Meyburg, B.-U., T. Belka, Š. Danko, J. Wójciak, G. Heise, T. Blohm & H. Matthes (2005): Geschlechtsreife, Ansiedlungsentfernung, Alter und Todesursachen beim Schreiadler (Aquila pomarina). Limicola 19: 153-179
(In German with English captions, an English summary and 22 colour photos).

Summary

Age at first breeding, philopatry, longevity and causes of mortality in the Lesser Spotted Eagle *Aquila pomarina*

To date there are no definite conclusions as to the age at which the Lesser Spotted Eagle *Aquila pomarina* reaches sexual maturity. In the course of a long-term study we were able to trap 4- and 5-year-old ringed birds in Germany and Slovakia. A 4-year-old female and a 5-year-old male reproduced; another 4-year-old male had paired up and occupied a territory but did not breed (Tab. 1).
The 4-year-old female and 5-year-old male were already in full adult plumage, whereas the 4-year-old male still had a yellow nape patch as well as many fresh juvenile type feathers on various parts of the body, including typical juvenile plumage in the rump area. From this it appears that male Lesser Spotted Eagles attain full adult plumage and sexual maturity one year later than female birds.
Both male birds had settled markedly closer (4.7 and 8 km) to their birthplace than two females (59 and 90 km) (Tab. 1). 18 adult birds reached an average age of 10 ½ years (Tab. 2). Taking this and the average breeding success of the Lesser Spotted Eagle into account, it can be calculated that sexually mature females produce about 4.5 and males approx. 3.9 fledged young during their lifespan.
Shooting was by far the commonest cause of mortality of Lesser Spotted Eagles – at least 11 of 30 ringed individuals (Tab. 2, 3 and 4).
Some 1- and 2-year-old ringed Lesser Spotted Eagles returned to the breeding area during the breeding season. On the other hand, a 2-year-old eagle caught in August had remained in the wintering area in Zambia (Tab. 4). The prevailing behaviour is still unclear.

Complete translation

(as for the English captions of the photos and the reference list see the original printed article)

The age at which first breeding takes place, philopatry and the average and maximum age, are all important parameters for the formulation of population models and analyses, and consequently for management and protection projects (Böhner & Langgemach 2004, Meyburg et al. 2004).

There are no definite conclusions as to the age at which the Lesser Spotted Eagle *Aquila pomarina* reaches sexual maturity. Glutz von Blotzheim et al. (1971) suspected that it was in the third or fourth year of life. It is equally unclear how the Lesser Spotted Eagle changes the colour of its feathers from juvenile to immature and adult plumage, and when this colour-change is complete. Although various publications contain illustrations of different stages of the colour-change process, the exact differentiation of the stage reached in relationship to the marking is shown only in a minimal number of cases, if at all.

There is also very little information concerning the year in which the birds over-wintering in Africa first return to the breeding territory, and where they spend the time in the interim. Finally, there are practically no concrete data on the distance and direction flown by the eagles when they move away from their birthplace, to what age they survive and how

many offspring each individual produces.

This lack of knowledge is due to the fact that only a very small number of Lesser Spotted Eagles are ringed, the recovery rate is only approx. 2.5% and other methods of marking (e.g. identification rings, wing marking, fitting with transmitters) or the trapping of adult birds only began a few years ago. Danko et al. (1996) evaluated the known ring recoveries at that time and so was able to come closer to the clarification of a number of questions. In this paper, we report on newer results, gained by ringing and trapping.

Methodology

As part of a long-term study, adult birds in the North German (B.-U.M.) and Slovakian (S.D. & T.B.) breeding territories were trapped using the Dho-ghaza method. This involves using a decoy bird (e.g. Eagle Owl *Bubo bubo*, White-tailed Eagle *Haliaeetus albicilla*, Golden Eagle *Aquila chrysaetos*, Goshawk *Accipiter gentilis* or Raven *Corvus corax*) on a perch in front of a net set in the open. If the Lesser Spotted Eagles fly close enough to the decoy bird on one of their feint attacks they become entangled in the net. Up to 1993 trapped birds in Germany were fitted with satellite or ground telemetry transmitters and ornithological station rings (Meyburg et al. 1995, Scheller et al. 2001). In Brandenburg, from 2004 onwards, trapped birds were also fitted with identification rings. In 2004, four nestlings in Brandenburg were also colour-ringed for the first time. In Slovakia, two adult eagles were fitted with satellite transmitters (Meyburg et al. 1995, 2004). S.D. ringed 268 Lesser Spotted Eagles in Slovakia, 28 of which were also colour-ringed. The 23 mm wide identification ring has two letters, or one letter and one number, black on a yellow background. This combination is repeated 3 times so that it is visible from all directions. Since 1999, T.B. fitted 69 nestlings and 8 adults with ornithological station as well as identification rings. Finally, 783 nestlings in the Lublin region of eastern Poland were fitted with ornithological station rings. Eight recoveries resulted from these ringing actions. These recoveries, as well as all other previous ones known to us, are evaluated in this paper. Ring recoveries from Lesser Spotted Eagles up to one year of age have not been included however.

