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Cainism, nestling management in Germany in 2004–2007 and satellite tracking of juveniles in the Lesser Spotted Eagle (*Aquila pomarina*)

Kainizmus, hniezdny manažment v Nemecku v rokoch 2004–2007 a satelitné sledovanie mláďat orla krikľavého (*Aquila pomarina*)

Bernd-Ulrich MEYBURG, Kai GRASZYNSKI, Torsten LANGGEMACH, Paul SÖMMER & Ugis BERGMANIS

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Abstract: The Lesser Spotted Eagle belongs to a species with obligatory cainism, which means that in the natural state it is rare that two young eagles fledge, although as a rule two chick's hatch. The breeding population in Germany is at the western edge of the species' range and is declining (a 23% decrease between 1993 and 2007). Local extinction can be anticipated and therefore nestling management has been implemented in the German federal state of Brandenburg since 2004 as a conservation measure by using human intervention to prevent the death of the younger sibling. This is in addition to other methods such as nest-site protection, habitat preservation, legislation etc. Furthermore, in 2007, second hatched eagle chicks (Abels) from Latvia were translocated for the first time. The managed pairs (nests physically inspected) were on average more successful than the unmanaged pairs (nests not physically inspected). It cannot be determined as to whether the inspection of the nests had a negative effect on breeding. Breeding success of the pairs present in Brandenburg, including non-breeders, increased by 57 % in 2007 due to nestling management, and that of the managed pairs alone by 67 %. In 2007 the behaviour of six young eagles was studied using satellite telemetry. This study determined that the Abels migrated as well as the first hatched eagle chicks (Cains), and that their survival chances were equally good. The Abels imported from Latvia migrated in two out of three cases along the same route as the German Lesser Spotted Eagles to the Bosporus. One Latvian Abel which fledged in Germany was tracked by satellite to Zambia where many Lesser Spotted Eagles winter. A German Abel wintered North of the Equator in the Sudan and neighbouring countries for over six months and started its return migration on 27 April 2008.

Abstrakt: Orol krikľavý je druh s pravidelným kainizmom, čo v prirodzených podmienkach spôsobuje len výnimočne vyletenie dvoch mláďat napriek vyliahnutiu dvoch mláďat zo znášky. Hniezdiaca populácia v Nemecku sa nachádza na západnom okraji areálu druhu a jej veľkosť klesá (23% pokles v období 1993–2007). Je možné očakávať lokálne vyhynutie, preto sa od roku 2004 v Nemeckej spolkovej republike Brandenbursko používa ako prostriedok ochrany hniezdny manažment. Predstavuje ľudskú intervenciu s cieľom zabrániť smrti mladšieho súrodenca spoločne s ďalšími metódami napr. ochrana hniezdisk a habitatov, legislatíva atď. V roku 2007 sa prvýkrát premiestnili z Lotyšska druhé vyliahnuté mláďatá (Ábelovia). Manažované hniezda (s priamou kontrolou) boli priemerne úspešnejšie ako hniezda bez manažmentu (priamej kontroly). Negatívny vply kontrol hniezd na hniezdnu úspešnosť nebol rozhodujúci. Hniezdna úspešnosť párov vyskytujúcich sa v Brandenbursku, zahŕňajúc aj nehniezdiace jedince, vzrástla kvôli hniezdnemu manažmentu na 57 % v roku 2007, pri manažovaných pároch samotných na 67 %. V roku 2007 sa študovalo satelitnou telemetriou správanie sa šiestich mladých orlov. Štúdia ukázala, že Ábelovia migrovali aspoň tak ako prvé vyliahnuté orlíčatá (Kainovia) a ich šance na prežitie boli rovnako dobré. Ábelovia privezení z Lotyšska migrovali k Bosporu v dvoch z troch prípadov po rovnakých trasách ako nemecké orly krikľavé. Jeden lotyšský Ábel, ktorý vyletel v Nemecku, bol sledovaný satelitom do Zambie, kde zimuje veľa orlov krikľavých. Nemecký Ábel zimoval severne od rovníka v Sudáne a v okolitých krajinách viac ako šesť mesiacov pričom začal migráciu späť 27. apríla 2008.

Key words: Lesser Spotted Eagle, *Aquila pomarina*, nestling management, cainism, Germany, satellite telemetry

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Introduction

Cainism within the Lesser Spotted Eagle species

In the past, while climbing to eyries, Wendland (1959), Sládek (1959), Geijlikman & Unanyan (1974) and others discovered that two Lesser Spotted Eagle chicks hatch as a rule but only one later survives to fledge. Initially only Meyburg (1974a, b, 2001a, 2002) followed up the events which led to the disappearance of the second nestling; during 1968–1974 he directly observed (from a hide) three nests in Eastern Slovakia. In 1990 at a further nest site in Mecklenburg-Western Pomerania (North-Eastern Germany), this phenomenon was recorded using a remote-controlled video camera (Scheller & Meyburg 1996).

In these four cases, and by monitoring other nests, the following factors can be summarised as responsible for cainism in the Lesser Spotted Eagle. First, there is a difference in size between the first and the second egg. After calculations made at 46 clutches, this difference is on average 2.3 mm in the length and 1.8 mm in the breadth of the egg (Meyburg 1970). As a result the first chick, (Cain), is heavier at the time of hatching as it hatches usually from the larger of the two eggs.

In addition Cain hatches several days earlier and thus has a temporal development advantage. A further factor is the reduced attention paid to the second chick, Abel, by the female. Owing to its smaller size and its awkwardness in feeding during the first few days, in comparison to its sibling, it apparently represents a lower key stimulus for the female.

Finally, there is a great deal of aggression between the young birds, even on the part of Abel. This leads to fights between the chicks in which one of them soon gains the upper hand and intimidates the other. This consent, by the weaker, to being bullied leads to the death of one of the nestlings, even when there is practically no difference in size (demonstrated by bringing together two young eagles of equal size in experiments). The weaker young eagle hardly has the courage to take part in feeding (Meyburg 1970, 1974a, b, 2001a, 2002). Food availability is however of no significance at this stage as, in the period immediately following hatching, there is always plenty of food available in the nest.

Cainism is prevalent in a lot of other raptor species (e.g. the Bearded Vulture, many eagle species) and other bird species such as Cranes, Cackatoos etc. Under the *Aquila* eagles it is most pronounced in Verraux's Eagle (*A. verrauxii*), the largest species. There is as yet no agreement among experts as to why two eggs are laid,



B.-U. Meyburg

Fig. 1. Cain and Abel.
Obr. 1. Kain a Ábel.

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which as a rule leads to only one young bird fledging, or the significance of cainism in terms of evolution (Meyburg 1974a, 2001a, 2002; Brown et al. 1977; Edwards & Collopy 1983; Simmons 1988; Gargett 1990). According to Brown et al. (1977) to date none of the attempts to explain this occurrence published are really convincing.

A short history of nestling management

From 1968–1974 B.-U. Meyburg, in cooperation with several Slovak bird of prey specialists, concerned himself intensively with the Lesser Spotted Eagle in Slovakia. Not only breeding biology was studied, but also other aspects such as diet, hunting behaviour etc. (Meyburg 1970, Palášthy & Meyburg 1973, Švehlík & Meyburg 1979). The question of cainism was however a central part of the research. B.-U. Meyburg was not only interested in how and why cainism occurred, but also the question as to whether this phenomenon could be used to protect the species, by using human intervention to prevent the death of the younger sibling, thereby doubling the reproductive rates of the majority of breeding pairs which have two chicks.

An important event was recorded at the beginning of August 1968. Two second hatched chicks, which had been hand-reared in captivity or reared by foster parents (Black Kites, *Milvus migrans*) were returned to their nests in the wild and they fledged a few days later with their siblings (Meyburg 1968; Fig. 2).

At one of the eyries in the Northern "Slanské vrchy" Mts observations were made and photographs taken from a hide in a neighbouring tree. It was noted that not only was the reintroduced Abel accepted without hesitation by both adults, but photographs were also taken showing the male presenting prey to the young birds and the female feeding them with small pieces of meat (Meyburg 1968, 1970).

