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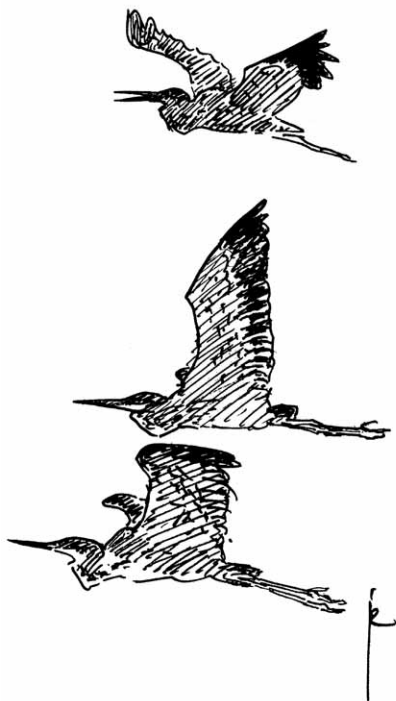
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Satellite-tracking migrating juvenile Purple Herons *Ardea purpurea* from the Camargue area, France

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Migratory movements of juvenile Purple Herons from the Camargue area in France were studied by satellite-tracking. Six juvenile birds were fitted with transmitters in early July 2004. Of these six, four successfully started migration in September. Tracked birds followed a western migratory route, heading out south-south-west, towards Spain, the Balearic Islands and then Algeria. They pursued their flight either south-west to the Moroccan Atlantic coast or straight to Mauritania, flying over the Sahara desert. Flight speed could be estimated for one of the birds and was about 40 kilometres per hour. The results of this study are consistent with previous ring recovery data and provide additional knowledge on the speed and departure date of juvenile Purple Herons during autumn migration.

Key words: Purple Heron, satellite-tracking, migration routes, autumn migration, Camargue

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Introduction

The Purple Heron *Ardea purpurea* is a colonial migratory species, which is highly sensitive to disturbance and breeds predominantly in reed marshes. Because reed marshes are scarce habitats, the breeding distribution of Purple Herons is very patchy and the species is considered one of the most vulnerable herons in Europe and the Mediterranean region (Hafner 2000, Marion *et al.* 2000). In France, most individuals breed on the Mediterranean coast where the population size

was about 800 pairs in 2004 (B. Poulin & Y. Kayser, unpubl. data). Aerial surveys revealed large annual fluctuations in numbers breeding in the Camargue, with a steep decline from 1982 to 1994 and a further decline between 1996 and 2000 (Hafner *et al.* 2004). Anthropogenic changes of the breeding sites, such as reed harvesting and water management practices, have led to low water levels in spring and probably explain part of the observed inter-annual variation (Barbraud *et al.* 2002).

Because the Purple Heron is migratory, its population size may also be affected by conditions encountered in wintering areas or at stopover places during migration. Several studies showed that the breeding populations of Purple Herons in Europe are influenced by the amount of rainfall in sub-Saharan Africa (Den Held 1980, Cavé 1983, Barbraud & Hafner 2001), but considerations of exactly how wintering conditions affect survival is hampered by our scant knowledge of their distribution and habitat on wintering grounds. Thanks to ring recoveries, the French populations are believed to use three different migratory routes (i.e. south-west towards Spain, south-east to Italy, and eastwards along the Po River towards the Adriatic Sea), and to predominantly winter south of 10°N in West Africa (Voisin 1996). However, further research is needed on the distribution, habitat use, winter mortality, and environmental limiting factors in the wintering range (Kushlan & Hancock 2005).

To gather complementary information on the stopover places and wintering quarters of Purple Herons from southern France, we equipped six juvenile birds with Argos transmitters during the spring 2004. We were also aiming to determine whether juvenile birds migrate back to Europe in spring or spend their first summer in Africa, as has been suspected (Voisin 1996).

Methods

Satellite transmitters (numbered 942 to 947) were fitted on 2 July 2004 on six juvenile Purple Herons from a single breeding colony in the Camargue area (43°30'N, 4°30'E). In order to minimize disturbance at the breeding site, the colony size (42 breeding pairs) and the approximate laying date had been estimated beforehand using aerial photographs, as described previously (Kayser *et al.* 1994, Moser 1986). The birds were captured on the nest and released within 10 minutes, so that the time spent in the heronry did not exceed one hour.

