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ORIGINAL ARTICLE

Why do female Lesser Spotted Eagles (*Aquila pomarina*) visit strange nests remote from their own?

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Abstract There is very little confirmed information on the social organisation of breeding Lesser Spotted Eagle populations, the turnover rate of adults, and their nest-site and partner fidelity. According to established knowledge, however, breeding individuals are territorial and defend at least the immediate vicinity of the nest site against their own species. It has further been thought that females rearing young, as with the females of other raptor species, remain within a radius of only a few kilometres of their eyrie. Using GPS satellite telemetry and DNA microsatellite analysis (DNA STR typing), we were able to disprove this prevailing hypothesis. A satellite-tracked female flew over 50 km away from her eyrie (D) in at least two different directions and visited at least one other occupied eyrie (T). It was also established that at least two strange females arrived at her eyrie, which contained young, from as far away as 57 km, and probably remained there for some considerable time. The pool of alleles represented at the different loci analysed, as well as the distribution of these alleles among the individuals, excludes the possibility that these females could be sisters or even half-sisters. Visits of strange eagles at this eyrie were also confirmed by direct observation. It can therefore be assumed that males only exhibit territorial behaviour towards their own sex and not towards strange females and that females do not exhibit territorial behaviour towards other females; but all these assumptions must be confirmed by further studies. For the first time it could be proved by means of microsatellite analysis that almost all females studied used the same breeding site for 2 consecutive years. The longest established period in which both partners of a pair remained at the same breeding site was 3 consecutive years.

Keywords Lesser Spotted Eagle · *Aquila pomarina* · Territorial behaviour · Home range · GPS satellite telemetry · DNA microsatellite analysis

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Introduction

There is almost no confirmed information on partner fidelity and social organisation of the Lesser Spotted Eagle (*Aquila pomarina)* in the breeding season. It is assumed however that a nest-site fidelity exists, i.e. both partners, providing they survive the long migration to and from southern Africa, return to the same nest site every year (Wendland 1932; von Dobay 1934; Meyburg 1970). In one case, a marked male in Slovakia was recorded at the same nest site for 11 consecutive years (Meyburg et al. 2004). As individuals generally cannot be told apart in the field, and in the past were

rarely marked (Danko et al. 1996), answers to these questions are still open.

According to established knowledge, breeding Lesser Spotted Eagles are territorial and defend at least the immediate vicinity of the nest site against their own species (Wendland 1951; Gedeon and Stubbe 1991; Meyburg 1991). It has further been thought that females rearing young, similar to females of other raptor species, remain within a radius of only a few kilometres of their eyrie until autumn migration.

Up to now it was only possible by means of satellite telemetry to study migration and wintering of raptors because the Doppler locations of the Argos transmitters hitherto available were not precise enough to study local movements. In 2004, satellite transmitters with global positioning system (GPS)-locating devices, which are small and light enough (45 g and even as small as 30 g) to be fitted to Lesser Spotted Eagles, became available. These new transmitters furnish exact GPS locations. In 2004, we were able to fit such transmitters to a pair of Lesser Spotted Eagles. The Argos satellite system is widely used to track animals globally; the results of this tracking can help in the management of wildlife (Fancy et al. 1988; Argos 1996). Further, we began DNA fingerprinting of Lesser Spotted Eagles, enabling the definite identification of individual birds by, for example,their moulted feathers (Rudnick et al. 2005).

Methods

Satellite tracking

On 17 July 2004 a pair of Lesser Spotted Eagles were fitted with GPS satellite transmitters (platform transmitter terminals, PTTs) near their eyrie (D) in a near-natural beech woodland in the Uckermark region of northeastern Germany. This breeding site has had a success rate since 1976 of 0.71 young per year and is amongst the most successful in the German federal state of Brandenburg (BB). The female was ringed as a nestling on 31 July 2000, 59 km northwest of where she had settled. Three further adult Lesser Spotted Eagles were fitted with GPS PTTs in 2005, including a female (PTT 57117) at nest site W. The young of all five eagles fledged successfully.

We used the dho-gaza method (Hamerstrom 1963; Clark 1981; Bloom 1987; Meyburg et al. 2005) to trap the adults, with an adult White-tailed Eagle (*Haliaetus albicilla*) as a decoy. With this method, the eagles attacked the live decoy, which was tethered to a perch behind a net in which they became entangled.