B.-U. Meyburg observed the four young eagles as long as he could after they flew from the nest, wondering whether both young eagles would continue to be cared for by their parents. Fortunately this proved to be the case. The next question was whether both would be fit enough to survive the long migration to Africa and back. This remained an open question as satellite tracking of birds did not exist at that time.

In the years up until 1974 nestling management was carried out in a few individual cases in order to confirm the results of 1968 and to perfect the method. During 1968–1974 11 Abels fledged in Slovakia with human assistance (Meyburg 1975, 1978a, b). The aim was not to rear as many Abels as possible, but to optimise procedures. At this stage there was great interest in such new management methods. This was the period in which the first attempts were made to save endangered species or populations by management, and not depending solely on conventional measures such as nest site protection. D. Zimmerman from New York therefore visited B.-U. Meyburg and J. Švehlík in Slovakia in 1974 and described the nestling management method for the American readership (Zimmerman 1974, 1975, 1976). Our experiments were also the first attempts to have young raptors reared by other species, which was from then on described in the relevant literature as "cross-fostering".

In 47 cases in Slovakia the clutch size could be determined, the mean being 1.68. In 15 cases (32 %) there was one egg and in 32 cases (68 %) two eggs. In 12 (35.3 %)



B.-U. Meyburg

Fig. 2. First nestling management – two young Lesser Spotted Eagles fledging from an eyrie in the northern "Slanské vrchy" Mts, Slovakia, August 1968.
Obr. 2. Prvý hniezdny manažment – dve mláďatá orla krikľavého vylietajú z hniezda v severnej časti Slanských vrchov, Slovensko, August 1968.

of the successful broods one young bird hatched, and in 22 cases (64.7 %) two young. From 78 eggs therefore 56 young birds (71.8 % of eggs laid) hatched. Apart from one case where the embryo died, two chicks hatched in all cases where two eggs were laid. This gives a loss of 38 % of young birds as a result of cainism, including the one egg clutches. Of the 61 broods monitored in Slovakia 52.2 % were successful (Švehlik & Meyburg 1979).

In 26 of the successful broods 42 chicks hatched. If attempts had been made to prevent the death of all Abels by nestling management the reproduction rate would have increased by 81 %. During the studies from 1968 to 1974 the intention was not to increase the Slovak population, but rather to establish whether nestling management offers a possibility of population conservation in an emergency.

It was established in 1968–1974 that adult birds tolerate nest climbing, and that they have no problem accepting the reintroduced Abels after they have been reared in captivity. Further they continue to feed the latter to the same degree as the Cains. This was demonstrated particularly well in July and August 1968 at a nest site in "Slanské vrchy" Mts, where the events were observed and photographed from a hide in a neighbouring tree by B.-U. Meyburg. Photographs were taken showing the adult feeding two young eagles with full plumage (Meyburg 1970, Palášthy & Meyburg 1973). At that time it was not possible to establish for how long the young eagles survive after fledging, or if the Abels are as fit as the Cains for the long distance migration to southern Africa. At this stage satellite telemetry was still not available. In 1982–1984, employing nestling management, Abels were also helped to fledge at 11 nest sites in Hungary (Haraszthy et al. 1996). The successful rescue of second chick was realised in six cases the Eastern Slovakia in 1970–1981 (Danko 1992; Fig. 3).



Š. Danko

Fig. 3. Successful case of the second chick´s rescue of *A. pomarina* in Eastern Slovakia, "Slanské vrchy" Mts, 15 July 1970.
Obr. 3. Úspesný prípad záchrany druhého mláďata *A. pomarina* na východnom Slovensku. Slanské vrchy, 15.júl 1970.

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Distribution and population development in Germany

Since about 1800 the total breeding area in Germany has shrunk by some 90 % from a then 83,000 km² to a small residual area today of some 10,000 km² (Fig. 4). This represents only some 2.8 % of the total land area of Germany. The western border of the breeding range has shifted several hundred kilometres eastwards (Meyburg et al. 2004). The present-day breeding area in Mecklenburg-Western Pomerania and Brandenburg represents the bottom of a much larger region in the North German Plain, which previously extended further west into Lower Saxony, Saxony-Anhalt and Schleswig Holstein.

The reasons for this decline were a massive annihilation campaign of shooting and egg theft. Increasing habitat loss became a negative factor only in the course of the 20th century. At present the species breeds only in the federal states of Mecklenburg-Western Pomerania, Brandenburg and Saxony-Anhalt in relatively small areas of 6,600, 3,600 and 13 km² respectively (Langgemach & Sömmer 1996; Meyburg 1996, 2001b; Scheller & Meyburg 2001; Scheller et al. 2001a).

Today (with the exception of an isolated instance in Saxony-Anhalt of only one breeding pair) the Lesser Spotted Eagle is confined to only a very small breeding area in the extreme Nnorth-East of Germany. Of the 102

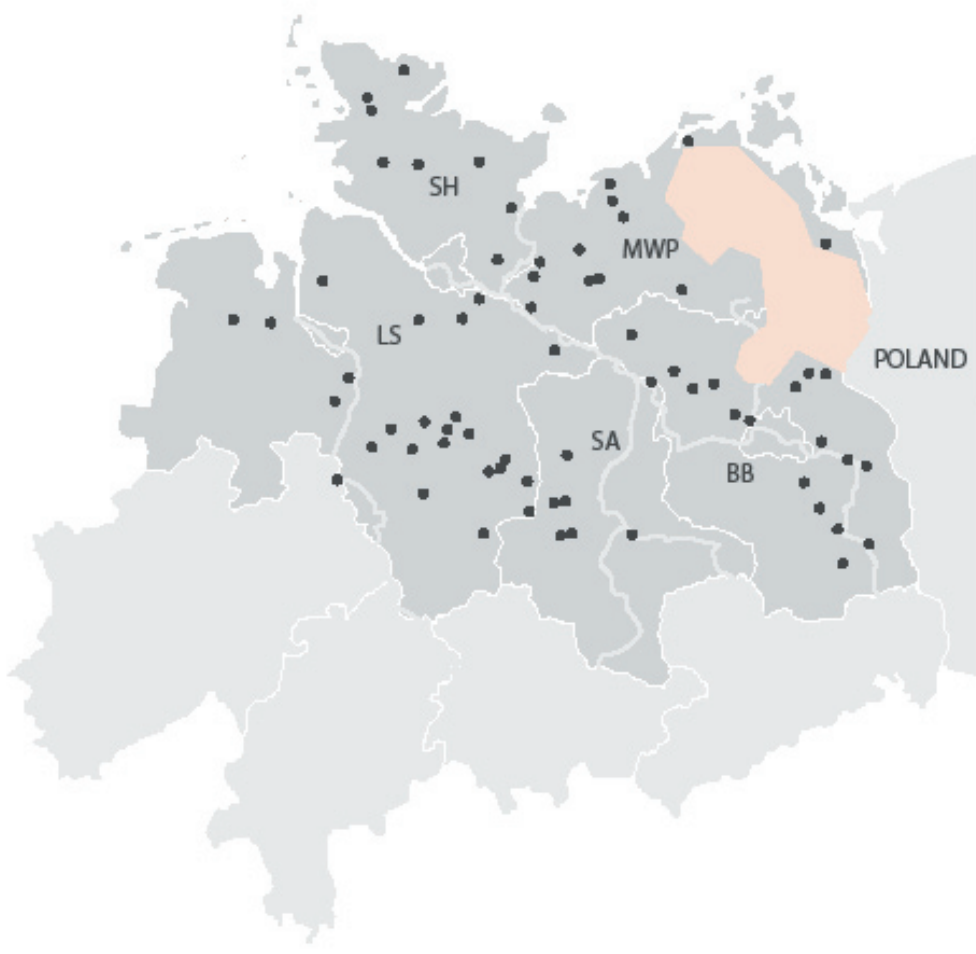


Fig. 4. Distribution of the Lesser Spotted Eagle in northern Germany, past and present (rose colour). Breeding sites of *A. pomarina* in the north German lowlands (black points) abandoned since 1880 (SH = Schleswig Holstein, MWP = Mecklenburg-West Pomerania, LS = Lower Saxonia, SA = Saxony-Anhalt, BB = Brandenburg).