Results

Attainment of sexual maturity

According to Cramp & Simmons (1980), the age at which the Lesser Spotted Eagle reaches sexual maturity is unknown. The trapping of three eagles of known age in the breeding territory (Table 1) enables more exact assertions to be made for the first time. A four-year-old female (No. 1) and a five-year-old male (No. 3) reproduced successfully, whilst a four-year-old (No. 2) mated and held territory but had no nest. Several instructive detailed observations in the breeding territory of these individuals are reported here.

The single offspring of female No. 1 fledged on 9 or 10 August. The female, which was fitted with a satellite transmitter with GPS locating device, left the breeding territory as early as the morning of 7 September and wintered in Namibia. Nevertheless, calls were heard from the area of the nest on 20 September, which indicated that feeding was taking place. It seems that the male was still caring for the young bird (G.H.).

The four-year-old male No. 2 originated from one of very rarely successful second broods. It is assumed that in addition to this male, the female that hatched second also fledged. This male was first sighted on 12.07.2004 in an area which had previously held no breeding pair and where it had not been observed on 15.05.2004. As the bird had an identification ring, it was carefully monitored by T.B. The male bird kept company with an unringed female, in fully coloured plumage, in a wood in the Spisska Magura Mountains in North Slovakia. The wood runs for some 500 m (at 600 m a.s.l.) alongside a small river and was directly adjacent to some 10 ha of freshly mown grassland where the birds hunted for food. The pair often perched at the wood margin and drove off Ravens *Corvus corax* and Common Buzzard *Buteo buteo*. They definitely had no nest, as the area was thoroughly searched and no transport of food was observed.

On 12.07.2004, around 13.00, the male caught a small mammal. The female flew to the male on the ground, took the prey from him, and consumed it immediately. Somewhat later, the male caught another item of prey that he then devoured. On 14.07.2004, the female caught a mouse in the meadow and the male flew to her. He did not however dare to approach her closer than 3 m and she consumed the prey herself.

On 12.07.2004, the male was observed on the topmost tip of a spruce where he took up a horizontal position for several minutes, flapped his wings and called. The female did not react, however. Both eagles were observed circling together.

Although Lesser Spotted Eagle pairs without young do not usually allow themselves to be trapped using the Dho-ghaza method, as they do not react aggressively to the decoy bird, this male behaved very belligerently towards the stuffed Eagle Owl. He attacked the decoy with a series of rapid dives from a height of 100–150 m, and got caught up in the net on the fourth attempt. The bird was then identified beyond doubt by its ring.

The five-year-old male No. 3 had an nestling weighing 840 g on 10.07.2004. At the same time most of the other young eagles in the region were somewhat further developed. Whether or not the nestling successfully fledged could not be determined..

Change in plumage colour

The one-year old female No. 36 still had a dark brown iris, and the nape patch and spots on the secondary coverts were still visible. The juvenile plumage was intact; the trousers were light coloured with brown spots (U. Kraatz verb.). The four-year-old female No. 1 (weight 1,150 g, wingspan 164 cm, wing length 51 cm, body length 61 cm) had the plumage of an adult bird. The head feathers were comparatively dark in colour. Nevertheless, three greater secondary coverts and three greater primary coverts had white tips. The tail feathers had bands of differing colour intensity with the bands of the newer feathers being fainter than the older ones. The two older outermost feathers still had a markedly light tip. The iris was pale yellow and, as in other adult Lesser Spotted Eagles, had brown spots in the lower halves of both eyes.

The male caught at the same time (weight 1,250 g, wingspan 147 cm, wing length 44.5 cm, body length 54 cm), which appeared to have fully coloured plumage, had bands on the tail feathers visible as pale above and darker below, a juvenile characteristic. Three tail feathers showed a striking, narrow white terminal band, which according to Cramp & Simmons (1980) is also a juvenile characteristic. The iris was light yellow and had brown spots.

The four-year-old male No. 2 (weight 1,450 g, wing length 47 cm, tail length 28 cm) still had many feathers with white and yellow spots on several parts of the body, especially on the breast, belly and rump, which is characteristic of juvenile birds that are incompletely coloured. Interestingly enough, these feathers were in part new ones. There were, however, no drop-shaped spots at all on the upper wing feathers, by which young Lesser Spotted Eagles in the open can best be identified.

The nape and back still showed fresh plumage with typical juvenile spots visible, and the golden yellow nape patch, a typical characteristic of a juvenile Lesser Spotted Eagle, was even more markedly pronounced.

Viewed from above, the tail had noticeable bands and five tail feathers had a relatively wide, yellowish, terminal band. Viewed from below, two further, not completely developed, feathers in the centre, with noticeable whitish tips, were visible. The iris was yellow with light brown spots in the lower half.

When observed from a distance of some 100 m with a 60x telescope (Meopta), the birds could be identified as sub-adult based on several characteristics (yellow stripes and spots on the breast and flanks); but the yellow nape patch was not apparent.

The five-year-old male No. 3 was in adult plumage with no remaining spots on breast and belly and no sign of a nape patch. The complete bottom half of the iris was brown and the upper half paler, somewhat brownish-yellow. The periphery of the iris had a narrow yellowish to ochre coloured rim.

