 15° 08'W) is an oasis approximately 65 km inland: mist nets were set up between *Balanites aegyptiaca* and *Prosopis* sp bushes between 14 April and 8 May 2003.

At all sites, daily trapping effort was more or less constant apart from the first few days when netting capacity was built up consecutively. An exception was Tichît, where nets were added throughout the period because of the low number of birds caught. On some days, especially in Tichît, nets remained closed due to heavy sand storms.

Methods

Species of 'Olivaceous Warblers' (*opaca* versus *pallida*) were determined using the criteria described by Svensson (2001). For this purpose, measurements of bill length and tarsus length were taken from most birds. The distribution of white on the outer tail feathers was also a good separation criterion. In some cases, however, 'Olivaceous Warblers' were not identified to species level, especially at the beginning of the project. These birds are not included in the analysis. All *pallida* caught were assigned to the subspecies *reiseri* mainly on the grounds of the distribution of white coloration on the outer tail feathers (Svensson 2001) which formed a broad fringe. The subspecies *elaeica* only rarely has broad white fringes on the outer tail feathers (Svensson 2001). For distributional reasons this subspecies is unlikely to occur in Mauritania, which is also the case for *laeneni* and *pallida*. The latter subspecies is difficult to separate from *reiseri* by morphology or wing formula as characters overlap widely (Svensson 2001).

During the project, 1,083 'Olivaceous Warblers' were mist-netted (including sites not considered in the analyses because of low trapping effort). Ninety-seven were not identified to species level, 504 were *H opaca* and 482 *H p reiseri*. Of these, 112 *H opaca* were mist-netted in autumn and 392 in spring, while only 42 *H p reiseri* were mist-netted in autumn and 440 in spring. In Figs 1 to 4 we first present the mean number of birds mist-netted per netting effort as birds per net-metre × hour (n/nmh*10,000) per pentad (Berthold 1973) pooled over all sites per season. Then, we present these data for all sites separately. We refrained from analysing sex- or age-specific patterns.

RESULTS

Hippolais opaca

During autumn migration, *H opaca* occurred at all major stations between 13 August and 14 October (Fig 1). However, substantial numbers of birds were only caught at three stations: PK28 (26), Tenlaba (33) and Tichît (31). At PK28, *H opaca* occurred later than at the inland sites but during a shorter period, with the majority of birds mist-netted between early and mid September (Fig 1b). At the inland sites, the majority of birds was also caught in the same period (Fig 1c, d). Tenlaba and Tichît ceased to operate on 24 September and 4 October, respectively. It is not possible to tell whether migration was still in progress at Tenlaba but the results show that there was regular passage through