Obr. 4. Rozšírenie orla krikľavého v Nemecku, minulosť a súčasnosť (ružová farba). Aktívne hniezdiská *A. pomarina* v severonemeckých nížinách (čierne body) opustené od roku 1880 (SH = Šlezvicko-Holštajnsko, MWP = Meklenbursko-Predpomoransko, LS = Dolné Sasko, SA = Sasko-Anhlatsko, BB = Brandenbursko).

breeding pairs recorded in 2007, 79 were to be found in Mecklenburg-Western Pomerania, 22 in Brandenburg and 1 in Saxony-Anhalt.

The reasons for the continuing decline are at present believed to be mainly habitat changes and hunting on migration routes. As long as the causes of the present population limitation persist, and protection measures are not intensified, the negative trend in Germany will continue, at worst until the species becomes extinct. The number of pairs in Germany dropped from 133 in 1993 to 102 in 2007, a 23% decline. Over the past 10 years the number of pairs in Brandenburg has declined drastically, from 31 in 1997 to 22 pairs in 2007 (Fig. 5).

Previously a breeding population also existed in Southern Germany. This, located in the Bohemian Forest during the 19th century, was undoubtedly part of a population that extended its range across the state border. Not many years ago an isolated population of 3–4 pairs, which has now become extinct, still existed in the Czech Republic (T. Bělka pers. comm.). The main population in Germany was, however, always to be found on the North German Plain.

Reliable data on how many Lesser Spotted Eagle breeding pairs inhabit Brandenburg (29,478 km^2) are available from about 1993, after a gradual improvement of the species-specific monitoring programme (Langgemach 2001). The number of breeding pairs has been significantly declining since that date (Fig. 5), as described in detail for the period up to 2003 by Böhner & Langgemach (2004). This decline continues despite a short-term stability between 2001 and 2004.

Population forecast

In relation to the Brandenburg population different possible developments were simulated using the Vortex software (each with 1,000 iterations over 50 years), developed by the Conservation Breeding Specialist Group of the IUCN (Lacy 2000, Miller & Lacy 2003). The parameter values shown in Table 1 and used for the simulation resulted in a population growth rate of -0.016 and therefore matched the actual development exactly (also an annual decline of 1.6 %, or growth rate r of -0.016, analysed by means of a regression analysis). On the basis of this main scenario, the effects of a different proportion of successfully breeding pairs or of additional second fledglings were simulated (Fig. 6). Further details about the simulation can be found in Böhner & Langgemach (2004).

Methods

Nestling management has been implemented in the German federal state of Brandenburg since 2004 as a con-

Tab. 1. Parameter values which best explain the current population dynamics in Brandenburg and which were used for the basic simulation scenario

Tab. 1. Parametrické hodnoty najlepšie vysvetľujúce súčasnú populačnú dynamiku v Brandenbursku, ktoré sa použili na simuláciu základného scenára

Parameter / Parameter	Value / Hodnota	Source / Zdroj
min. breeding age (♂♂ and ♀♀) min. vek rozmnožovania (♂♂ a ♀♀)	4 years / 4 roky	Meyburg et al. (2005)
max. breeding age max. vek rozmnožovania	20 years / 20 rokov*	Danko et al. (1996)
breeding system systém rozmnožovania	monogamy / monogamia	Meyburg (1970)
ratio of successful pairs pomer úspešných párov	60 % (+/- 10 %)	monitoring data from Brandenburg
young per successful brood mláďa na úspešnú znášku	1 (or 2 using young bird management) 1 (alebo 2 využijúc manažment mláďat)	Meyburg (1970, 1971)
sex ratio (at hatch) pomer pohlavia (v znáške)	1:01	assumption / predpoklad
mortality in 1st year mortalita v 1. roku	60 % (+/- 10 %)	Meyburg et al. (1993, 1995)
mortality in 2nd year mortalita v 2. roku	10 % (+/- 3 %)	
mortality in 3rd year mortalita v 3. roku	8 % (+/- 1 %)	assumption / predpoklad
estimated habitat capacity in Brandenburg odhadovaná kapacita prostredia v Brandenbursku	100 individuals; 50 pairs 100 jedincov; 50 párov	

* ring recoveries up to 27 years of age / podľa spätných nálezov až 27 rokov

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servation measure, in addition to other methods such as nest-site protection, habitat preservation, legislation etc. In addition, in 2007, Abels from Latvia were translocated for the first time.

The young Abels were reared in the Woblitz nature protection station near Himmelpfort (Brandenburg), some 90 km north of Berlin. During the first 12 days or so after hatching the young birds were kept in a closed room under infrared light (heating lamps) and fed by hand. Further rearing took place in artificial nests of some 1 m in diameter in which two young were placed, initially separated by an acrylic glass sheet which permitted visual contact. This is to enable the earliest possible habituation with each other and an early reduction in aggression. Feeding is done without visual contact to humans. The acrylglas divider is removed as soon as possible, when there is no evidence of any form of aggression, usually after 30–40 days.

The three, second laid eggs taken from nests in Latvia on 6 June hatched successfully. The Abels were reared in Latvia until they were 20 to 23 days old; at first by U. Bergmanis near the nest sites until 24 June, then in Riga Zoo. On 3 July they were brought to the Woblitz nature protection station in Germany.

The Latvian Abels were placed in the nests as early as 11 July, in order to "imprint" on them their new nest site. The respective nest occupants (Cains or single brood birds) were removed at the same time to be placed into other eyries later.

Two "pairs" of young eagles, which showed no mutual aggression any more, were placed in nests on 13 and 15 July and subsequently fledged. The last Abel was placed in a nest at the end of July. The young Lesser Spotted Eagles fledged between 18 July and 19 August 2007.

As for the satellite telemetry studies, the method etc. reference should be made to Meyburg & Fuller (2007), Meyburg & Meyburg (2002, 2007, 2008), Meyburg et al. (2005). The transmitters were fitted like backpacks, using Teflon ribbon to attach them to the bird. We used the ArcView 3.3 Geographical Information System (ESRI, Redlands, CA, USA) and Google Earth to manage and analyze geographical data.

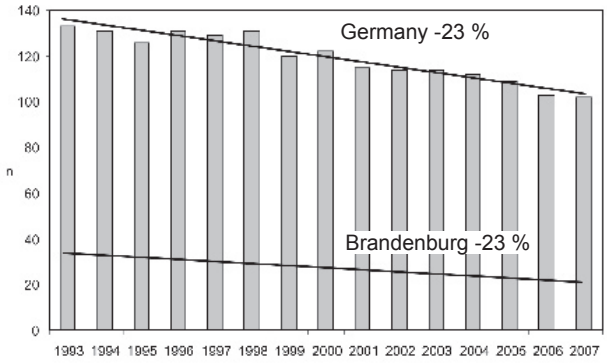


Fig. 5. The number of pairs (n) in Germany and in Brandenburg (1993–2007).
Obr. 6. Počet párov (n) v Nemecku a v Brandenbursku (1993–2007).

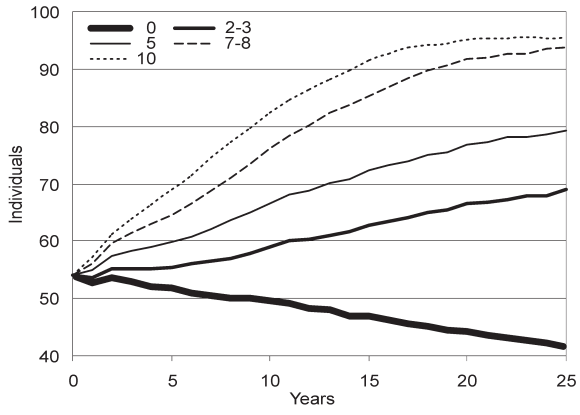


Fig. 6. Effect of the number of nests with a second fledgling on the population dynamics of the Lesser Spotted Eagle in Brandenburg according to a computer simulation (for details see text).
Obr. 6. Efekt počtu hniezd s druhým mláďaťom na populačnú dynamiku orla krikľavého v Brandenbursku podľa počítačovej simulácie (detaily pozri v texte).