Distance of settlement from birthplace

For four of the trapped birds, all parameters (birthplace, age, sex, settlement area, and breeding success) that are required for clarification of the birds' philopatry were known (see Table 1). Accordingly, it seems that males settle closer to their birthplace (up to 10 km distant) than the females (up to 100 km distant).

Age

The 12 birds found in the breeding territory (Table 2) had an average age of somewhat over 11 years whereas the five found on the migration route (Table 3) averaged only just nine years. The average age of all 17 adults was 10.5 years.

Whereabouts and return of young birds

The combined ring recoveries of one- and two-year-old eagles, as well as the

observations of a bird with wing markings, are shown in Table 4. We have no information on ring recoveries or definite observations of three-year-old birds.

Three one-year-old birds were present in the breeding territory. Seven of the eight two-year-old birds were either present in the breeding territory or on migration; that is they were already returning. Eagle No. 35 appears to be the only definite proof of the stopover of a one- or two-year-old Lesser Spotted Eagle in the wintering region during the breeding season.

The eight eagles which were still non-breeding and which were observed or found in the breeding territory stayed between 28 and 800 km, on average 334 km distant, from their birthplace.

Causes of mortality

By far the most common cause of death was by shooting (see Table 2, 3 and 4). At least 10 of the 31 eagles that had returned, and referred to here, were shot. Eagle No. 25 was very probably shot as well because in the Near East, especially in Syria, the Lebanon, and Turkey, a great deal of hunting takes place (Leshem 1985, Meyburg 2005).

The mortality rate of the adult birds on migration was very high (Table 3) - at least four of the five individuals - in comparison to recoveries in the breeding territory (Table 2). A further example is an adult bird not shown in the table which was caught and ringed as an adult by U. Bergmanis (corresp.) and was shot two years later near Samandag in Turkey (c.f. eagle No. 21). Several of the eagles fitted with transmitters by B.-U.M. were probably also shot, as location transmissions ceased abruptly during migration over Turkey and the birds failed to return to their breeding site.

Four out of 14 one- and two-year-old individuals were shot in the breeding territory, but there was 'only' one proven case of an adult bird being shot. A further case of a one-year-old shot in Belarus was referred to by Dombrowski (2004). Two adults were found with broken wings and a further three were discovered ill, injured, or exhausted. Three eagles, belonging to all age classes, were electrocuted by flying into power cables, and one adult bird by road traffic. Four adult Lesser Spotted Eagles were found dead in the last few years in Brandenburg; but as they were not ringed they are not included in the statistics in the tables. In one case, death was due to internal illness and another to an injury of unknown origin. Only the old remains of two other birds were found (T. Langgemach corresp.).

Discussion

The attainment of sexual maturity

The three trappings of adult Lesser Spotted Eagles of known age lead one to believe that females reach sexual maturity earlier than males. Danko et al. (1996) collated all available ring recoveries of the species from the various ornithological ringing stations. The age at which sexual maturity is reached cannot be determined from these. From the results presented in this paper it is clear that in any event male Lesser Spotted Eagles are not sexually mature until they are five years old, considerably later than suggested by Glutz von Blotzheim et al. (1971). Whether or not the four-year-old female that bred successfully at four years of age possibly also bred as a three-year-old can unfortunately not be clarified. The number of individuals in the survey is of course far too small to clarify this matter once and for all. For this, more observations are necessary.

A comparison with the Spanish Imperial Eagle *A. adalberti* is interesting. This species breeds not infrequently in juvenile plumage, and the male evidently also attains sexual maturity later. Calderón et al. (1987) observed six pairs in the Doñana region all of which had a partner with incompletely coloured plumage. In four cases the female was in juvenile plumage, four clutches were begun and one eaglet was reared to fledging. In both other

cases where the male was in juvenile plumage, nests were built but no eggs were laid. Ferrer (2001, p 95), taking the quality of the individual territories and on the basis of a larger sample, believed it could be concluded that immature pairs, including those of two immature individuals, could breed just as successfully as adults.

The considerably larger and closely related Golden Eagle *A. chrysaetos* breeds probably in most cases at the earliest when it is four years old (Watson 1997). Six individuals in North America, ringed as nestlings, were observed breeding at an average age of 4.7 years (earliest four, latest seven years) (Steenhof et al. 1984).

Colouring

Forsman (1999, pp 324-325) demonstrated the difficulty of determining the age of incompletely coloured Lesser Spotted Eagles, and the point in time at which adult plumage is complete. His assertions were based on observation and photographs of free-flying individuals, mainly on migration over Israel, without however determining precisely the actual age. Nevertheless, his study concludes that the birds attain full adult plumage at an age of some four to five years. According to Cramp & Simmons (1980), the adult plumage is not complete before the fourth year of life; Ferguson–Lees & Christie (2001) give the September of the fifth year. Clark (1999) states that the eagles are essentially in adult plumage by the fourth winter, although some birds can still display immature feathers. New upper-tail coverts are mid-brown with whitish tips.

Some differences of opinion on the individual stages of the colour-changes, and the point in time at which full adult plumage is attained, still exist therefore. According to the results presented here the male birds appear to attain not only sexual maturity later than females, but also need more time until all feathers with typical juvenile colouring have disappeared. There is, however, probably a great deal of individual discrepancy in the time scale. Cramp & Simmons (1980, p 210) state that almost five-year-old individuals can still have a rusty-yellow nape patch and juvenile-like plumage spots.

