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MARIA ON MIGRATION: A SATELLITE-TELEMETRICAL STUDY ON A SPRING AND AN AUTUMN MIGRATION OF AN ESTONIAN OSPREY

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Abstract. In the current study we tracked a female osprey (called Maria), using a GPS-transmitter with solar battery, during the autumn migration from her nest site in NE-Estonia to the wintering area by river Congo in Central Africa, and back. The autumn migration lasted for 39 days (06.08–13.09.2006) and the spring migration 26 days (07.03–02.04.2007), including stopovers of 12...13 and 4 days respectively. There were no major differences between the routes, daily activity and habitat selection in autumn and in spring. The average daily distance during migration was 277 km in autumn and 332 km in spring. There was a significant difference between the average daily distance during autumn migration, being 422 km in the beginning of the migration and 158 km in the end, whereas no such difference was recorded during spring migration. The average flight speed during autumn migration was 43.1±16.1 km/h and 50.5±17.9 km/h during spring migration.

Introduction

Ospreys (*Pandion haliaetus*) in Europe are migratory birds wintering in Africa (Cramp & Simmons 1980). Recoveries of ringed birds (Österlöf 1977, Saurola 1994) provide ample of information about the migration paths and wintering areas of this species, but this method still remains inadequate for obtaining sufficient information of that. Even though data of the ringed birds provides some information about the migration

timing (Lokki & Saurola 2004) a far better method for obtaining data of migration time and flight speed is satellite-tracking that enables to observe a particular individual (Hake *et al*. 2001, Kjellén *et al*. 2001, Martell *et al*. 2001, Saurola 2006). Latter method has been effectively applied during the past decade. However, in these studies often only autumn migration has been observed due to untimely depletion of power supplies of the transmitters. Nowadays there are new transmitters, working on solar energy, that are able to recharge themselves and last for several years. Moreover, modern GPS-based transmitters are able to determine the location of a bird with an error of only a few meters and therefore enable to study the migration behaviour of birds in detail.

There are neither any reviews of the migration paths of the Estonian Osprey population nor any detailed studies on its behaviour on migration. The current study provides an overview of the migration of an adult female osprey, called Maria, who was satellite-tracked using GPS-transmitter with solar battery on her journey from her nest site in Puhatu mire in Northeast Estonia to the wintering area in Central Africa in autumn 2006, and back in next spring. In addition to the bird's migration path also flight speed, daily activity periods and biotope use during the migration are described in this paper. Furthermore, we compare data collected by satellite telemetry with that obtained by recoveries of Ospreys ringed in Estonia.

Methods

Maria was caught from her nesting site on the 22nd of July in 2006 using a stuffed Eagle Owl and a mist net. A GPS-transmitter with solar battery weighing 30g (Microwave Inc.) was tied on the eagle's back. The transmitter was sending out signals every two hours between 7:00 and 19:00 (local time in Estonia, GMT+3) but also transmitted information about altitude, flight speed and direction. It is possible to calculate the average time the journey started or ended in a particular day by using data of the first or the last location point.

First location signals were registered on the 23rd of July whereas during the entire pre-migration time of nestling feeding altogether 60 location signals were registered confirming the reliability and accuracy of the transmitter. Altogether 158 location signals were registered during autumn migration and 113 during spring migration. Registered locations were analyzed with MapInfo 6.5 and information about the landscape was obtained from satellite photographs (GoogleEarth).

Results

Autumn migration

It took 39 days for Maria to reach the wintering area at Congo River in Mid Africa (17°28′E and 0°54′S) that is 6730 km from her original nest site in Puhatu. During the journey Maria passed about 7200 km (Fig. 1). Autumn migration started in the morning on 6th of August: at 3 pm on the 5th of August Maria still was 26 km northeast from her nest catching prey at Narva water reservoir whereas in the exact same time on the 6th of August she had already started migration and was registered 173 km (height 923 m and flight rate 60 km/h) south from her nest, in Pskov oblast in Russia. The measured flight speed 40 km/h suggested that she probably started migration at 10:00–11:00. Maria reached her winter quarters on the 13th of September about 16:00 since at 15:00 she still was registered 34 km in northeast while at 17:00 already at her wintering area.

Figure 1. The migration routes of the osprey „Maria" on the autumn 2006 (black dots) and on the spring 2007 (white dots).