Results and discussion

Nestling management in Brandenburg 2004–2006

In this situation those involved in the protection of the Lesser Spotted Eagle in Brandenburg decided in 2003 to introduce nestling management as an additional conservation measure (to existing habitat and legal protection etc.). The decision was taken after intensive discussions considering all relevant aspects (e.g. habitat quality and capacity (Langgemach et al. 2001, Böhner & Langgemach 2004), population health (e.g. reproduction parameters (Langgemach et al. 2005), genetics (Seibold et al. 1999), considerations on possible disturbances (Meyburg 1970), and political support (MLUV 2005). Nestling management will hopefully enable us to bridge the time-frame until the conditions in the breeding area and on migration routes have improved, and reduce the current acute threat situation. As it seems likely that the full implementation of these

Tab. 4. Some data on managed young eagles in Brandenburg in 2007
Tab. 4. Niektoré údaje o manažovaných mladých orloch v Brandenbursku v roku 2007

PTT and colour ring[1] No.	Nest of origin	Chick	Removal from the eyrie [egg or chick]	Hatching date	Placing into an eyrie	Eyrie in which chick was placed	Nest leaving date	Nestling period duration [days]	Remarks
75001 AU	B_h	one-egg-clutch	11 July		27 July	L_h			hit by a car in Sudan[A]
75006 CL orange[1]	Latvia	Abel	6 June egg	10 June	11 July	S_s	before 12 August	ca. 61	satellite tracked to Zambia[B]
75010 AN	Zi	Abel	7 June egg	12 June	28 July	S_s	before 6 August	ca. 55	wintered in Sudan, returned to Europe in 2008[C]
75003 CD orange	Latvia	Abel	6 June egg	13 June	11 July	L_h	10 August	ca. 60	eyrie fell down due to very strong rain; tracked up to the southern tip of the Sinai peninsula (Egypt)[D]
75002 C9 orange	Latvia	Abel	6 June egg	10 June	11 July	Zi	ca. 7 August	ca. 58	tracked up to southern Peloponnese (Greece)[E]
AM	H_z	Abel	8 June egg	10 June	15 July	H_z	9 August	60	not satellite tracked[F]
AP	L_h	Abel	4 June egg	9 June	11 July	B_h	14 or 15 August	66 or 67	
AV	S_s	one-egg-clutch	11 July nestling	5 June (4 June started hatching)	27 July	B_h	before 3 August	ca. 57	
AS	L_h	Cain	11 July nestling	ca. 5 June (4 June started hatching)	13 July	Wo	before 8 August	ca. 63	
AO	Wo	Abel	4 June egg	8 June	13 July	Wo	ca. 8 August	ca. 61	
AR	A_h	Abel	9 June egg	17 June	28 July	A_h	19 August	63	
DA	A_h	Cain	28 July fully feathered nestling	ca. 10 June (9 June started hatching)	28 July	Go (MNP)	8 August	59	Cain; moved from Brandenburg to Mecklenburg-West. Pomerania, not sat. tracked[G]
75007 AW	Zi	Cain	11 July	ca. 8 June (7 June started hatching)	27 July	Zi	before 6 August	ca. 56	tracked as far as Bosnia, possibly killed by human beings[H]
AT	L_a	Cain	11 July		15 July	H_z	before 9 August		shooted in Malta (“Sigmar”), not satellite tracked[I]

[1] metal rings from Germany and orange rings from Latvia for introduced nestlings / kovové krúžky z Nemecka a oranžové krúžky z Lotyšska pre introdukované mláďatá

[A] zrazený autom v Sudáne; [B] satelitom sledovaný do Zambie; [C] zimoval v Sudáne, do Európy sa vrátil v roku 2008; [D] hniezdo spadlo v dôsledku silného dažďa; sledovaný po južný cíp Sinajského polostrova (Egypt); [E] sledovaný po Peloponéz (Grécko); [F] satelitom nesledovaný; [G] Kain; presun z Brandenburska do Meklenburska-Predpomoranska; sat. nesledovaný; [H] sledovaný po Bosnu, možno zabitý ľuďmi; [I] zastrelený na Malte (“Sigmar”), satelitom nesledovaný

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Tab. 2. Synopsis of nestling management in Brandenburg 2004–2007
Tab. 2. Prehľad o hniezdnom manažmente v Brandenbursku 2004–2007

Nests climbed (some more than once) with eggs and/or chicks[a]	Successful fledging[b]	Additional young birds fledged[c] *	Failed broods for reasons outside the scope of the project[d]	Failed broods for reasons unknown[e]
45	32 (71 %)	13**	8	1

* one more additional young eagle from this project fledged in Mecklenburg-Western Pomerania / v rámci tohto projektu vyletelo ďalšie orlíča v Meklenbursku-Predpomoransku

** 3 from Latvia included / zahrnuté 3 z Lotyšska

[a] kontrolované hniezda (niektoré viackrát) s vajíčkami a/alebo mláďatami, [b] úspešné vyletenie, [c] pridané mláďa vyletelo, [d] znáška neúspešná z dôvodov mimo oblasti projektu, [e] znáška neúspešná z neznámych príčin

measures will take several years, urgent and immediate action is required in order to support and stabilise the endangered population in Germany.

Nestling management recorded not only additional fledged young eagles, but a great deal of other information was acquired such as clutch size, hatch rate, diet, diseases and deformities in young birds etc. This would not have been possible had these measures not been taken. From 2004–2006 the costs of the nestling management was borne by those taking part in the project and the World Working Group on Birds of Prey (WWGBP). These included, in addition to the authors and the responsible authorities, many nest wardens, foresters, registered hunters etc.

Of 28 nests physically checked several times during 2004–2006, 21 young birds fledged. Without taking into account the additional second chicks which fledged as a result of nestling management, this represents a breeding success per brood of 0.75, which is a good above-average value (Tab. 2). If the five additional Abels are counted, 70 broods fledged 48 young eagles in 2004–2006.

Through a great stroke of luck U. Kraatz (pers. comm.) was able to identify the first successfully captive reared Abel (2004) on 21 July 2005 in the Randowbruch (Brandenburg) by reading the colour ring (9B) on its left leg, this was read from only 40 m with a scope. This Abel was taken from a nest (A_h) in the Uckermark (Brandenburg) and replaced in another nest (L_B) in Oberhavelland on 1 August 2004. The location where it was observed is 38 km South-East of its parent's eyrie and 65 km Nnorth--Eeast of the nest where it fledged. In this area dozens of non-breeders sometimes concentrate in summer (Mundt & Uhlig 1996). The proverbial 'needle in the haystack had been found'; this Abel, at least, had proven itself fit enough to endure the long migration to its wintering area and back.

This provided the first evidence that an Abel reared in captivity was fit enough to survive and cope with the long migration to Southern Africa and back. Secondly until this time there had been no reliable evidence of a one-year--old Lesser Spotted Eagle in the German breeding area, and only a few records in other countries, in particular Belarus, but also Latvia (Siewert 1932, Danko et al. 1996, Dombrovski 2004, Meyburg et al. 2005, P. Wernicke, pers. comm.).

Tab. 3. Clutch size of the Lesser Spotted Eagle in Brandenburg 2004–2007
Tab. 3. Veľkosť znášky orla krikľavého v Brandenbursku v období 2004–2007

No. of eggs Počet vajec	2004	2005	2006	2007	∑
2	5 (83 %)	2 (25 %)	6 (60 %)	8 (67 %)	21 (58 %)
1	1 (17 %)	6 (75 %)	4 (40 %)	4 (33 %)	15 (42 %)
unclear* nejasné*	1	3	3		7

* only one small chick found, but second chick might already have perished / nájdené len jedno mláďa ale druhé mláďa mohlo zahynúť

During 2004–2006 many valuable lessons were learnt, not least that an adequate increase in young birds in Brandenburg could not be achieved. The reasons for this were and are as follows. The nests were often located too late or not at all. Some nests were not accessible or could not be checked for other reasons. It was not uncommon, especially in 2005, to find a clutch of only one egg (Tab. 3). In some cases we arrived too late. The second chick had probably already disappeared or was found dead or dying. The total number of pairs for Brandenburg is already very small and further pairs disappear every year.