It still remains to be established that sexual maturity and the attainment of full adult plumage in eagles do not necessarily need to occur simultaneously. Both Imperial Eagle species (*A. heliaca* and *A. adalberti*) for example, breed successfully relatively frequently in juvenile plumage (Ferrer 2001).

In Brandenburg, T. Langgemach (corresp.) found juvenile moult body feathers beneath the nests of successful breeders on at least three occasions. According to him, many skins of adult birds in the Naturkundemuseum in Berlin still reveal immature feathers among the body feathers. It is possible that some adult birds always retain individual juvenile feathers. For example, on 06.07.1997 B.-U.M and J. Matthes trapped a male in Mecklenburg West Pomerania that displayed juvenile body feathers, particularly in the rump area, but also in part on the breast, belly, and underwing. It was caught again on 18.07.1998. There were six juvenile plumage feathers on the nape that had not been there the previous year, and there were also new feathers with juvenile colouring on the back and rump. The lower half of the iris of both eyes was still partly brown. The male bred successfully in both 1997 and 1998. Several other successful breeders trapped by B.-U.M. in MecklenbuitsdWest Pomerania displayed individual juvenile plumage feathers.

In this connection the observation of a Lesser Spotted Eagle male, which U. Bergmanis trapped and ringed at its breeding site in Latvia, is remarkable. P. Wernicke (corresp.) observed the same bird in August 2003 at the same location. This male was very dark in colour and had a dark iris (Plate 16). The remnants of the juvenile spotting in the nape and breast area are very conspicuous. The bird had bred for many years and still had the spots.

Also of interest is a reproducing Spotted Eagle *A. clanga* trapped in Poland, which, like the Lesser Spotted Eagle males Nos. 2 and 3, also had many fresh, spotted juvenile-like feathers in the rump area (Meyburg et al. 1997).

Continual observation of captive birds, to determine when for example the juvenile nape

patch is replaced by the adult colouring, when the iris becomes yellow and how the drop-shaped spots of juvenile plumage disappear, has unfortunately not been carried out to date. Such studies should however take account of the fact that colour change in captivity often takes much longer than with wild birds (Glutz von Blotzheim et al. 1971 p 623). Should in future a young Lesser Spotted Eagle be caught and kept in captivity, these details must in any event be recorded and photographically documented, even if the changes take place on a different time scale to those of wild birds. A captive Spanish Imperial Eagle, for example, attained full adult plumage not before it was six years old (Meyburg & Meyburg 1991).

The time scale of the colour-change in the iris, which is pale in young and amber coloured in typically adult birds, is also still unclear. A Lesser Spotted Eagle in Rostock Zoo, which had reached some 20 years of age, had a light blue-green iris (J. Matthes verb.).

In contrast to the Lesser Spotted Eagle, adult Greater Spotted Eagles have a dark iris (Meyburg et al. 1997, Plates p 84) which is an important identification characteristic in separating the species. In an area in Mecklenburg-West Pomerania, well outside the distribution range of *A. clanga,* mixed breeding has been observed over a number of years and confirmed by DNA analysis (J. P. Schwanbeck verb, own unpublished data, Helbig et al. 2005). In one instance an eaglet fledged. A second mixed pair on the western edge of the distribution range of *A. pomarina* in Mecklenburg-West Pomerania was confirmed in two successive years by H.M. (also verb. J. Matthes). Eggs were laid in 2004 but no chick was hatched. In 2005, the eagles again left the nest before laying eggs. In the overlap region of the species in Poland (own unpublished data), Estonia (Lõhmus & Väli 2001), Latvia (Bergmanis et al. 1997, Bergmanis & Strazds 2001) Lithuania (Treinys 2005) and Belarus (Dombrowski 2002, 2005) quite a few mixed pairs have been observed in the past few years. This hybridization apparently seems to result in the iris of adult Lesser Spotted Eagles (or hybrids?) not being amber-yellow. U. Bergmanis (verb.) managed to trap three successfully breeding eagles in Latvia with a dark iris, which otherwise were identified phenotypically as Lesser Spotted Eagles (Plates 17-19). Perhaps they were actually hybrids that matched the Lesser Spotted Eagle phenotype to the greatest possible extent.

In this connection the observation of a Lesser Spotted Eagle male, trapped and ringed by U. Bergmanis in 2001, is also remarkable. P. Wernicke (corresp.) observed this bird in August 2003 at the same location and was able to photograph it in Spring 2005. The male is rather dark coloured for a Lesser Spotted Eagle and has a very dark iris. The remnants of the juvenile spots in the nape and breast areas are also very conspicuous (Plate 16). The bird has bred for several years and still displays the spots.

B.-U.M., H.M., K. Graszynski, and T. Mizera trapped a possible hybrid in Poland on 19.07.2002, which however was more strongly reminiscent of a Greater Spotted Eagle. This male had a markedly lighter iris than is usual in the Greater Spotted Eagle, not yellowish, however, as in the adult Lesser Spotted Eagle. In addition, the head was altogether conspicuously pale coloured. This bird had produced an eaglet together with a Greater Spotted Eagle female. The eagle was fitted with a satellite transmitter and its migration behaviour was that of a Greater Spotted Eagle. Finally, an eagle wintering in Spain was classified as a possible hybrid (Gutiérrez & Villa 2002).