We used GPS/Argos solar-powered satellite transmitters supplied by Microwave Telemetry (Columbia, MD, USA) with a mass of 45 or 30 g. They were fitted as backpacks, using Teflon ribbon (Bally Ribbon Mills, Bally, PA, USA) to attach them to the birds. The transmitters were programmed for 16 consecutive hourly GPS fixes per day, transmitted to Argos every third day, provided that the level of light was sufficient to generate power for the transmitter. This is the first time that Lesser Spotted Eagles have been fitted with this type of transmitter.

The GPS operates through a network of satellites launched by the United States Department of Defense. Argos/GPS transmitters contain a GPS receiver, which collects fixes at pre-set intervals (1 h in this study) from the GPS satellite network. The data are then relayed to ground-based Argos processing centres.

We used ArcView 3.3 (ESRI, Redlands, CA, USA) geographical information system (GIS) to manage and analyse geographical data, and imported GPS locations into ArcView. We also used Google Earth's satellite image program to plot locations and to measure distances between locations.

In the period 1994–2002 we had fitted 19 adult eagles in Mecklenburg-Western Pomerania (MWP) (northeastern Germany) with Argos/Doppler-locating PTTs. Insofar as these birds, identifiable by their PTTs, permit conclusions to be drawn on philopatry or resettlement, the results have also been included here.

Sample collection, DNA methods and genetic tagging

Starting in 2000, we ringed and colour-ringed 13 trapped adult birds and took blood samples for DNA analysis. All occupied eyries in BB and MWP known to us were checked, and blood samples from nestlings, eggshell remnants and naturally moulted adult feathers were collected for DNA analysis. In 2005, saliva samples from small chicks were taken for analysis in order to establish the affiliation of the adult birds with the breeding site should the chicks later disappear. Feathers collected from one breeding site (T) in 1999 were also analysed. The analysis was carried out in the CODGENE laboratory in France.

The use of DNA analysis enabled genetic determination of both adult and juvenile Lesser Spotted Eagles in a wide radius around eyrie D. All individuals were allocated a code number (Table 1). Female D was allocated the genetic code number AP 04-07 and her mate AP 04-09.

To isolate DNA from single adult feathers, 5 mm was cut from the bottom of each shaft. DNA extraction

Table 1 DNA STR-typing results of Lesser Spotted Eagles

Breeding sites (BS)	Adults, their sex and year	Nestlings, their sex and year	Remarks
A-H	AP 04-04 ♀ (2004 and 2005)	AP 04-18 ♀ (2004)	Only the 2nd young bird was examined, parentage of the ♀ established
B-g	AP 04-02 ♀ (2004 and 2005)	Eggs infertile in both years	
BN	AP 05-29 ♂ (2005), AP 05-30 ♀ (2005)		
B-b	AP 04-20 ♂ (2004)		
D	AP 04-09 ♂ (2004), AP 04-07 ♀ (2004), AP 04-05 ♀ (2004), AP 04-23 ♀ (2004)	AP 04-06 ♂ (2004)	AP 04-07 was fitted with PTT 41861 and AP 04-09 with PTT 41860. AP 04-09 and AP 04-07 proved to be parents of nestling AP 04-06. The presence of AP 04-05 was proved by two primaries (see also BS E); the presence of AP 04-23 was proved by one primary. The origin of this ♀ is not known
E	AP 04-05 ♀ (2005 and 2005)	2004 no blood sample taken, AP 05-25 ♂ (2005)	AP 04-05 was proved as being present at BS D, 57 km distant. See row above. Parentage of the ♀ established
H	AP 05-32 ♀ (2005)		
G	AP 04-12 ♂ (2001-2004)	No blood sample taken	See text
Lb		AP 04-14 ♂ 1st chick, AP 04-17 ♂ 2nd chick	
N-B		AP 04-19	
Lau	AP 05-27 ♂ (2005)	AP 05-28 ♀ (2005)	Parentage of the ♂ established
P-M	AP 04-21 ♀ (2004)[a], AP 04-22 ♂ (2004)	Egg unfertilized	
Pr		AP 04-10 ♂ 2nd chick	A feather of the 1st young could not be identified
Schl	AP 04-13 ♀ (2004 and 2005)		
T	AP 04-08 ♀ (2004 and 2005), AP 04-07 ♀ (2004), AP 05-37 ♂ (1999), AP 05-38 ♀ (1999)	2004 no blood sample taken, AP 05-34 ♂ (2005) 1st chick, AP 05-23 ♂ (2005) 2nd chick	Among a total of seven small feathers collected on 13 June 2004, one belonged to AP 04-07, see BS D, distance 51 km. Parentage of ♀ AP 04-08 established for 2005
Z	AP 05-33 ♀ (2005)		
T-B	AP 05-31 ♀ (2005)		
Tr-Fl	AP 04-15 ♀ (2004)	No blood sample taken	
Z-R	AP 04-03 ♀ (2004)	No blood sample taken	
LA	AP 05-25 ♀ (2005)	AP 05-26 ♂ (2005)	Parentage of the ♀ established
N	AP 04-01 ♀ (2004)		
W	AP 05-35 ♀ (2005)	No blood sample taken	
St	AP 05-36 ♂ 2005)	No blood sample taken	