Nestling Management in 2007

In 2007, 22 pairs were present in Brandenburg of which 20 bred. Twelve nests were climbed between 4 and 9 June. Four nests contained two eggs each and three nests each had one egg. On two occasions two chicks were found

and twice one chick and an unhatched egg, one of which was unfertilised. In one case only one chick was found in the nest. Altogether five fertilised second eggs and two Abels could be taken from the nests. All the eggs hatched successfully and all seven young eagles were successfully reared in the Woblitz Nature Centre, as well as three Abels translocated from Latvia.

Of the 12 nests climbed for collecting Abels or second-laid eggs, 10 broods (83,3 %) were successful from which 17 young birds fledged (7×2, 3×1). Eight nests were not climbed, 5 of which (71.4 %) had successful broods.

One Cain from Brandenburg was translocated to Mecklenburg-Western Pomerania so two young birds fledged from one nest. In 8 nests (7 in Brandenburg, 1 in Mecklenburg-Western Pomerania) in which a second young bird was placed fledged two young eagles.

In 2007 eight nests were not included in the management programme and not climbed. The reasons for this were as follows: Three nests were not located in time to remove the second eggs or chicks, two nests could not physically be climbed, one brood failed early in the breeding season, one nest was found only just before the young bird fledged and in one case the landowner refused access to the nest site. Of the eight unmanaged nests five were successful.

In 2007 14 young birds fledged from the 22 pairs present in Brandenburg that year. This average of 0.64 young per pair present is within the long term mean (1993–2007: 0.63, n = 308). Including the eight young eagles released into the wild, 22 young birds fledged from the occupied territories in Brandenburg in 2007, i. e. 1.0 young bird for each pair present. The breeding success of the pairs present was thereby increased by 57 %; an additional young bird was released into the wild in Mecklenburg-Western Pomerania. Taking only the managed pairs into account, there was an increase in breeding success of 67 %. If the years 2004–2006 are included in the calculations an increase of 23 % in reproduction is arrived at.

It was and still is planned to import at least 10 Abels annually from Latvia. 2007 was however an extremely bad year for the Lesser Spotted Eagle in Latvia and its neighbouring countries. Many birds arrived very late at their breeding site. Only 25 % of the pairs bred as compared with a usual figure of 59 %. Young birds hatched in only five nests from 61 pairs. The breeding success rate was lower than ever before with only 0.08 young per pair present as opposed to the average of 0.46.

The time spent in the eyries in Brandenburg in 2007 varied between some 55 to 66/67 days; an average of 60 days. This is 3–5 days longer than recorded in the relevant literature to date (Wendland 1959, Sládek 1957), which was based on only a few instances.

Observations at the first eyrie with two young eagles in Brandenburg in 2004

In September 2004 an eyrie (L-B) was observed on several days, from which two young birds fledged, including an Abel introduced from another nest. This latter bird was fitted with the colour ring 9B which was read in the following year in Brandenburg. In comparison to the strikingly spotted Cain, almost like a Greater Spotted Eagle *Aquila clanga*, the introduced Abel had very dark plumage. This made it easy to tell them apart, in addition to their begging calls which were different in pitch. Whereas Abel was not observed flying any great distance, Cain flew quite far on a number of occasions. On 4 September the male fed the young, flying into the woodland close to the eyrie, although Cain flew over a kilometre to meet him. As a result Abel, which always kept close to the eyrie, received the greater share of the prey. On the following day feeding by the female was observed. Transfer of prey in flight was not seen. As early as 10 September both young eagles had evidently left the area whereas both adult eagles were still observed on 15 September.

Observations after the introduction of a second young bird

On 28 July 2007 a Cain from Brandenburg was translocated into the eyrie of an unmanaged pair in Mecklenburg-Western Pomerania containing a young eagle of about the same age. This Cain was replaced by an Abel which had been removed from the eyrie before hatching and which had been reared in captivity. The subsequent developments were observed in Mecklenburg-Western Pomerania for 58 hours by J. and H. Matthes.

On 7 August, Cain was observed sitting on a branch about 1 m above the eyrie while the Mecklenburg-Western Pomerania bird was still in the eyrie. On 9 August the young eagle from Brandenburg had already fledged and the Mecklenburg-Western Pomerania bird sat on a branch near the eyrie. The Brandenburg bird therefore fledged on 8 August (+/- one day). On both the 12 and 16 August there was still one young eagle in the eyrie but it could not be established if it had already fledged and returned. The two young eagles in the field could not always be identified from one another. On 18 August, for the first time, there was no young eagle either in the eyrie or on the branch. Both young eagles returned quite

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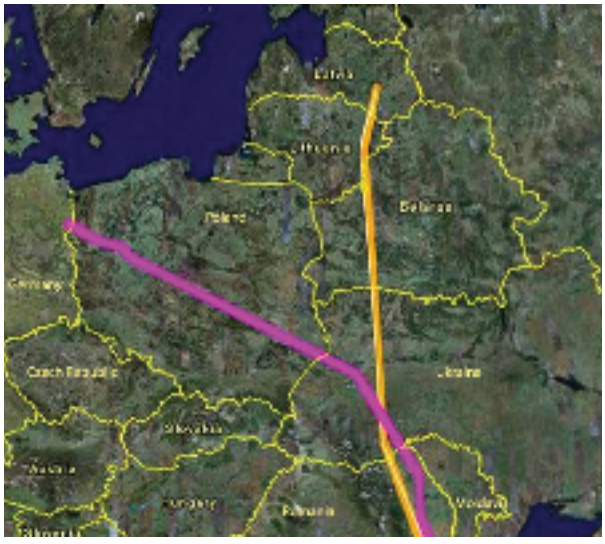


Fig. 7. Satellite photo showing the migration routes of a young eagle from a non-managed brood (transmitter PTT 20643; yellow line) in Latvia in 1993 and of the Latvian Abel translocated to Germany in 2007 (PTT 75006; purple line). From the western Ukraine onwards the migration routes are more or less similar.
Obr. 7. Satelitná snímka zobrazujúca migračné trasy mladého orla zo znášky bez zásahu označeného transmiterom (PTT 20643; žltá čiara) v Lotyšsku v roku 1993 a lotyšského Ábela preneseného do Nemecka v roku 2007 (PTT 75006; fialová čiara). Zo západnej Ukrajiny ďalej sú migračné trasy viac-menej podobné.

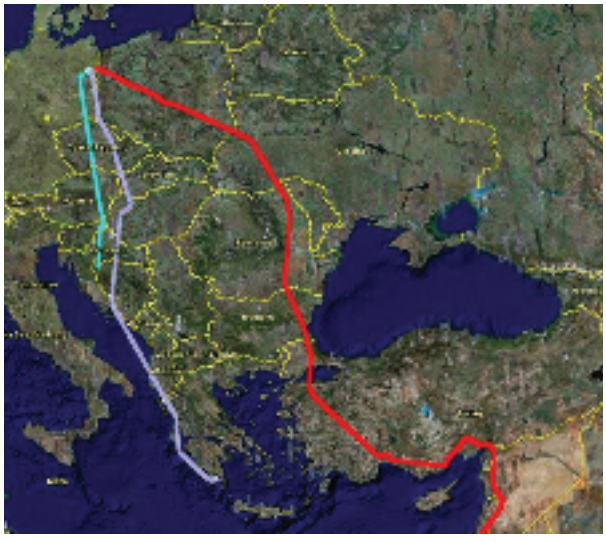


Fig. 8. Satellite photo showing the migration routes of six young eagles fitted with transmitters in 2007. Four eagles with transmitters migrated along the same 'correct' route (red line) across the Bosporus, through Anatolia and the Near East. Locations of two birds, which diverged too far to the south, broke off within Europe.
Obr. 8. Satelitná snímka zobrazujúca migračné trasy šiestich mladých orlov označených transmitermi v roku 2007. Štyri orly s transmitermi migrovali pozdĺž tej istej 'správnej' trasy (červená čiara) cez Bospor, Anatóliu a Blízky Východ. Pozície dvoch vtákov, ktoré odbočili na juh príliš skoro, sa stratili v Európe.

frequently to the eyrie until at least 18 August, which was evident from plenty of droppings. On 23 August the Mecklenburg-Western Pomerania eagle was observed sitting on the eyrie branch and at midday on 28 August prey was handed over. Until 6 September both young eagles were frequently seen flying around in the area, at times circling at a great height. On 14 September both adult birds were observed and on 15 and 16 September the female only. On 17 September there was no sign of the adult birds.