It is probably acceptable to categorize brownish spotting in the otherwise yellow iris, which is usually present, as an individual characteristic of Lesser Spotted Eagles. It is well worth the effort to note and photograph these details exactly for later re-identification. P. Wernicke (corresp.) was able to prove philopatry in a male in Latvia based on the iris pattern. This bird had a pale iris with a characteristic spot pattern. The bird was photographed at the same location in August 2004 and in April 2005. The iris pattern was identical.

Settlement distance

Animal philopatry demonstrates an aspect of settlement behaviour and consequently population dynamism. The term philopatry can be regarded from the viewpoint of the individual's relationship to its birthplace, or the habitat and breeding site selected later. In modern ornithology, the population biology based on this aspect plays a considerable role, because it is closely related to human influence and issues of conservation (Newton 1998). Additionally, comparative studies of individually marked birds are also used, for example, to analyse life cycles and mating techniques, the principles of which can generate data about their evolution and the extirpation probabilities of a species.

Both Lesser Spotted Eagle males described settled markedly less distant (4.7 and 8 km) from their birthplace than the two females (59 and 90 km) (see Table 1).

The other 12 adult Lesser Spotted Eagles, the sex of which was not determined, were relocated during the breeding season and are listed in Table 2. They probably did not breed in every case, which makes the calculation of the settlement distance problematic. These birds settled at an average distance of 110 km (0 – 550 km) from their birthplace. Interestingly enough two eagles were located directly at their birthplace, where they seemed to have settled.

Age, individual breeding success, and change of partner

There are no dependable data on the life expectancy or annual mortality rate of adult birds, as the mortality rate of adult eagles is very difficult to establish. Estimates are based normally on the numerical ratio of incompletely coloured birds to adult individuals observed. It can be assumed that, in a stable population, the loss of adult birds equates to the influx of sub-adult individuals (Newton 1979). It is therefore important to be aware of this numerical ratio.

Bezzel and Fünfstück (1994) estimated the average life expectancy of adult Golden Eagles in the German Alps as somewhat less than 13 years. A life expectancy of 10.5 years for the much smaller Lesser Spotted Eagle would fit well into this picture. On the other hand, the Spanish Imperial Eagle, which is almost as large as the Golden Eagle, is credited with an average life expectancy of 21 to 22 years (Ferrer 2001). In this latter study the three oldest ringed birds, with ages of 18.5 and 21.5 years, were however markedly younger than the oldest known Lesser Spotted Eagle.

Bezzel and Fünfstück (1994) estimated the annual mortality rate of adult Golden Eagles at 0.92% and the survival rate at 92.5%. K. Nellist & Crane (in Watson 1997) estimated the latter at 97.5% for the Golden Eagle in Scotland. This figure would give a life expectancy of over 39 years.

Assuming that the average life expectancy calculated here of 10.5 years for the Lesser Spotted Eagle is correct, and that females are sexually mature at four years and males at five, it would mean that females would produce on average a maximum of 7.5 and males of 6.5 fledged young in the course of their lifetime. As, however, the average breeding success can be accepted as only 0.6 young per pair/year (including non-breeding pairs), it would mean that females would produce on average only 4.5 and males only 3.9 fledged young in the course of their lifetime.

A reproduction factor of 0.6 young per pair/year is assumed here, as in a population simulation for Brandenburg (Böhner & Langgemach 2004, Meyburg et al. 2004) for the average number of breeding successes. In the 1990s in Mecklenburg West-Pomerania this figure was only 0.5 (Scheller et al. 2001). A correspondingly lower average breeding success would be anticipated here.

A breeding male ringed in Slovakia in 1992, at that time of unspecified age, and which survived until the start of the 2002 breeding season, produced six young within the ten breeding periods (Meyburg et al. 2004). The oldest known Lesser Spotted Eagle at 26 years of age (No. 16) could have produced theoretically 21 fledged young in its lifetime, leaving aside the rare cases of successful second broods. As with other species, the

breeding success or occurrence of individual pairs varies greatly. Relatively few pairs are responsible for the majority of offspring.

The breeding occurrence of female No. 1, with a breeding success rate since 1976 of 0.71 young per year – with the exception of the unsoundly documented year 1991 – is amongst the most successful in Brandenburg (G.H., T.B.). The fact that this breeding occurrence existed over several decades, and that young Lesser Spotted Eagles were reared in many of those years, but that in 2004 a young female was definitely observed, confirms earlier suspicions (Meyburg 1991) that a change of partner can take place unnoticed. Important information on this aspect, and on the individual reproductive success, will hopefully be gained in future from individual markings on identification rings visible from a distance, and by DNA analysis.