[a] Phenotypically a Greater Spotted Eagle (*Aquila clanga*). This bird was observed again in 2005 at the same site but did not breed

was performed with rachis (calamus) ''marrow'' from feather samples and fragments of the eggshell membrane. Reduced to the smallest possible particles, the samples were incubated in a solution enriched with proteinase K at 56°C for 6 h and further treated with the NucleoSpin Tissue method (Macherey-Nagel) according to the manufacturer's instructions. Blood samples were treated directly with GFX Genomic Blood DNA Purification Kit (Amersham Biosciences) according to the manufacturer's instructions.

Sex identification was based on two conserved CHD (chromo-helicase-DNA-binding) genes that are located on the avian sex chromosomes of birds. The CHD-W gene is located on the W chromosome, therefore it is unique to females. The sex determination was carried out with the P2/P8 PCR test (Griffiths et al. 1998), but we used labelled primers for optimal identification and detection. Birds of known sex were used to establish the male and female reference peak sizes (380 and 384 bp, respectively). For individual identification of 38 individuals and parentage assessment, DNA samples were genotyped at the following six microsatellite loci: Aa15 (number of alleles 8, H_O 0.68), Aa26 (number of alleles 7, H_O 0.79), Aa35 (number of alleles 9, H_O 0.71), Aa39 (number of alleles 4, H_O 0.33), Aa43 (number of alleles 10, H_O 0.68) and Aa49 (number of alleles 6, H_O 0.37) (Martinez-Cruz et al. 2002). The fluorescent-labelled fragments were

analysed on an ABI PRISIM 3100 Genetic Analyser (Applied Biosystems). Genescan 3.7 and GeneMapper 3.2 software (Applied Biosystems) was used for allele scoring. Allelic and genotype frequencies were calculated in order to perform identity testing and determine the parentage probability (data not shown) for each bird.

Field observations

On 8, 9, 13, 14 and 18 August 2004, in addition to more sporadic observations on other days, pair D was intensively observed from various viewpoints with a good overview. Both binoculars and telescope were used. The fitted transmitters made it easy to identify the resident pair, even at great distances, and the moult gaps on the male facilitated easy differentiation from the female.

Results

The offspring of eyrie D left the nest on 9 or 10 August 2004. The female left the breeding territory during the morning of 7 September and wintered in Namibia and Botswana. The male was still caring for the young bird on 20 September.

Satellite telemetry in 2004

The transmitter fitted to male D (PTT 41860) only sent back fixes until 10 August 2004, whereas that of the female D (PTT 41861) was still functioning at the time of publication of this paper. The transmitter of the female sent 40 GPS fixes up to the start of its autumn migration on the morning of 7 September, a relatively small number compared to the male. This is probably due to the fact that, as expected, the female bird spent most of its time in the woods near the eyrie and much less time than the male hunting in open country. This presumably resulted in the transmitter often not being adequately recharged.

On two occasions in 2004, it was established by telemetry that the female, which was then rearing a fully feathered eaglet, was remote from its eyrie. On 2 August 2004, at 0600 hours (all times given in GMT), it was located perched some 47 km northwest of the eyrie in a woodland near the village of Gross Varchow (53°34′N/12°59′E) about half way between Neubrandenburg and Waren (Müritz). Given the time of day, it can be assumed that it had spent the night there.

On 10 August 2004, it was located in flight at 1500 hours (altitude 526 m a.s.l, speed 68 kph, direction 303°). At 1600 hours, and again at 2000 hours, it was located perched in a woodland some 29 km west of the breeding territory (53°21′N/13°12′E). At the later time (2200 hours Central European Summertime), it would be dark even in August, so it can again be assumed that the bird spent the night there.