We used 30-g platform transmitter terminals or PTTs (Microwave Telemetry Inc., PTT 100) that we attached as backpacks using flexible Teflon

ribbon harnesses. Because we did not plan to recapture the birds, a breakaway link made of biodegradable surgical wire had previously been sewed on each harness, so that the birds would lose the transmitter and the harness after a few months. We scheduled each PTT to transmit for 8h every 1–8 days, with more frequent sampling during times of the year when we expected most long-range movements.

The PTTs were tracked by CLS/Service Argos in Toulouse, France. Locations provided by the Argos system are divided into different classes (labeled A, B, Z and 0–3) depending on validation, number of messages received and location accuracy. The accuracy is supposed to be within 1 km for three classes of locations (1–3), while the accuracy for 0, A, B and Z is unspecified. The high-quality locations represented 13% of our data set, which is close to what was found in other studies (Hake *et al.* 2001). Unless specified, only high-quality locations were used.

Results

Of the six juvenile birds equipped, one faced transmitter failure or died within the first week (943), and a second stopped transmitting in early September (944). The four remaining birds successfully started migration (Fig. 1). One of them (946) seemed to have left the Camargue in late August and spent some time in south-west France near the Spanish border before flying to Algeria in mid-September. The corresponding location classes were low (A and B), which means that less than four signals were received by the satellites, but it is very likely that the locations registered were accurate (Hays *et al.* 2001). Unlike PTTs 942 and 946, location accuracy was high for PTTs 945 and 947 and allowed to assess migration departure dates: PTT 945 and 947 were last detected in the Camargue on 12 and 14 September, and were reported in the Mediterranean Sea north of Oran and Alger on 14 and 16 September. All four birds travelled south-south-west across the Mediterranean Sea, flying over the Balearic Islands (942 and 947) before reaching the Algerian coast near Cherchell, where PTT 945 was registered near the Damous

Unfortunately, migratory movements could not be followed as long as expected. All four signals stopped moving before the birds reached their wintering quarters, indicating either that the birds died or had dropped their transmitter. The latter hypothesis is the most likely as each harness had a breakaway link and all PTTs stopped moving almost simultaneously. This mishap is illustrative of the trade-offs that have to be made when dealing with both research and conservation issues. The data obtained on the first part of migration however allowed to gain information about departure dates and flight speed of juvenile herons and confirmed the western migratory route previously suggested by ring recovery data (Voisin 1996).

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SAMENVATTING

Deze pilotstudie beschrijft hoe de trekbewegingen van jonge Purperreigers, geboren in de Camargue in Zuid-oost-Frankrijk, werden gevolgd met behulp van satelliet-telemetrie. Na het broedseizoen, begin juli 2004, werden zes jonge vogels uitgerust met een tuigje met een satellietzender. De onderzoekers gebruikten afbreekbaar draad om er zeker van te zijn dat het tuigje na een paar maanden zou afvallen. Eén zender viel in de eerste week al uit, terwijl een tweede reeds begin september niet meer werkte. De overige vier gaven een signaal tot de derde week van september en stelden de onderzoekers in staat een groot deel van de trekroute door Zuid-Europa en Noordwest-Afrika te documenteren. De Purperreigers vertrokken tussen 12 en 14 september en volgden een westelijke trekroute. Vanuit de Camargue vlogen ze richting zuidzuidwest via Spanje en de Balearen naar de kust van Algerije. Twee vogels vlogen daarna in zuidwestelijke richting door naar de Marokkaanse kust. Een derde vogel vervolgde zijn trek rechtstreeks over de Sahara en werd het laatst waargenomen in het noorden van Mauritanië. Zijn vliegsnelheid op dit deel van de route was 40 km per uur. Toen de vierde Purperreiger nog in Noord-Algerije was viel de zender uit, gelijktijdig met het stoppen van de zenders van de andere drie vogels. De trekbewegingen van deze vier jonge Purperreigers kwamen overeen met de patronen die uit oudere ringgegevens te herleiden waren. Er wordt daarom geopperd dat de trekroutes de laatste tientallen jaren niet zijn veranderd. (YIV)

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