Whereabouts and return of young birds

In contrast to young Greater Spotted Eagles, Lesser Spotted Eagles with incompletely coloured plumage are observed only exceptionally in countries with a breeding population, but are possibly often overlooked. J. Svehlik (verb. and in Cramp & Simmons 1980, p 207) observed a gathering of 20 immature and non-breeding adult birds in East Slovakia. Dombrowski (2004) observed in 1999-2002 17 immature Lesser Spotted Eagles in Belarus and found a further seven among 39 skins in Moscow and Minsk museums. He also mentioned an additional case in Lithuania. A young Lesser Spotted Eagle, ringed in August 1956, was 'collected' (i.e. shot) on 10 July 1957 in Orsha, eastern Belarus (R. Patapavicius in Dombrowski 2004). In the Ivanovo region, 200 km east of Moscow and at the outermost north-eastern edge of the distribution range, a possible previous year's individual was observed on 14 August (Melnikov et al**.** 2001). Equally remarkable is the first confirmed sighting in Germany of a one-year-old Lesser Spotted Eagle by Ulf Kraatz (verb.) on 21.07.2005 in Randow, north-east Brandenburg, not far from its birthplace. The colour-ring (9 B) on the left leg could be read clearly through a telescope at a distance of 40 m. The eagle was hunting in loose companionship with a number of other Lesser Spotted Eagles, among which there was at least one other non-fully coloured individual.

This observation is also remarkable in another respect. Second-hatched Lesser Spotted Eagles survive extremely rarely beyond the first few days in the nest. They almost always fall victim to so-called Cainism (Meyburg 2001). In 1968, Meyburg (1971) developed a method of preventing the death of the second-born bird and this technique was re-started in Brandenburg in 2004. Eagle no. 36 was the first second-hatched young bird to survive through human intervention. Observation continued until it left the breeding territory. New observation and confirmed ring reading of this individual provided the first evidence that a second-hatched Lesser Spotted Eagle, saved through human intervention, was also fit enough after becoming self-dependent to survive the migration to Africa and the return flight to the breeding territory.

In answer to the repeated question as to where the young eagles spend their first year of life (Meyburg 1991) it has now been established that at least some one-year-old individuals, as well as two-year-old birds, return to the breeding territory. An additional and very valuable piece of information is the only ring recovery report to date, which locates a two-year-old bird (No. 35) in the African wintering area in Zambia in August – i.e. during summer in the northern hemisphere. Whether or not the majority of two-year-old birds already return to the breeding territory, as can be interpreted from Table 4, seems questionable however. The probability that the presence of a bird is observed, or reported, is much more unlikely in Africa than in Europe. The argument for a not inconsiderable number of birds of this age category remaining in Africa during summer is supported by the observation of two immature individuals at the beginning of July and the end of August in Rwanda (Van de Weghe 1978). How large the percentage of returning birds is in comparison with those remaining in Africa can only be clarified by further studies, in particular with the help of satellite telemetry.

The open question of the whereabouts of sub-adult Egyptian Vultures *Neophron* percnopterus could also be answered in one instance by the use of satellite telemetry. A young bird remained continuously until attaining three years of age in its African wintering area (Meyburg et al. 2004).

Bird No. 31 in Table 4 is probably a Greater Spotted Eagle as the recovery location is markedly north of the breeding range of the Lesser Spotted Eagle.

A female immature Lesser Spotted Eagle trapped on 09.02.1994 in Namibia was fitted with a satellite transmitter (Plate 20). Spots covered the whole body, more marked than is usual, although it no longer had a nape patch. The iris was almost as yellow as that of an adult bird. It was estimated to be not quite two years old. The bird left its wintering area in Namibia at the end of February but did not arrive in its summer quarters in eastern Hungary until 26 June. The bird took more than two months longer on the homeward journey than two adults fitted with transmitters. These, however, were breeding males (Meyburg et al. 1995, 2004).

Another not fully adult female Lesser Spotted Eagle, trapped on 11 February 1994 and classified as sub-adult, already had a completely yellow iris and uniformly brown plumage with only very few individual paler spots. It was estimated to be at least three years old. This bird left Namibia at the end of March on migration and reached its summer quarters in the south of the Ukraine on 30 May, i.e. 1.5 months later than breeding birds. It left for Africa again around 10 September (Meyburg et al. 2001).

Wernicke (2005) laid out bait at a location in Latvia from 28.04 to 06.05.2004, which he observed and photographed from a hide. He saw the resident breeding pair daily on the bait and, on both 28 April and 1 May, another non-adult bird. The age of the immature eagle (Plate 15), photographed whilst flying off, was determined with the help of W. S. Clark (corresp.) using his method of judging the moult of the primaries (Clark 2004). This put the bird at two years of age as it had begun its second moult. During the first moult, it had moulted up to P8, whereas P9 and P10 remained unmoulted. The second moult had begun with the first primary.

Although the breeding pair defended the bait against strange adult eagles, and also Common Buzzards and Ravens, no active attempt to drive off the non-adult bird was observed. Wernicke also established that experienced Lesser Spotted Eagles did not recognise a non-adult eagle at a distance of only 200-300m.

In the Uckermark, B.-U. and C. Meyburg once observed how an immature or sub-adult individual visited a Lesser Spotted Eagle's nest and remained there for about 10 minutes. Unfortunately they were not able to observe what it did there. During this period, the adult eagles were far away in their hunting grounds. As the nest in question had been occupied consecutively for a number of years, the possibility that the visitor had been born there cannot be excluded.