Apart from these long-range flights, the female had only a small home range (1.56 km^2 in size) (Meyburg et al. 2006).

Genetic tagging and genetic parentage analyses

Forty-nine out of 56 samples collected in 2004 (moult feathers, eggshells and blood samples) yielded sufficient DNA for definitive individual identification. In 2005, 41 additional samples out of 48 collected allowed individual identification. These samples, including some older ones, enabled genetic tagging of 36 individuals at 24 nest sites. The mean number of alleles per locus was 7.3. To date it has not been possible to assign one adult female (AP 04-23) to a breeding site. In addition to 10 nestlings (7 males and 3 females), 27 adults (8 males and 18 females) were identified (Table 1).

Several fresh primaries from AP 04-07 were found beneath eyrie D during the nestling period. In addition, feathers from two other females were recovered, one of them (AP 04-05) having its eyrie E some 57 km distant (Fig. 1). Of seven small feathers found directly beneath another eyrie (T), some 51 km distant, one

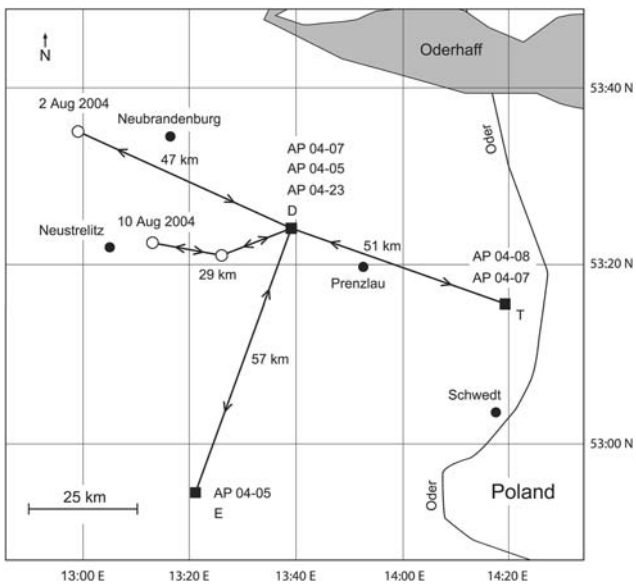

Fig. 1 The three eyries, D, E and T, (with distances) are shown, with the genetic code of the females whose moult feathers were found at the locations in 2004. Also shown, with dates, are the two northwesterly excursions of female AP 04-07 fitted with PTT 41861. These were determined by satellite telemetry GPS fixes

belonged to the female AP 04-07 fitted with the transmitter. This latter bird distanced itself therefore more than 50 km, in different directions, from its eyrie and eaglet.

In six cases the parentage of the nestlings could be established: at eyries A-H, D, E, Lau, T and LA, it could definitely be established that at least one of the adults was the parent of the nestlings. At eyrie D, where both parents (AP 04-07 and AP 04-09) were caught, the male and female parentage of the nestling AP 04-06 could be determined. As it was not expected that strange adults would visit the nest, blood samples to establish parentage were not taken from all nestlings in 2004. There was no evidence that the social parents were not also the genetic parents.

Feathers of female AP 04-05 were found at both eyries D and E, which lie 57 km apart (Fig. 1). This female bred at site E in both 2004 and 2005. It is indeed remarkable that two large primaries of this bird were found some 50 m away from eyrie D on 13 June 2004. This leads to the conclusion that the bird was there often, or over a long period of time, or both.

A primary from another female (AP 04-23) was found on 8 August 2004 immediately beneath eyrie D. It is not clear to which eyrie this bird belonged. In all, three primaries and one small feather of the resident female AP 04-07, two primaries of the strange female AP 04-05 and a further primary of another strange female, AP 04-23, were found at this eyrie. The pool of alleles represented at the different loci analysed, as well as the distribution of these alleles among the individuals, excludes the possibility that they could be sisters or even half-sisters. No feathers of the resident male were found, however, although he was moulting very strongly.

Direct observation at eyrie D in 2004

Strange adult Lesser Spotted Eagles were often spotted over the eyrie woodland during direct observations made in the period 8–18 August 2004. On occasion, up to four individuals were present simultaneously, sometimes together with the resident pair and circling at low altitude without any sign of aggressive behaviour. On at least one occasion, at 1538 hours on 14 August 2004, a strange individual was seen flying into the woods in the vicinity of the eyrie together with the resident female.