Joonis 1. *Kalakotkas Maria teekond 2006. a. sügisrändel (mustad punktid) ja 2007. a. kevadrändel (valged punktid).*

Maria's autumn migration may be divided into two parts that are separated by a resting period. First, she flew to southern Belarus that lies 760 km from her nest site. We may speculate that Maria made it with 2-3 days, on the 8th or 9th of August, since already on her first migration day she passed 409 km reaching the Latvian-Lithuanian border, and she continued her journey the next day at 14:00. Unfortunately there are no data of the consecutive days. Thereafter, on the 11th of August Maria was recorded at Pripjeti River in southern Belarus, in an area of 26 km^2 (according to the 14 registered locations), and she remained there until August 22nd. After the stopover Maria flew to her winter quarters with 23 days making only short overwintering stops.

Spring migration

The overall length of Maria's spring migration was 7500 km and it lasted for 26 days. Migration started on the 7th of March in 2007 between 12:30 and 12:45 since at 11:00 Maria still was reported to be in her winter quarters whereas at 13:00 she was already 12 km northeast at a flight rate of 50 km/h. Maria reached her nest site on April the 2nd, probably between 15:15 and 15:30 since at 15:00 she still was in Russia, 10 km from her nest, heading north at a flight speed of 65 km/h and at 17:00 she was registered at her nest site.

Also Maria's spring migration may be divided into two periods. Between those periods there lies a stopover of four days (25–29.03) near the north eastern border of Romania. Maria's autumn and spring migration paths did not differ from each other very much. However, the spring migration path was 170 km longer resulting from a change in direction in North Africa where she chose to pass Libya (Fig.1). Maria did not pass the Mediterranean Sea at once but moved eastwards while looking for a more convenient site to cross.

Migration behaviour

During her autumn migration Maria passed 277±150 (SD) km per day whereas in the beginning of the journey until September the 1st her daily flight distance was significantly longer (422±83 km) compared to that on the end of migration (158±56 km; $t_{2,20}$= 8.8; P<0.001; Fig. 2A). During the spring migration she passed 332±150 km per day whereas there was no major differences between daily distances (Fig. 2B). The longest distance during autumn migration (583 km) was measured on August 27th when crossing the Mediterranean Sea, and the flying probably lasted until 21:00–22:00. Another long distance, 547 km, was covered on September the 1st when crossing the Ennedi Plateau that is located in the eastern part of The Republic of Chad. The longest distance during spring migration was 502 km when crossing the Sahara Desert.

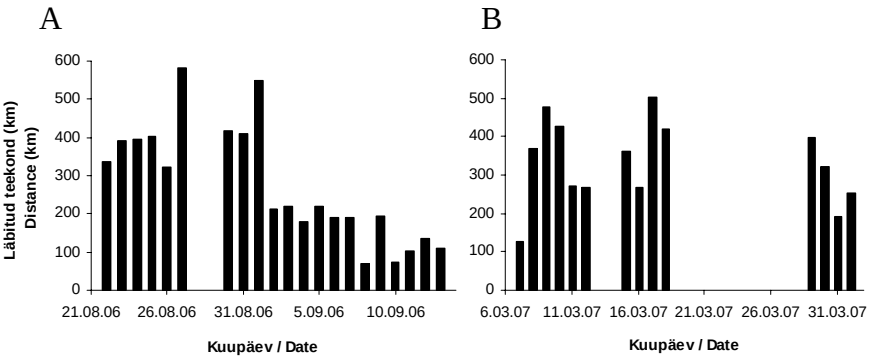

Figure 2. Known daily distances covered by the osprey „Maria" during autumn- (A) and spring migration (B). Data of the first day of autumn migration and the last day of spring migration are not shown.

Joonis 2. *Kalakotkas Maria teadaolevate päevateekondade pikkus sügis- (A) ja kevadrändel (B). Joonisel pole esitatud sügisrände esimese ja kevadrände viimase päeva teekonda (vastavalt 409 ja 224 km).*

The daily activity rates during autumn and spring migration were similar (Fig. 3). Usually Maria was flying between 11:00 and 17:00, however, during on one fifth of the days she began her journey already at 9:00 and during one third of her autumn migration and half of her spring migration she was still reported moving at 19:00 (Fig. 3). The mean times for starting and finishing the daily flight was calculated by the closest registered flight points and were 10:11±0:49 (n=17) and 18:24±2:58 (n=16) during autumn migration, and 11:14±1:26 (n=11) and 19:45±1:04 (n=13) during spring migration, respectively.