Satellite tracking of the young eagles

There are many unanswered questions concerning the biology of the Lesser Spotted Eagle during the period after the departure for the first migration until they reach sexual maturity. Very little is known about the whereabouts of the young birds after they leave the natal area; about their survival rate, the age at which they return to the breeding area for the first time, philopatry etc. Behavioural studies of the birds during this period of several years, from their first leaving of the natal area until sexual maturity and settlement, are now achievable by means of satellite tracking (Meyburg & Fuller 2007, Meyburg & Meyburg 2007, 2008).

In 1992 the first young Lesser Spotted Eagle from Mecklenburg-Western Pomerania was fitted with a satellite transmitter (PTT) (Meyburg et al. 1993). In 1993, two more young birds from Mecklenburg-Western Pomerania and one from Latvia were satellite tracked (Meyburg et al. 1995). These four young eagles were from unmanaged nests. In 2007 six young eagles which fledged in Germany, but three of which came originally from Latvia, were fitted with GPS transmitters (see Tab. 4). They fledged from 3 nests – a German and a Latvian "pair" together from each nest.

The first important question to be answered, which could not previously be studied, is whether the Abels have the same survival chances as the Cains, and if they later settle in the area where they had fledged. A further important question for the project was: How will the Latvian eagles migrate and where will they later settle?

In order to assess the migration behaviour of the young birds it is helpful to have good knowledge of the migration routes of the experienced adult birds. These were studied from 1994 onwards using a number

Tab. 5. Satellite telemetry migration data of adult birds 2005–2007
Tab. 5. Údaje o migrácii dospelých vtákov na základe satelitnej telemetrie v rokoch 2005–2007

PTT No. Č. PTT	Sex Pohlavie	Breeding site Lokalita hniezdenia	Breeding site departure Opustenie lokality hniezdenia	South Sahara boundary overflight (14 ° N) Prelet hranice južnej Sahary (14 ° N)	Equator overflight Prelet rovníka	Tanzania southern border overflight Prelet južnej hranice Tanzánie	Remarks Poznámky
				2005			
23196	♂	St (M-V)	18. 9. 2005	20. 10. 2005	30. 10. 2005	31. 12. 2005[1]	reared one young[A]
41861	♀	D_Wald (BB)	17. 9. 2005	6. 11. 2005[2]	15. 11. 2005	19. 11. 2005	did not start brood[B]
				2006			
23196	♂	St (M-V)	20. 9. 2006	18. 10. 2006	30. 10. 2006	19. 12. 2006[3]	reared one young[A]
41861	♀	D_Wald (BB)	16. 9. 2006	16. 10. 2006	25. 10. 2006	29. 10. 2006	probably did not start brood[C]
64614	♂	L_hof (BB)	14. 9. 2006	11. 10. 2006	29. 10. 2006	18. 11. 2006	reared one young[A]
36235	♂	Br Süd (BB)	ca. 20. 9. 2006[4]	16. 10. 2006	25. 10. 2006	–	reared one young, wintered in southern Tanzania; arrival in winter quarters near the border to the Congo and Zambia on 4. 12. 2006[D]
				2007			
23196	♂	St (M-V)	ca. 17. 9. 2007[5]	17. 10. 2007	25. 10. 2007	31. 10. 2007	did not start brood[B]
41861	♀	D_Wald (BB)	ca. 15. 9. 2007[6]	8. 10. 2007	15. 10. 2007	18. 10. 2007	did not start brood[B]
64614	♂	L_hof (BB)	ca. 19. 9. 2007[7]	18. 10. 2007	26. 10. 2007	22. 11. 2007	rearing of 2 young from end of July (NM)[E]
36235	♂	Br Süd (BB)	23. 9. 2007	18. 10. 2007	26. 10. 2007	1. 12. 2007[8]	brood (young birds) lost[F]
74996	♂	B_heide (BB)	18. 9. 2007	19. 10. 2007	26. 10. 2007	4. 11. 2007	rearing of 2 young from end of July (NM)[E]

[1, 3] rested for over a month in Tanzania south of Lake Victoria / oddychoval viac ako mesiac v Tanzánii južne od Viktóriinho jazera

[2] 'lost' 10 days on migration; flew 'by mistake' to the southern tip of the Sinai Peninsula and then flew north again almost to Suez in order to cross the Gulf of Suez / na 10 dní 'stratená' počas migrácie; 'chybne' letela na južný cíp Sinajského polostrova a potom letela opäť cez celý Suez s cieľom križovať Suezský záliv

[4] still in the area of the eyrie on 15. 9. 2006; on 21. 9. 2006 already 200 km distant from eyrie / v hniezdnej oblasti ešte 15. 9. 2006; 21. 9. 2006 už 200 km od hniezda

[5] 15. 9. 2007 still at breeding site, on 19. 9. 2007 already 350 km distant from breeding area / 15. 9. 2007 ešte na hniezdnej lokalite, 19. 9. 2007 už 350 km od hniezdiska

[6] on September 19, 2007 500 km distant from summering area / 19. septembra 2007 500 km od oblasti letného výskytu

[7] in the morning September 18, 2007 still at breeding site, on September 23, 2007 already 830 km distant from breeding area / ráno 18. septembra 2007 ešte na mieste hniezdenia, 23. septembra 2007 už 830 km od hniezdnej lokality

[8] on December 20, 2007 the bird returned from Zambia to winter once more in Tanzania / 20. decembra 2007 sa vrátil zo Zambie zimovať ešte raz v Tanzánii

NM – nestling management / hniezdny manažment

[A] vychoval jedno mláďa; [B] nezačal/a sa rozmnožovať; [C] pravdepodobne sa nezačala rozmnožovať; [D] vychoval jedno mláďa; zimoval v južnej Tanzánii; prílet na zimovisko pri hranici s Kongom a Zambiou 4. 12. 2006; [E] vychovajú 2 mláďatá od konca júla (NM); [F] znáška (mladé vtáky) zanikla

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of individuals (Meyburg et al. 1995, 2000, 2004 and unpublished).

The direction taken on the first migration by all bird species is generally considered to be inherent. Accordingly Latvian birds migrate in a Southerly direction in order to reach the Bosporus and Asia Minor, whereas German Lesser Spotted Eagles leave the breeding area in a South-Easterly direction. The latter migrate through Poland more or less parallel to the country's Southern border until reaching the Western Ukraine where they swing towards the South. Would the Latvian eagles migrate South towards Greece, fly into a cul-de-sac and perish, as did the first German eagle fitted with a transmitter in 1992?

The first results of satellite tracking 10 young Lesser Spotted Eagles

From the tracking data of the first 10 young eagles the following facts can be established. The four satellite tracked Abels in 2007 migrated at least 'as good as' the other two birds (one Cain and one eagle from a one-egg-clutch) and their survival chances are just as good (Figs 7 and 8). In two from three cases the young eagles translocated from Latvia to Germany migrated along the same route as German Lesser Spotted Eagles to the Bosporus, i.e. at first in a South-Easterly direction through Poland more or less parallel to the country's Southern border until reaching the Western Ukraine. From there they flew further in a Southerly direction (Figs 7 and 8). Of the 10 young eagles only four reached Africa. It is assumed that the transmitters of two of the eagles which arrived in their winter quarters ceased to operate or were removed by the birds.