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Table 1: Details of the ringing of 4 nestlings, place and age of trapping and reproduction behaviour

No.	Birthplace and date of ringing	Location and date of trapping	Time gap until re-trapped	Distance and direction from birthplace	Name of trapper and other details
1	Near Demmin (Mecklenburg West Pomerania)[1] 53°45' N / 012°59'E 31.07.2000	Northern Uckermark[1] 17.7.2004	4 years	59 km SE	B.-U. Meyburg et al. (this paper), reproducing female, eaglet fledged
2	Podolinec, Panske luky, Spisska Magura Mountains, East Slovakia 49° 17´00´´N/ 20° 35´10´´E 14.7.2000	Between Kamienka and Stranany, Spisska Magura, East Slovakia 49°21´20´´N / 20° 35´00´´E 12.7.2004	4 years	8 km N	T. Bělka (this paper), paired, non-breeding male holding territory
3	Vysne, Ruzbachy, Spisska Magura, East Slovakia 49° 17´30´´ N/ 20°33´00´´ E 18.7.1990	Kamienka, Spisska Magura, East Slovakia 49°19´40´´N / 20° 35´00´´E 16.7.1995	5 years	4.7 Km SE	T. Bělka (this paper), reproducing male with eaglet
4	Zempleni Mountains, Hungary 48°13'N/ 21°23'E 8.7.1989	Závadka, East Slovakia 48°56'N/ 21°52'E 29.7.1996	7 years	90 km NNE	Š. Danko (this paper), reproducing female with eaglet

[1] = exact location not given for security reasons

Table 2: Details of ringing of nestlings, recovery location, age and cause of mortality of adult LSEs reported from the breeding areas

No.	Birthplace and date of ringing	Recovery location and date	Time gap to recovery	Distance and direction from birthplace	Source, recovery details and other comments
5	Stale, gm. Grębów, woj. Podkarpatskie, Poland 50°31,821´N/ 21° 46,947´E 8.7.97	Zbydniów, gm. Zaleszany, woj. Podkarpatskie, Poland 50°38´N / 21°57´E 2.7.2001	4 years	16.4 km	J. Wójciak (this paper), remnants of the cadaver only found at entrance to fox's den
6	Desznica, Nowy Zmigrod, Podkarpatskie, Poland 49.33 N / 21.29 E 27.6.1999	Near Hrabské, Bardejov District, East Slovakia 49.20.03 N/ 21.04.03 E 9.7.2004	5 years	38 km SW	Š. Danko (this paper) & M. Stoj corresp., found exhausted, released on 2. 9. 2004 after healing
7	Rujiena, Latvia 28.7.1950	Saulkrasti, Latvia 19.6.1955	5 years	80 km SW	Danko et al. 1996, shot
8	Launingken, former East Prussia 3.8.1933	Launingken, former East Prussia 13.9.1938	5 years	0 km	Tischler 1941, found in poor health at birthplace
9	Dusetos, Lithuania 55°44'N/ 25°52'E 20.7.1987	Suwalki, Poland 53°56'N/ 22°59'E 31.7.1993	6 years	272 km SW	Danko et al. 1996, found dead. Probably flew into power line
10	Horostyta, gm. Wyryki, woj. Lubelskie, Poland 51°36.600´N / 23° 13.500´E 08.07.1989	Piotrowice, woj. Świętokrzyskie, Poland 50°12´N / 20°39´E 16.06.1996	7 years	240 km	J. Wójciak (this paper) Electric shock
11	Medzev, East Slovakia 48°40' N/ 20°53' E 3.7.1993	Vranov nad Toplou, East Slovakia 48°53'N/ 21°41' E 20.8.2002	9 years	61 km ENE	M. Dravecky corresp., found with broken wing
12	Budos Miskas, Kaisiadorys, Lithuania 55°54'N/ 24°50'E 4.7.1929	Budos Miskas, Kaisiadorys, Lithuania 55°54'N/ 24°50'E 24.4.1940	11 years	0 km	Danko et al. 1996, found injured at birthplace
13	Schorfheide, Brandenburg 53°02'N/ 13°50'E 17.7.1954	Falkenthal, Brandenburg 52°54'N/ 13°18'E 6.8.1971	17 years	12 km WSW	Schlenker 1975, victim of vehicle traffic, found dead
14	No details	No details 6.8., no year given	18 years	39 km	Mikhelson (in Mikhelson & Viksne 1982)
15	Hlboká dolina near Hýľov, East Slovakia 48°45´N/ 21°03´E 10.7.1983	Bodorka near Medzev, East Slovakia 48°42´N/ 20°50´E 2.9.2004	21 years	17 km WSW	Š. Danko (this paper) & M. Dravecky corresp., breeding bird with broken wing found one km from eyrie, second oldest known to date
16	Lubana, Latvia 2.7.1931	Porecja, Belarus 7.8.1957	26 years	550 km SSW	Kasparson 1966, found dead, oldest known Lesser Spotted Eagle to date

Table 3: Details of ringing, recovery location, age and cause of mortality of adult LSEs from migration routes