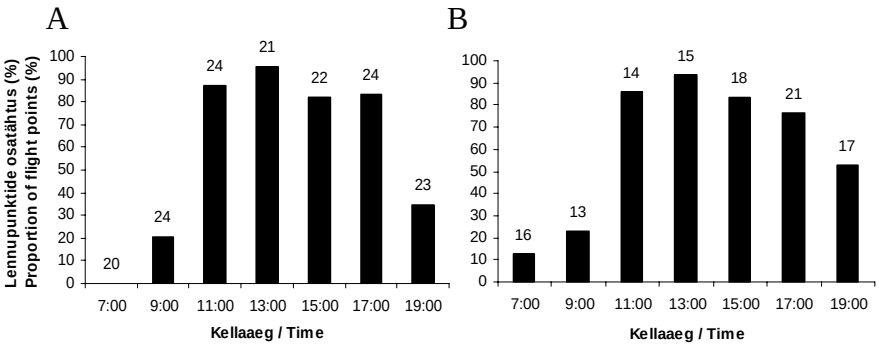

Figure 3. The daily migratory activity (proportion of flight points among registered locations) during autumn (A) and spring migration (B). The total number of registered locations is shown above bars.

Joonis 3. *Kalakotkas Maria rändeaktiivsus (registreeritud lennu-punktide osatähtsus) päeva lõikes sügis- (**A**) ning kevadrändel (**B**). Määratud asukohapunktide koguarv on näidatud tulpade kohal.*

During autumn migration Maria moved somewhat slower (34.8 km/h) and lower (225 m altitude) in the mornings than later on (43.3 km/h and 797 m). Yet, a significant difference was registered only in altitude of flight (ANOVA: $F = 2.74$; $df = 5$; $P < 0.002$) and not in flight speed (ANOVA: $F = 0.42$; $df = 5$; $P < 0.83$). However, there were no differences in these parameters on spring migration. The mean registered flight speed was 43.1±16.1 (8–85) km/h during autumn migration and 50.5±17.9 (16–102) km/h during spring migration.

However, the mean daily flight speed calculated from the estimated daily migration time and covered distance was 33.1±8.1 km/h during autumn and 39.2±10.0 km/h during spring migration. The mean altitude of flight was measured 804±439 (between 123–1916 m) during autumn and 878 m (55–2044 m) during spring migration.

Maria spent the nights in typical biotopes for the particular region. Usually in a forest (7 times autumn, and 7 times in spring), less often in a desert (3, 3), cultivated landscape (2, 0), mountains (2, 2) and savanna (2, 1). Maria probably foraged in mornings or in evenings since her stopover was registered less than a kilometre away from the closest water body 8 out of 18 times during autumn and 6 out of 14 times during spring migration. In Europe these water bodies usually were lakes (3 times) or rivers (1) whereas in Africa only rivers (9) were recorded. During the rest of the day only flight points were registered.

Discussion

The current study is describing the migration of an Osprey breeding in Estonia. The results have provided a lot of information since studies that have been carried out in the past mostly covered data obtained by ringing and remained rather insufficient. There are only 6 recoveries of the Osprey ringed in Estonia (all ringed as nestlings; Table 1) and only two juveniles found in northern Bulgaria and on the eastern coast of Egypt may be considered as migrating birds. These recoveries also suggest that the migration path used by Maria is also used by other Estonian Ospreys. Similar route is used by Ospreys migrating from Finland (Saurola 2006) whereas Ospreys migrating from Scandinavia use another path – usually through Western Europe followed by crossing the Mediterranean Sea from west or middle part (Österlöf 1977, Hake *et al*. 2001). Ospreys from Sweden and Finland are mostly migrating to West Africa (Österlöf 1977, Hake *et al*. 2001, Lokki & Saurola 2004) whereas the winter quarters of Maria lies in the eastern part of the area where birds from northwestern Europe migrate.

Table 1. Recoveries of the Osprey ringed in Estonia (as nestlings).

Tabel 1. *Taasleiud Eestis märgistatud kalakotkastest (rõngastatud pesapojana).*

Ringing/*Rõngastamine*		Recovery/*Taasleid*		
Date/*Aeg*	Location/*Koht*	Date/*Aeg*	Location/*Koht*[1]	*Coordinates*/ Koordinaadid
8.07.1992	Karula, Valgamaa	17.04.1999	Smiltene, Valka, LVA	57°20'N; 25°47'E
8.07.1995	Koorküla, Valgamaa	15.04.1999	Muijala, Uusimaa, FIN	60°17'N; 24°12'E
8.07.1999	Puhatu, Ida-Virumaa	6.06.2001	Belskiy, Tver, RUS	55°50'N; 32°57'E
14.07.1999	Misso, Võrumaa	3.10.1999	Metschka, Ruse, BGR	43°35'N; 25°48'E
7.07.2000	Meelva, Põlvamaa	23.07.2005	Alauksta, Cēsis, LVA	57°06'N; 25°46'E[2]
17.07.2006	Lohusuu, I-Virumaa	Sept.2006	Hurghada, EGY	27°54'N; 33°29'E[2]