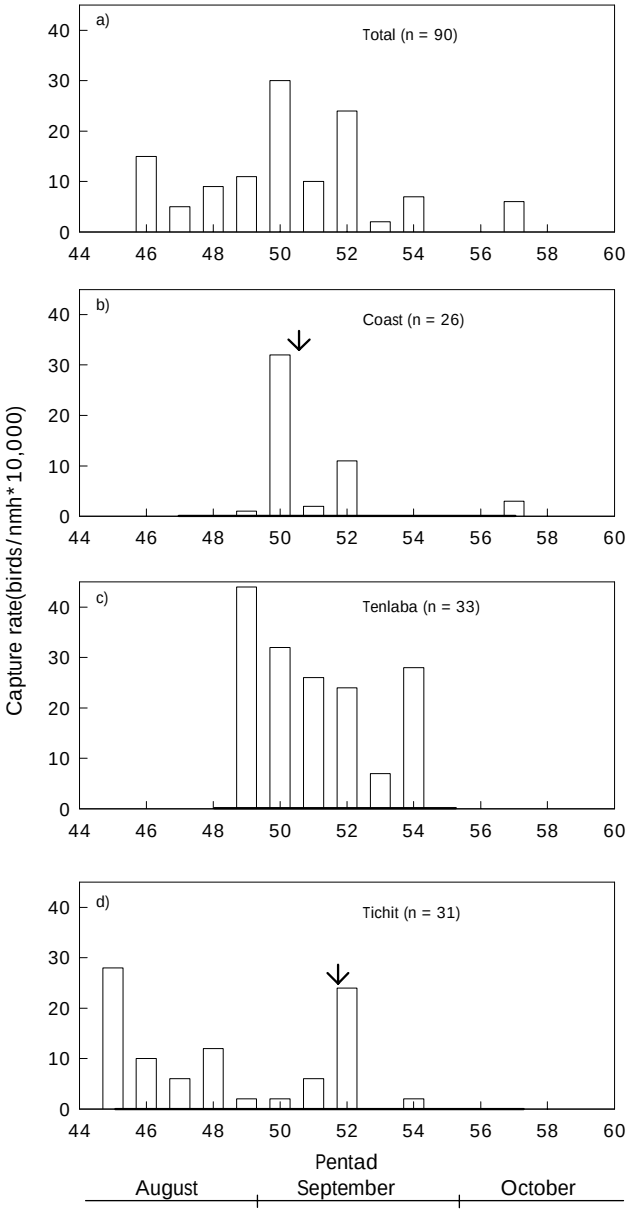

Figure 1. Phenology of *H opaca* in autumn. Mean capture rate for sites in total a) and separately b) to d). The solid bar on the x-axis indicates the periods with trapping effort. The black triangle indicates the median. The high value for Tichît in pentad 45 is due to one bird mist-netted on 13 August, the last day of pentad 45, when the station started to operate. No bird is indicated in pentad 45 in a) because the bird mist-netted in Tichît would indicate a misleadingly high trapping rate.

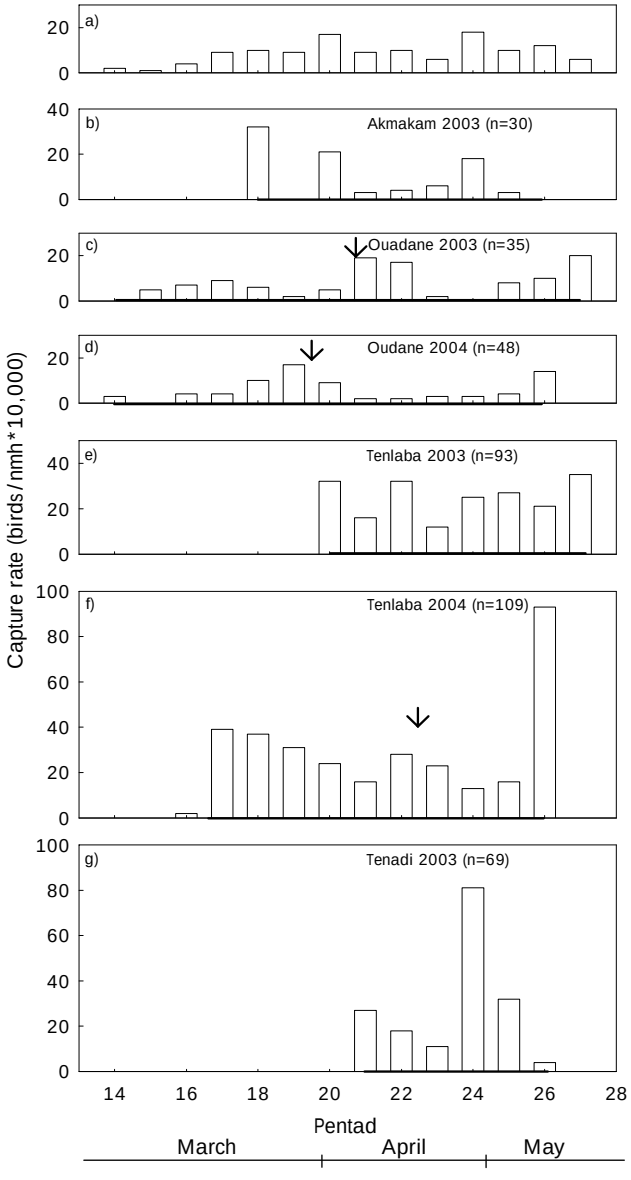

Figure 2. Phenology of *H opaca* in spring. Mean capture rate for sites in total a) and separately b) to g). The solid bar on the x-axis indicates the periods with trapping effort. The black triangle indicates the median. The high value for Akmakam in pentad 18 is due to one bird mist-netted at the end of pentad 18, when the station started to operate.