No.	Birthplace and date of ringing	Recovery location and date	Age reached	Source, recovery details and other comments
17	Podbiel, Slovakia 49°17' N/ 19°33' E 19.7.1986	Latakia, Syria 35°48' N/ 35°32' E March 1991	5 years	Danko et al. 1996, shot
18	Kisielce, Poland 53°36' N/ 19°16' E 9.7.1981	Ghuta, Syria 33°30'N/ 36°19' E 13.10.1988	7 years	Danko et al. 1996, found with gunshot wounds and taken into care
19	Tula, Russia 54°45' N/ 37°40' E 25.7.1951	Ramat Yeshai, Israel 32°42' N/ 35°10' E May 1959	8 years	Danko et al. 1996, details of cause of death unknown
20	Pitkanomme, Estonia 58°23' N/ 24°33' E 3.8.1964	Pleven, Bulgaria 43°23' N/ 24°37' E 1976	12 years	Danko et al. 1996, found shot, exact date of death unknown
21	Zemplinska Teplica 48°39´ N/ 21°32´ E East Slovakia	Samandag, Turkey 36°04´ N/ 36°02´ E 1999	12 years	Š. Danko, shot

Table 4: Details of ringing, recovery location, age and cause of mortality of 1 and 2 year old marked LSEs

No.	Birthplace and date of ringing (marking) as nestling	Recovery or observation location and date	Age reached (or age when observed)	Distance and direction from birthplace[1]	Source, recovery details and other comments
22	Kolonia Górka, gm. Mircze, woj. Lubelskie, Poland 50°38´N / 23°59´E 25.6.2002	Ojsławice, gm. Secemin, woj. Świętokrzyskie, Poland 50°42´N / 19°52´E 13.6.2003	1 year	291 km SW	J. Wójciak (this paper), injured by electric shock, taken to rehabilitation centre
23	Lubana, Latvia 2.7.1935	Kiev, Ukraine 12.9.1936	1 year	800 km SSE	Kasparson 1966, Recovery details unknown
24	Birza, Lithuania 56°12' N/ 24°44' E 1956	Orsha, Vitebsk, Belarus 54°30' N/ 30°25' E 7.10.1957	1 year	406 km E	Danko et al. 1996, shot
25	Snepele, Kuldiga, Latvia 56°50'26''N/ 21° 56'52''E 05.07.1965	Lebanon 32°55'N/ 35°4'E	1 year		U. Bergmanis corresp., no details on cause of death but probably shot
26	Kamienka, East Slovakia, 49°20' N/ 20°37' E 13.7.1996	Letsitele, South Africa, 23°52' S/ 30°15' E 24.12.1997	1 ½ years		J. Vrána corresp., decayed cadaver found
27	Teici, Latvia 56°35' 57''N/ 26° 36'57''E 16.7.2001	Samandag, Hatay, Turkey April 2003 36°30'5'' N/ 36°11'31''E	2 years		U. Bergmanis corresp., shot
28	Hromoš, East Slovakia 49°15´ N/ 20°48´ E 20.7.1999	Čaňa, East Slovakia 48°36´ N/ 21°19´ E 15.11.2001	2 years	80 km SSE	Š. Danko (this paper), found freshly dead
29	Kalkenhof, Poland 53°34' N/ 21°00' E 20.5.1932	Pewel Slem, Poland 49°41' N/ 19°19' E 15.10.1934	2 years	450 km SSW	Danko et al. 1996, found dead, date and cause of death unknown
30	Rakoš, Slovakia 48°39' N/ 21°27' E 15.7.1980	Batroun, Lebanon 34°15' N/ 35°40' E 2.9.82	2 years		Danko et al. 1996, shot
31	Kozino, Belarus 55°10' N/ 30°18' E 17.6.1984	Lake Lagoda, Russia 59°53' N/ 30°20' E 26.4.86	2 years	492 km N	Danko et al. 1996, this bird could also be a Spotted Eagle (see text)
32	Near Vranov nad Toplou, East Slovakia[2] 1991 with wing marking	Trebisov, East Slovakia 48°39´N/ 21°42´E 15.8.1993	2 years (observed alive)	approx. 28 km S	Danko et al. 1996, observed by M. Balla (verb.) with wing marking on mown field of clover, clearly a non-breeder
33	Petryłów, gm. Sawin, woj. Lubelskie, Poland 51°21´N / 23°´E 5.7.99	Chervonograd, Sokalskiy Dist., Ukraine 50°23´N / 24°14´E 10.09.2001	2 years	122 km SE	J. Wójciak (this paper), shot
34	Strenci, Latvia 57°37'40''N/ 25° 41'19''E 1952	Filabusi, Africa 20°33'S/ 29°25'E	2 years		U. Bergmanis corresp, no details of cause of death
35	Liski, gm. Dołhoby-czów, woj. Lubelskie, Poland 50°29´N / 23°58´E 18.07.2000	Milongo, Isoka, Zambia 10°08´S / 32°37´E 16.8.2002	2 years		J. Wójciak (this paper), Caught by locals in a trap
36	Uckermark, Brandenburg 1.8.2004	Randowbruch, Uckermark 21.7.2005	1 year	35 km S	B.-U.- Meyburg & Ulf Kraatz (this paper), observed in company of other immature eagles

[1] = when recovered in breeding territory [2] = exact ringing location not known