German Abel (PTT 75010)

Wintering

This German Abel wintered in the Southeast of the Sudan and the neighbouring areas of Ethiopia, Uganda and Kenya. It reached its winter quarters on 19 October 2007 (at 11 h, 12° 24' N / 34° 32' E) and departed on 27 April 2008 (at 7 h, 6° 57' N / 34° 33' E). Wintering area extended North-South over 1200 km and east-west over 600 km (see Fig. 11). It is the first Lesser Spotted Eagle with a transmitter to winter North of the Equator; all other individuals wintered South of the 10th Parallel (Meyburg et al. 1995, 2000, 2001, 2004 and unpublished). During wintering 1,746 GPS fixes were acquired. This is the first young eagle for which a complete study of wintering behaviour could be made.

Initially, from 19 October to 20 November, the eagle wintered in the Northern part of its winter quarters in an

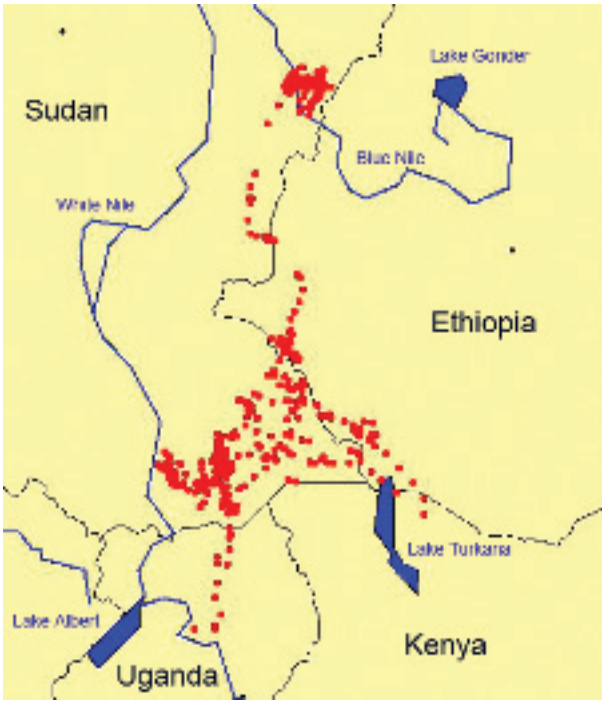


Fig. 9. Wintering of German Abel (PTT 75010) in Sudan and neighbouring areas from 19 October 2007 until 27 April 2008 based on 1,748 GPS fixes (red dots).
Obr. 9. Zimovanie nemeckého Ábela (PTT 75010) v Sudáne a okolitých oblastiach od 19. októbra 2007 do 27. apríla 2008 na základe 1 748 GPS záznamov (červené body).

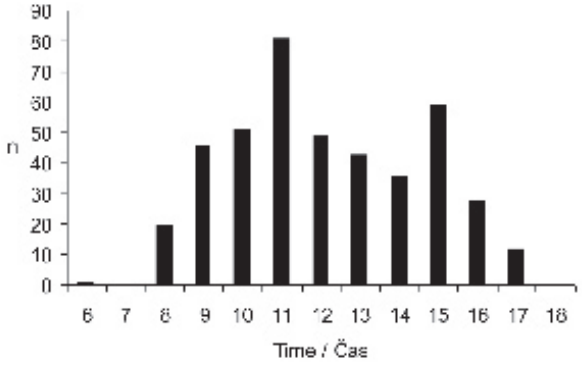


Fig. 10. Distribution according to time of day of the 426 GPS fixes of the eagle while in flight in its wintering area. The bird was located most frequently flying about 5 hours after sunrise (19 % of fixes). Flight activity decreased from about 2 hours before sunset. It apparently hardly ever flew before 8:00 hrs and after 17:00 hrs.
Obr. 10. Rozloženie 426 GPS záznamov cez deň počas letu orlov letov v oblasti zimovania. Vták najčastejšie lietal asi 5 hodín po východe slnka (19 % záznamov). Letová aktivita klesla asi 2 hodiny pred západom slnka. Je zrejmé, že ťažko lietali pred 8:00 hod. a po 17:00 hod.



Fig. 11. Spring migration in 2008 of the young eagle (75010). Up to the 21 May in Syria the depiction of the route is based on precise GPS fixes (solid line), subsequently only imprecise Doppler fixes (dotted line) were on the whole received. The last three fixes in the European part of Turkey are however GPS fixes.
Obr. 11. Jarná migrácia mladého orla (75010) v roku 2008. Do 21. mája v Sýrii je opis trasy založený na presných GPS pozíciách (hrubá čiara), následne sa získali len nepresné Dopplerovské pozície (čiarkovaná čiara). Posledné tri záznamy v európskej časti Turecka sú GPS lokalizácie.

area some 6,000 km² in size between the Blue Nile and the Ethiopian border (396 GPS fixes). Thereafter it was located 800 km further South in an area of some 67,000 km² in the lowlands West of the Ethiopian Highlands as far as the White Nile. From 30 November to 3 December it stayed in Uganda for a short period and reached the southernmost point of its wintering, 1° 48' N / 33° 03' E, at Lake Kyoga. It visited the northernmost part of Kenya on 3 and 4 February.

The eagle stayed at heights of between some 400 and 1,500 m a. s. l. This was calculated from1,320 altitude fixes of the bird whilst stationary. Some 426 fixes (24.4 %) were made during flight. The average flight speed was some 37 km/h and maximum 93 km/h. The



Fig. 12. From the Mediterranean coast the young eagle (75010) migrated unusually far distant to the Northeast, 233 km at the latitude of Jerusalem. The Lebanon was therefore not transited.
Obr. 12. Od stredomorského pobrežia migroval mladý orol (75010) na nezvyčajne dlhú vzdialenosť na severovýchod, 233 km na úroveň Jeruzalema. Cez Libanon preto nebol križovaný.

eagle's flight began about 2 hours after sunrise. It was most frequently located flying about 5 hours after sunrise. Flight activity decreased from about 2 hours before sunset. The latest recorded fix of the bird in flight was about one hour before sunset (Fig. 8). As the times of sunrise and sunset fluctuated during the wintering period and from location to location (under +/- 30 minutes), a mean value was calculated respectively.

Spring migration

The spring migration of a one-year old Lesser Spotted Eagle has never previously been tracked by satellite telemetry. For this reason it will be treated in more detail here. After two days of migration, on 27 April (flight distance covered 112 km) and 28 April (189 km) the bird again rested from 29 April to 7 May (9° 43' 27'' N / 33° 50' 53''). On 8 May, shortly after 11.00 hrs, it finally continued its migration, this time without further pause in Africa.

It reached the Red Sea coast in the Eritrea/Sudan border area on the evening of 11 May (Fig. 11). At 8.00 hrs on 18 May it flew over the Suez. From the Mediterranean coast it migrated an unusually far distance to the North, 233 km at the latitude of Jerusalem (Fig. 12). Therefore The Lebanon was not transited. At the end of the 1st June it reached the European part of Turkey. On the 3,858 km long stretch from its winter quarters as far as Syria, migration could be tracked precisely

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B.-U. Meyburg

Fig. 13. Two nestlings fledging from the same nest with colour rings and just fitted with satellite transmitters before returned to the eyrie. The Latvian bird on the left with orange ring was tracked to Zambia. The German nestling on the right wintered in Sudan. It was tracked back to Europe in spring 2008.
Obr. 13. Dve mláďatá vyletené z jedného hniezda s farebnými krúžkami a s práve osadenými satelitnými vysielačkami pred vrátením sa do hniezda. Lotyšský vták vľavo s oranžovým krúžkom bol sledovaný do Zambie. Nemecké mláďa vpravo zimovalo v Sudáne. Do Európy sa vrátilo späť na jar 2008.

by 177 GPS fixes, with up to 14 fixes daily at hourly intervals. Subsequently, after 21 May in Syria, the less precise Doppler fixes were the only ones available. The migration route is therefore indicated by a dotted line in Fig. 11. If the usual migration route is assumed, the eagle covered some 1,300 km up to the last fix. It is not clear whether the eagle reached Europe via the Bosporus or the Sea of Marmara. The last GPS fix was on 12 June at midday, 133 km west of Istanbul. As the GPS fixes were increasingly sparse from Eritrea onwards, although there should have been no lack of direct sunlight onto the transmitter, the PTT possibly became defective. Other reasons for loss of contact could have been the death of the eagle or the removal of the transmitter by the bird.