Behaviour of the females with PTT 41861 and 57117 in 2005

In 2005, female AP 04-07 with PTT 41861 was present in the general breeding area from 21 April to 5 September. During this period 130 GPS fixes were recorded. After its arrival, the bird at first sought out its old eyrie D where a male was already present. It could not be confirmed that it was the male from the previous year. Subsequently however, the female commuted several times between this old eyrie and another old eyrie (Kb) some 37 km distant to the south (Randowbruch area), which had also been occupied for a number of years. No eggs were laid at the old eyrie D, and no other female was observed there. At the new nest (K-b), a single egg was laid but was abandoned. It is not clear if the egg was laid by female AP 04-07.

From 14 May at 1500 hours until 16 May at 1300 hours the bird was again, as in the previous year, located in Gross Varchow woodland half way between Neubrandenburg and Waren (Müritz), some 47 km northwest of the 2004 eyrie D. This woodland, which had not previously been known as a breeding site for the species, was visited four times in 2005 and twice in 2006. On three occasions, a single Lesser Spotted Eagle was observed, although it was not the female with the transmitter (A. Hoffmann, personal communication).

The female also visited breeding site T again in 2005. The eagle spent the night of 30 April/1 May some 800 m from the once again occupied eyrie. On the following morning at 0800 hours it was located flying directly over the nest at low altitude. It was also located in several other areas of woodland where breeding activity had been suspected in the past but where breeding had not been confirmed. The total area of the bird's home range in 2005 was 2.287 km^2 (Fig. 2).

The female AP 05-35 fitted with PTT 57117 had a home range of at least 82.3 km^2 in area, which included the eyrie of the neighbouring eagle pair. In one case the female was directly observed only a few hundred metres distant from this occupied neighbouring eyrie. It was located noticeably often more than 3 km distant from its eyrie, proportionally more often than all three males (Meyburg et al. 2006).

Behaviour of the female with PTT 41861 in 2006

In 2006, the bird with PTT 41861 remained in the breeding area from 26 April until 5 September. During this period it was located 177 times, including a single fix at the 2004 nest site D. Again it had a very large home range (2,289 km^2) and, for example, visited the Gross Varchow woodland half way between Neubrandenburg and Waren (Müritz) on two occasions, some 77 km distant from its core area and which it had also visited in the previous 2 years. Sixty-four percent of all fixes, however, were concentrated in an area of only 3.26 km^2 in a wooded area southeast of Pasewalk.

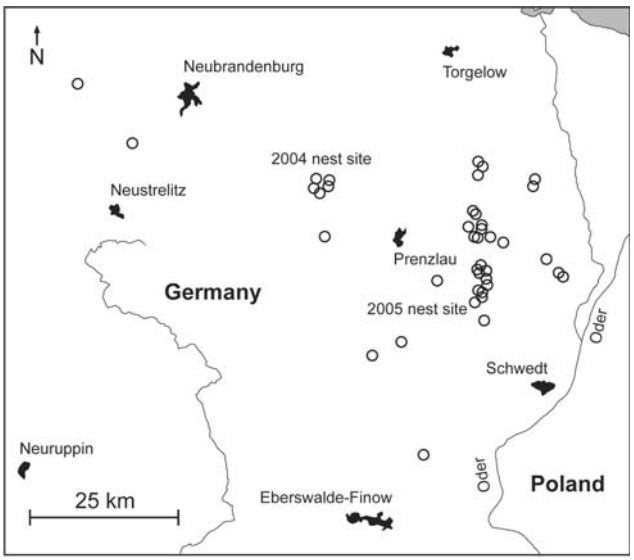

Fig. 2 GPS fixes of female AP 04-07 fitted with PTT 41861 in the breeding season 2005

A further 16% of fixes came from the Randowbruch, 23 km to the south, where the bird was also sighted directly on one occasion and where it had spent most of its time in 2005. For a period of several days, it was located there very close to an occupied eyrie (Sse). There were also several fixes from the proximity of the nest site Kb, which was occupied in 2005 but without successful brood. Altogether the fixes lead to the conclusion that the female did not breed.