the Adrar at least between the end of August and late September. In total, only six (5%) out of 112 birds in autumn were mist-netted in October with the last bird (a retrap) caught on 14 October at Gabou (18° 21'N, 12° 20'W) in the south.

During both spring periods birds were mist-netted throughout the entire season (Fig 2). Distinctly more birds were caught at Ouadâne and Tenlaba compared to the numbers in autumn at the same sites. No *H opaca* was mist-netted in Iouîk in spring 2003, despite high trapping effort (45,234 nmh).

The first birds on spring migration were mist-netted in Ouadâne in early March in both years (Fig 2c, d). In 2003, peaks in the number of birds mist-netted occurred in mid April and mid May. In 2004, numbers peaked in late March/early April. At Tenlaba in 2003, birds were caught more or less constantly throughout the trapping period (Fig 2e). Considerable passage probably occurred before mist-netting started. In spring 2004, the first *H opaca* was mist-netted in the middle of March. From mid March onwards, birds were mist-netted in relatively higher numbers more or less constantly with a distinct peak in early May. The median of mist-netted birds/nmh at Tenlaba in 2004 was almost two weeks later than at nearby Ouadâne. The highest capture rate in Tenadi (17° 52'N, 15° 08'W) in 2003 was at the end of April (Fig 2g). At Akmakam (21° 53'N 11° 13'W), trapping started at the end of March. A relatively high capture rate was found in early and late April (Fig 2b).

Hippolais pallida reiseri

During autumn migration *H p reiseri* were mist-netted at the inland stations Tenlaba, Tichît, Gabou and Ouadâne. However, at the latter site only two birds were caught despite the high trapping effort, and the species was not trapped at the coast.

We found a relatively high capture rate in late August (Fig 3a), mostly due to the high number of birds caught in Tenlaba. Afterwards, birds were captured continuously in Tenlaba until the station ceased to operate on 24 September (Fig 3c). At the more southerly station of Tichît (Fig 3b), no *H p reiseri* was caught until mid September when six birds were mist-netted. After then no further *H p reiseri* were caught. At Gabou, ten birds were caught between 9 October and 12 October, although nearly all trapping was in this period at this site. These were the latest birds in the season and all of them were first-year birds moulting remiges.

H p reiseri were mist-netted on spring migration at the inland sites of Ouadâne, Tenlaba and Tenadi (Fig 4). No birds were caught at the coast in Iouîk. During spring migration distinctly more *H p reiseri* were caught

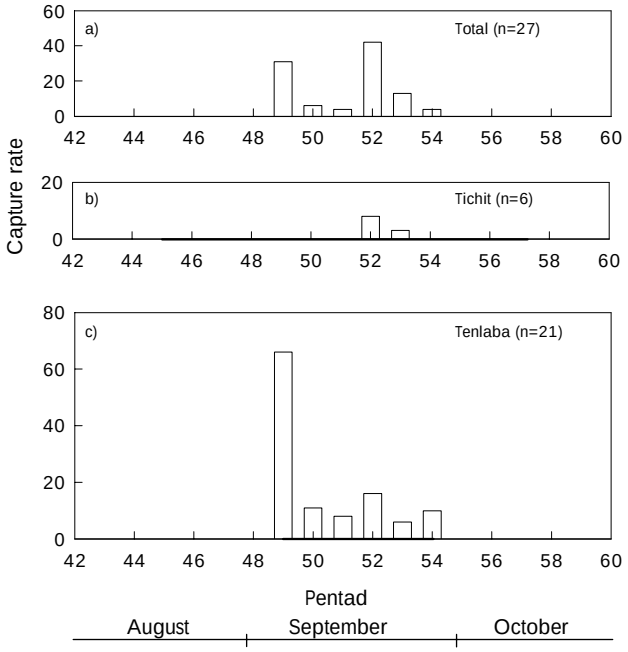

Figure 3. Phenology of *H p reiseri* in autumn. Mean capture rate for sites in total a) and separately b) and c). The solid bar on the x-axis indicates the periods with trapping effort. The black triangle indicates the median.