[1] BGR – Bulgaria/*Bulgaaria;* EGY – Egypt/*Egiptus*; FIN – Finland/*Soome*; LVA – Latvia/*Läti*; RUS – Russia/*Venemaa*

[2] approximate coordinates/*umbkaudsed koordinaadid*

The strategy of the autumn migration did not differ from what was known before – females leave their nest site in the beginning of August, stay few weeks on a stopover-site away from nest sites and thereafter continue their migration (Bildstein 2006). Also data in the current study of daily activity, distance and the total length of the migration path together with the time spent on the journey are similar to what has been observed before (Kjellén *et al*. 2001). Nevertheless, there are some differences in the lengths of daily paths: unlike the Estonian Ospreys Swedish Ospreys tend to choose a shorter path in the beginning of the autumn migration (Kjellén *et al*. 2001).

The highest registered flight speed of Maria was 102 km/h. In this exceptional case we cannot exclude an error of the transmitter, yet, a speed of 85 km/h was registered altogether 4 times. According to Randla (1976) the flight speed of an Osprey may reach even up to 128 km/h. Difference between the mean daily flight speed registered by the transmitter and the speed calculated from the probable daily migration time does probably not indicate to the inaccuracy of the transmitter or

calculations but rather shows that Ospreys use different flight types – in addition to the direct migratory flapping flight and gliding the Ospreys used also soaring in order to gain altitude; the latter is not taken into consideration when speed is calculated from the daily migration time.

The major part of the total daily migration time Maria spent flying. She usually fed in the mornings or in the evenings and spent the night close to a water body. The dependence on a nearby water body may even be underestimated in this study since on satellite images the presence of temporary and small water bodies, or the ones in the middle of the forest, are difficult to be detected. The actual current natural circumstances may differ from the ones that the images reflect and mainly result from the difference in the amount of rainfall. The daily distance became shorter as the autumn migration progressed and her flight directions differed more from the actual migration course. In the beginning this driftage might have been due to the problems in feeding within landscapes poor in water bodies. During the last five days of her autumn migration she was following the Congo River and the drifting might have resulted from trying to find a suitable place for the night. Spring migration did not bring along such differences with an only exception in North Africa when Maria headed east crossing the Tibesti Mountains. The possibility of finding rivers, and food, is probably higher in the mountains than it is in the desert. In comparison with other eagles, a rather straight migration path is characteristic to the Osprey and even though it prefers moving across mainland and along the coast it is not insuperable for the Osprey to cross large water bodies (the Mediterranean Sea) or deserts (the Sahara) (Meyer *et al*. 2000, Bildstein 2006).

According to data from the years 2006 and 2007 the autumn migration took 11% and spring migration 4% of Maria's year. Even though these numbers differ in time and among individuals they still accentuate the shortness of the total migration period compared to time of the wintering (46%) and the breeding season (36%). The wintering and breeding season of the Osprey also need further research whereas GPS satellite telemetry is an effective method for this.

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Maria rännakud: Kirde-Eesti kalakotka sügis- ja kevadrände satelliittelemeetriline uuring

Kokkuvõte. Käesolevas töös antakse ülevaade GPS-saatjaga varustatud täiskasvanud emase kalakotka rändest oma pesitsusalalt Kirde-Eestis talvitusalale Kesk-Aafrikas 2006. a. augustis-septembris ja tagasirändest 2007. a. märtsis-aprillis. Sügisränne kestis kokku 39 ja kevadränne 26 päeva, kuid mõlemal korral tegi kalakotkas ühe pikema, vastavalt 12...13- ja 4-päevase rändepeatuse. Rändemarsruudid, päevane aktiivsus ning peatuspaikade valik olid nii kevadel kui sügisel sarnased. Päevane rändeteekond oli sügisel keskmiselt 277 km ja kevadel 332 km, seejuures lendas kotkas sügisrände alguses päevas keskmiselt 422 km ja lõpus 158 km; kevadrändel sellist muutust ei täheldatud. Keskmiseks lennukiiruseks registreeriti sügisrändel 43,1±16,1 km/h, kevadrändel 50,5±17,9 km/h.

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