Breeding site attachment, resettlement and turnover

In both 2004 and 2005, the presence of five females was confirmed at the same five breeding sites (AP 04-02, AP 04-04, AP 04-05, AP 04-08 and AP 04-13). Female AP 04-21, phenotypically a Greater Spotted Eagle (*Aquila clanga*), was observed again in 2005 at its old breeding site but did not lay eggs (J. Matthes, personal communication). The feathers collected from the adults at breeding site T in 1999 bore no relationship to the individuals living there in 2004 and 2005: male and female had therefore both been replaced.

Several eagles fitted with PTTs in previous years provided evidence of philopatry over a considerable number of years. A female fitted with a transmitter at breeding site CT in 1996 was still present there in 2004 (M. Neubauer, personal communication). A male fitted with a transmitter in 2001 at site G returned to the same breeding site until 2003. In 2004 it was paired at the neighbouring breeding site C, only 1.5 km distant. Two birds without transmitters were present at its old breeding site G. It did not reappear in 2005. As it was located for the last time on 7 April 2005 near Suez, it is assumed to have perished during migration. A female, also fitted with a transmitter at breeding site G in 2000, was in the following years always present some 45 km further to the east, but her eyrie was never found. This bird's PTT was located for the last time on 31 January 2006 in Namibia.

Another male fitted with a transmitter in 1996 at breeding site P-G bred there up to and through 2002. In April 2003, Argos transmissions stopped during migration in the Suez area. A male without a transmitter was subsequently present at the breeding site so that it can be assumed that the original male bird perished in the Middle East.

Both adult birds at breeding site G-BL were fitted with transmitters in 1996 and they were confirmed as being present in 1997 and 1998. In 1999, both adults present at this site were without transmitters (C. Rohde, personal communication), so that a change of both partners at this site probably also took place.

In 1999, the male at breeding site W was fitted with a transmitter and was also present in subsequent years. In 2002 and 2003, however, it returned to the site only at the end of May, by which time a new male had taken its place. In both years, the males tolerated each other with seemingly no great conflict. In 2002, the breeding attempt was unsuccessful, but in 2003, the late arrival, fitted with transmitter, helped with the feeding of the young bird (C. Rohde, personal communication). The female present in 2002 and 2003 had a ring and so was presumably the same bird in both years. No useful observations could be made in 2004. In 2005, however, both adults were caught and neither was ringed, showing that a change of partner had taken place in the meantime.

Discussion

The GPS transmitters have two advantages over transmitters with Argos fixes which use the Doppler phenomenon. The accuracy of GPS transmitter locations is guaranteed and much higher (±20 m or better) than all Argos fixes, and it additionally provides positions at regular intervals making it possible to study particular behaviour patterns, such as hourly movements.

Because the data are derived from only a small number of individuals, care should be taken when drawing general conclusions. Nevertheless, as ranging behaviour of adult female Lesser Spotted Eagles in the breeding area using GPS satellite telemetry has not been studied before, and because females are rarely

trapped, the data are potentially important. The questions addressed here, however, must be the subject of further study.

Territorial behaviour and home ranges

The amount of overlap in the home ranges of raptors varies from almost nil to almost complete, apart from nesting territories (Newton 1979). To date the Lesser Spotted Eagle has been regarded as territorial and as defending at least the immediate area of the eyrie against other individuals of the species (Wendland 1951; Meyburg 1991). According to Gedeon and Stubbe (1991), the Lesser Spotted Eagle is strongly territorial, and in both the immediate eyrie area, and in the hunting grounds, boundary crossing by individuals from neighbouring territories is observed extremely rarely. Our own earlier observations suggested that the hunting ground further from the eyrie area is not defended, which was confirmed in a study using VHF telemetry (Scheller et al. 2001). Even the immediate area of the eyrie is often defended only to a minor extent (Meyburg 1991).

According to our recent studies by means of GPS satellite telemetry, however, successful male breeders have a strong sense of territory without even an overlap between their hunting territories (Meyburg et al. 2006). The females on the other hand display very little or no territorial behaviour. Strange individual females are apparently tolerated in the immediate area of the eyrie by both resident male and female birds.

The differing opinions over territorial behaviour—from very pronounced to scarcely noticeable—in the relevant literature are therefore seemingly based on the obviously very different behaviours of males and females, a fact which was not recognised until now. The precise extent of this gender-specific difference, however, must be studied on the basis of a larger number of individuals.