at Ouadâne compared to autumn. Birds were caught from early March to early May, when the stations ceased to operate in both years (Fig 4b, c). In 2003, a relatively high number of birds was mist-netted in mid April. In 2004, birds were mist-netted more or less constantly in Ouadâne until early April, after which numbers dropped until a further peak in early May. In 2003, the station at Tenlaba started to operate in early April when already about 10% of all birds were caught (Fig 4d). Similar to nearby Ouadâne, higher numbers of birds were mist-netted in mid April. The station at Tenadi started to operate in mid April in 2003. No birds were caught until early May but six birds were trapped in mid May (Fig 4f).

DISCUSSION

The phenology of *H opaca* and *H p reiseri* is described for the first time in the western Sahara. The results suggest that autumn migration of *H opaca* through Mauritania takes place between mid August and late September. The earlier occurrence of migrating birds at the inland site (Tichît) compared to the coast (PK28) could either be the result of chance events locally causing earlier versus more concentrated landfall, or

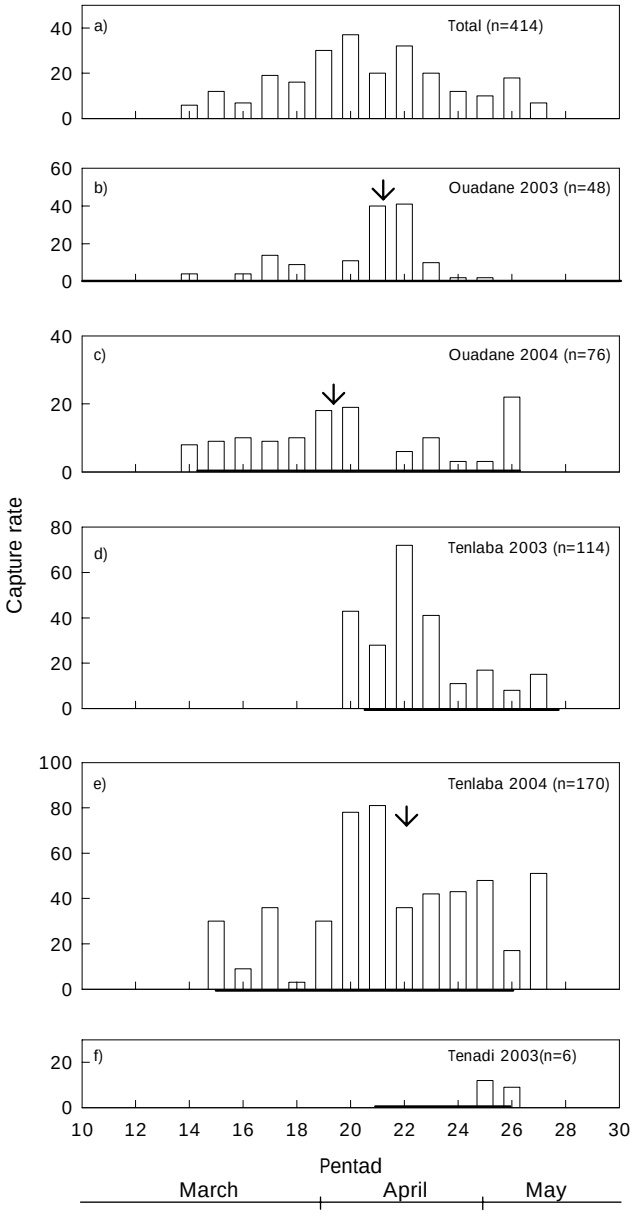

Figure 4. Phenology of *H p reiseri* in spring. Mean capture rate for sites in total a) and separately b) to f). The solid bar on the x-axis indicates the periods with trapping effort. The black triangle indicates the median. The high value for Tenlaba in pentad 15 is due to one bird mist-netted at the end of pentad 15, when the station started to operate.