Until now it has been assumed that females rearing a young bird remain within a radius of only a few kilometres from the eyrie, probably primarily to protect the offspring against enemies. For this reason they seldom go hunting themselves during the nestling period, and later only infrequently (Meyburg 1970). We have repeatedly recorded losses of fully feathered nestlings of eagles to Goshawks and martens, especially towards the end of the nestling period. With the help of VHF telemetry, it could be established in the case of two females that their home ranges were considerably smaller than those of males (Scheller et al. 2001).

On the other hand, the results of GPS satellite telemetry of two females show a differing picture. Female AP 04-07, apart from its distant excursions, had a very small home range of only 1.56 km^2. For female AP 05-35, however, a home range of 82.3 km^2 was recorded. This was larger than the territories of four males fitted with transmitters; only one male had a larger home range. A total of 28.9% of fixes of the female in July 2005 place it more than 6 km from the eyrie, although it had a large nestling.

Long-range flights and visits to alien, occupied eyries

The hypothesis, valid up to now, that successful reproducing females only move up to a few kilometres from their eyrie and nestling has been disproved by both satellite telemetry and DNA typing. In addition it has been established that strange females visit eyries containing young and possibly do so repeatedly and remain there for some time. This has been confirmed by both direct observation as well as DNA typing.

The long-range flights from the eyrie during the rearing of young determined by this study are indeed very surprising and, as far as we know, not known in any other raptor species. Even more surprising, however, is that alien, occupied eyries are visited and that the birds stay there for long periods without any obvious conflict with the resident birds. There can hardly be any other explanation for the discovery of several moulted feathers of strange females, especially primaries.

The flights of female AP 04-07, determined by two different methods, of up to over 50 km from her eyrie during the rearing of young, including at least one visit to an alien, occupied nest, are surprising and difficult to explain. The visits of two strange females to the eyrie of AP 04-07 are equally astonishing. The likelihood of determining such behaviour, even with the help of GPS satellite telemetry, is low because only a small part of the activity is recorded. It is impossible to determine this behaviour using conventional methods, except in a regular trapping programme (e.g. with the Kestrel *Falco tinnunculus* or Sparrowhawk *Accipiter nisus*). It is therefore suspected that the practice is more frequent than we know.

Female Sparrowhawks, once they stop brooding their young in summer, begin to range over wide areas, mainly in search of food for the young. Each female roams over an area containing the nests of several other pairs (Newton 1986). Two radio-tagged females were recorded up to 8.5 km from their nests, and in the process they passed through the nesting places of several other pairs (Newton 1986). I. Newton (personal communication) recorded females in the late nestling or post-fledging periods near the nests of other

individuals many times. The distances were much smaller, but considering that Sparrowhawks themselves are smaller, and that they nest at much higher densities, the phenomenon may be similar.

Female Goshawks (*Accipter gentilis*) also visit alien nests. Ziesemer (1983, 1999 and personal communication) caught a brooding female on 13 March 1979 on a nest 2.5 km southeast of its own eyrie and again on 27 June 1979 at another alien nest, with large young, 2.5 km northeast of its own breeding site. The behaviour of the female Lesser Spotted Eagle is, however, not directly comparable with the Goshawk observations as it visits much more distant eyries.

In Peregrines (*Falco peregrinus*) and Black Kites (*Milvus migrans*), extra adults sometimes appear for a time at Peregrine and Kite eyries during observer visits, joining the pair already present. This happens mainly in the nestling period. These extra birds are usually assumed to be 'floating' non-breeding females, but there is no evidence for this view, and they could be breeders from neighbouring nests. Similar observations are frequent in Ospreys (*Pandion haliaetus*), which often fly over other Osprey nests on their journeys between nest and feeding area, and these passing birds often linger near other occupied nests.

One can only speculate on the reasons for such behaviour in Lesser Spotted Eagles. They are exposed to great dangers on their extremely long migration to southern Africa, and there is evidence that adult birds are also shot down during their detour around the Mediterranean (Meyburg 2005; Meyburg et al. 1995). The situation could therefore sometimes arise that a female arriving back at its old breeding site does not find its partner of the previous year as it has been killed. It could be to the females advantage to familiarise itself with other breeding sites in the immediate and wider vicinity in order to find a new partner quickly. This also applies when she no longer finds the male at the old breeding site attractive, as was obviously the case in 2005 with the female fitted with PTT 41861 reported on in this paper. There is sometimes a gap of only a few days between arrival at the breeding site and egg-laying. The Lesser Spotted Eagle is under time pressure in this period.