reflect a real difference in migration routes; more data would help to clarify the issue. Migration seems to take place over a broad front, from the coast to sites as far east as at least Tichît and probably further east (Cramp 1992), although the density of migrants might decline further inland. The scarcity of birds at our stations after September, as well as the phenology data on spring migration, indicates that the final wintering areas of the species may be south of central Mauritania. These results agree with those of Lamarche (1988) who reported migration through the Nouakchott area from August to mid September and the absence of birds north of 17°N from November onwards. Several authors report that the Senegal River valley serves as a wintering site for the species, as well as the Sahel zone as far east as Nigeria, where some may even stay throughout the year without evidence of breeding (Morel & Roux 1966, Browne 1981, Lamarche 1988, Morel & Morel 1990, Cramp 1992, Elgood 1994, Urban *et al* 1997).

In contrast to autumn, no *H opaca* were mist-netted at the coast on spring migration, which indicates either loop migration or the lack of landfall due to other, unknown reasons. Transect counts in Iouîk, however, revealed that there were hardly any birds on the ground at the coast in spring (unpublished data). Migration inland seems to be continuous throughout spring, with migration beginning in early March. By early May, numbers had dropped considerably at the southern station at Tenadi. At the northern stations (Ouadâne, Tenlaba), new birds were still captured in early and mid May, indicating that migration lasts well into May. As Tenlaba and Ouadâne are only 14 km apart, we suggest that the reason for the two weeks' difference in the median dates of captures is mainly due to local variation in methods or sites (*eg* sound luring in Tenlaba and/or habitat differences). Our data are similar to those of Lamarche (1988) who reported *H opaca* being observed until June in Mauritania. In other African countries *H opaca* is recorded until April in Togo (Cheke & Walsh 1996) and Mali (Lamarche 1981), until May in Senegal (some over-summer, Morel & Roux 1966) and Gambia (Gore 1990) and until June in Nigeria (Elgood 1994). According to Svensson (2001) arrival on the North African breeding grounds is from late March to early April but they do not arrive on European breeding grounds until about 10 May. In contrast, Cramp (1992) gives arrival dates in North African breeding grounds as mid April to early May. The peak of migration in Coto Doñana, Spain, is probably during the first week of May, whereas migration over the Strait of Gibraltar continues until early June (Cramp 1992).

H p reiseri were detected only at inland sites in both autumn and spring, and seem to have been absent along the coast. This might be the reason for the previous scarcity of records from the country (Lamarche 1988): there were two previous records in the country compared to the 482 individuals mist-netted during this study.

In autumn, birds seem to migrate through central Mauritania before mid September. Late birds, mist-netted in Gabou in mid October, were all first-year

individuals showing active primary moult, indicating possible differential migration of first-year and adult birds (Salewski *et al* 2005). On spring migration, occurrence of *H p reiseri* followed a more continuous pattern from early March to early May with more concentrated landfall in April. Our data coincide with observations that first birds arrive on breeding grounds in north Algeria in March and in Morocco (probably *H p reiseri*) in late March to early April (Cramp 1992). Our data suggest, however, that the taxon is not breeding in southern and central Mauritania. Some *H p reiseri* were singing in May, as were some other long-distance migrants, but they did not set up territories for any period of time. The exact wintering areas remain inadequately known and might be situated between Senegal, Mali, Niger and northern Nigeria (Lamarche 1981, Morel & Morel 1990, Svensson 2001).

The reconstruction of migration phenology from trapping data is subject to possible pitfalls. Some birds could migrate non-stop, or with long hops, overshooting the study sites completely. As the relation between migration intensity and landfall is unknown, the investigation of migration phenology of the genus *Hippolais* deserves further research.

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