According to current knowledge, males are markedly more philopatric than females (Meyburg et al. 2004, 2005). A bachelor male with his own eyrie will probably not leave its site but rather wait for an unattached female to move in. The reverse appears less probable. As the time gap between arrival and egg-laying is very short, familiarisation with other eyries is perhaps of particular advantage to the female.

Site attachment and resettlement

As most raptor species are found nesting in the same places year after year, it has often been assumed that individual adults are faithful both to their nesting territories and to their mates in successive years; studies with marked birds are rare however (Newton 1979; Jenkins and Jackman 1993; Forero et al. 1999; Wink et al. 1999; McDonald et al. 2003). It is known that Lesser Spotted Eagle breeding sites are often occupied for decades. On the other hand, practically nothing is known about the turnover rate of the adult birds. It was possible, for the first time, to prove genetically that almost all females bred at the same nest site for 2 consecutive years and, to prove with the assistance of telemetry that two resettlements of between 35 and 45 km took place. Firm evidence that females, like males, are present at the same breeding site for a considerable number of years is still mostly lacking. The period of 9 consecutive years reported here for the bird at site CT seems to be the longest known for a female. It was possible to establish longer presence at a breeding place in Slovakia in the case of a male fitted with a transmitter. It bred for 11 consecutive years, from 1992 to 2002, at the same site. This would appear to be the longest record to date of an adult bird's presence at the same breeding site.

The continuous presence of several males for a number of years at the same breeding site in Germany was established using telemetry. It could, however, also be proved that a marked male (G) had resettled, though only to a neighbouring site some 1.5 km distant. At one breeding site (T), after a gap of 5 years, both adults had changed, whereas the longest recorded presence of both partners of a pair at a breeding site (3 consecutive years) could be firmly established. In the same way that males settle markedly closer to their birthplace than females (Meyburg et al. 2005), they probably also remain at a chosen breeding site for a longer period of time. Further long-term studies are necessary, however, to gain information on the turnover rate or on resettlement, both factors being important for the protection of this rare species.

Zusammenfassung

Weshalb besuchen Schreiadler-Weibchen (*Aquila pomarina*) weit entfernte fremde Nester?

Es gibt kaum Informationen über die soziale Organisation von Schreiadler-Brutpopulationen, die turnover-Rate der Altvögel und deren Partner- und Brutplatz-

treue. Nach bisheriger Kenntnis verhalten sich brütende Schreiadler territorial und verteidigen mindestens den engeren Nestbereich gegen Artgenossen. Von den Weibchen, die einen Jungvogel zu versorgen haben, wurde bisher angenommen, dass sie sich—wie auch andere Greifvogelweibchen mit Nachwuchs—in einem Umkreis von wenigen Kilometern um das Nest aufhalten. Diese Hypothese wird durch Untersuchungen mit Hilfe der GPS-Satelliten-Telemetrie und von DNA-Analysen (DNA STR typing) widerlegt. Ein besendertes Weibchen (D) entfernte sich mindestens 50 km in zwei entgegengesetzten Richtungen von seinem Horst (D) und besuchte dabei ein fremdes besetztes Nest (T). Mindestens zwei fremde Weibchen besuchten den Horst D mit Jungvogel des besenderten Weibchens und hielten sich dort wahrscheinlich längere Zeit auf, wobei der eine fremde Vogel (E) von seinem Brutplatz aus 57 km Entfernung kam. Besuche fremder Altvögel an diesem Horst wurden auch visuell festgestellt. Es ist daher anzunehmen, dass Männchen nur untereinander Territorialverhalten zeigen, nicht aber gegenüber fremden Weibchen. Nach den hier getroffenen Feststellungen ist ferner zu vermuten, dass sich Weibchen untereinander nicht territorial verhalten. Diese Annahmen müssten jedoch durch weitere Untersuchungen überprüft werden. Eine nähere Verwandtschaft der sich besuchenden Weibchen (Geschwister oder Halb-Geschwister) konnte bei den DNA-Analysen ausgeschlossen werden. Erstmals konnte auf diese Weise nachgewiesen werden, dass fast alle untersuchten Weibchen in zwei aufeinanderfolgenden Jahren am selben Brutplatz brüteten. Der längste Zeitraum, über den beide Partner eines Paares an einem Brutplatz nachgewiesen werde konnten, betrug drei aufeinanderfolgende Jahre.

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