It was possible to precisely calculate the daily distances covered on 6 days. These gave a figure of between 112 and 459 km per day, a mean of 227 km/day. The average daily distance covered for the complete route as far as Syria was 241 km. This demonstrates that the eagle migrated very rapidly, especially for a non-breeding individual.

The longest daily distance covered, as far as could be established, was on 12 May vaguely following the course of the Sudanese-Eritrean border and on into Central Eritrea. On this day the bird covered almost 460 km in a flight time of about 8 hours. The top speed for spring migration of 90 km/h was recorded at midday, at a height of 1,488 m a. s. l. – 870 m above ground level. Between 9:00 and 10:00 hrs the average speed was 54 km/h and between 10:00 and 11:00 hrs 55 km/h.

The largest number of fixes was made on 28 April, when a distance of 189 km was flown, permitting the daily activity to be quite well documented. The eagle had not yet started migrating at 7.00 hrs and by 8.00 hrs had

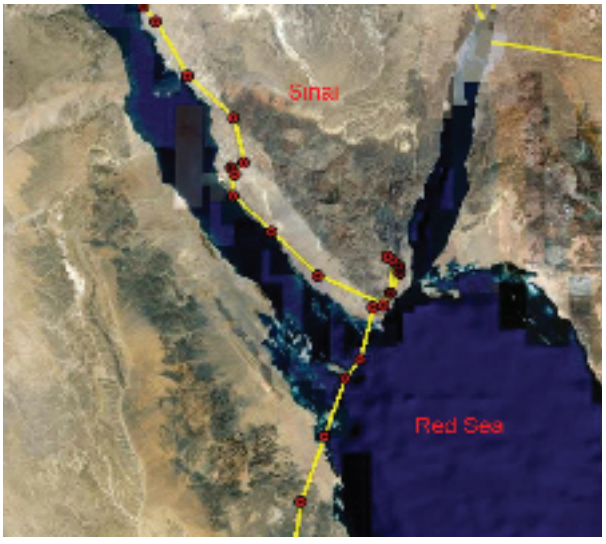


Fig. 14. Satellite image showing the crossing of the Golf of Suez from the southern tip of the Sinai Peninsula to Africa by a Latvian Abel (PTT 75006). For further details see text.
Obr. 14. Satelitná snímka zobrazujúca prekonanie Suezského zálivu lotyšským Ábelom (PTT 75006) z južného cípu Sinajského polostrova do Afriky. Detaily pozri v texte.

only just covered 13 km. Up until 12.00 hrs it flew at an average speed of between 26 and 60 km/h. The actual measured speed for the full hour fluctuated between 25 and 60 km/h and the flight height over ground level were between 290 and 830 m a.s.l. From 13.00 hrs onwards only short stretches were flown, between 13.00 hrs and 14.00 hrs for example only 1.7 km was covered. The bird is therefore assumed to have rested and foraged for food in this period. Shortly after 16.00 hrs migration ceased for the day.

During migration flight heights of between 1,500 and 2,000 m a. s. l. were recorded on 8 occasions and twice over 2,000 m a. s. l. The precise height above 2,000 m a.s.l could not be recorded. Flight speeds of between 50 to 60 km/h were recorded regularly and on five occasions between 60 to 71 km/h as well.

Latvian Abel (PTT 75006)

The Latvian Abel was tracked as far as Mozambique. On 15 December it reached the southernmost point of its migration route (15° 43' S / 31° 3' E) and then flew northwards into Zambia again. On 9 January 2008 it was located for the last time (11° 44' S/ 32° 25' E) in the North Luangwa National Park. We assume that this young eagle bit through the Teflon harness and removed the transmitter. This species is one of those where some individuals go to extreme efforts to remove the PTTs. This has been determined in the case of a captive bird. Most individuals however tolerate the transmitters for many years and breed successfully with them fitted.

This eagle demonstrated surprising behaviour between 20 October and 9 November in the southern Kordofan region of South Sudan somewhat west of the White Nile. It rested in an area only 0.33 km² in size (11° 2' 30''N / 32° 9' 49'' E). During this period 153 GPS fixes were made. The eagle was not recorded in flight on any occasion which suggests it was hunting on foot only.

The fate of the ten young eagles

Probably only three young eagles (30 %) survived until the beginning of November, assuming that none of the others had removed their PTTs. The loss rate for 10 young eagles tracked was assessed as follows: Three individuals probably drowned attempting to cross the sea; two of them attempting the route from the southern tip of the Peloponnese (Greece) to Crete and one attempting the crossing from the southern tip of the Sinai Peninsula across the Gulf of Suez to Africa. This can be concluded from the fact that contact was lost suddenly in each case. It is very unlikely that the transmitters ceased to operate just at this point in time. The distance to be covered across open water is some 80 km in both cases. The Peloponnese and Sinai Peninsulas are evidently death traps for young Lesser Spotted Eagles.

A further Abel from Latvia (with PTT 75006) managed the crossing. It reached the southern tip of the Sinai Peninsula at 10.00 hrs on 3 October and then flew a short distance to the north where it spent the night. On 4 October it crossed the coastline between 8.00 and 9.00 hrs. At 9.00 hrs it was located over the sea at a height of 681 m a.s.l and at a flight speed of 44 km/h. At 10.00 hrs it circled over an island at a height of 880 m a. s. l., probably to gain height on a thermal updraft, and had almost reached the coast of Africa at 11.00 hrs. At this point in time it flew at a height of 376 m a. s. l. with a flight speed of 62 km/h. From coast to coast a distance of 84 km was covered. This is the first occasion on which the overflight from Sinai could be precisely tracked with satellite telemetry (Figs 14 and 15). Even adult birds shrink from attempting this crossing. In 1997 and 1998 a female flew back to Suez (Meyburg et al. 2002) and in 2005 another female flew back almost the whole way to Suez in order to cross the Gulf at a narrow point.

In 1993 two young eagles were definitely shot down over the Lebanon (Meyburg et al. 1995). A further young eagle (with PTT 75007) which only flew as far as Bosnia in 2007 was possibly killed by humans. In Germany it

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Fig. 15. Young *A. pomarina* with satellite tag and with German ring, Sharm El Sheik, Sinai peninsula, Egypt. 12 October 2008. Four days later it was found dead there together with 26 other young *A. pomarina*, probably because of the polluted water in the pools.
Obr. 15. Mláďa *A. pomarina* so satelitnou vysielačkou a s nemeckým krúžkom, Sharm El Sheik, Sinajský polostrov, Egypt. 12. október 2008. O štyri dni neskôr sa našiel sa uhynutý s ďalšími 26 mláďatami *A. pomarina* pravdepodobne v dôsledku otravy vody v nádrži.

had landed on the roofs of houses. Another Cain (called "Sigmar" in the press), not fitted with a transmitter, was shot and wounded over Malta. It was subsequently treated in the University Veterinary Clinic in Berlin but had to be put down later. A Latvian Abel with a transmitter (PTT 75001) collided with a vehicle in Southern Sudan near the Ethiopian border.

The Lesser Spotted Eagle, with only some 100 breeding pairs remaining, is one of the most severely threatened bird species in Germany. The negative population trend continues. Population development in the past few years has shown that the time available to reverse this trend is very limited. The main reasons for the population decline are habitat degradation and losses during migration, the latter in particular from shooting (e.g. Meyburg 2005, Meyburg et al. 2005). Measures to combat these problems have been initiated on various levels. However it will probably take many years until the measures are implemented, and therefore immediate interim measures are urgently needed in order to support and stabilise the endangered German population. These interim measures could bridge the gap until improvements in the situation in the breeding area and on migration routes have been achieved, and thus alleviate the present situation of acute threat to the species.

There is only one single record of the fledging of two young eagles without human assistance in Germany (Starke 1994) compared to over 1300 successful broods with only one young eagle (n = 286 in Brandenburg and 1018 in Mecklenburg-Western Pomerania). In this situation it was decided to introduce nestling management as a conservation measure in addition to other efforts. A great deal of attention was paid to the question of whether the few eyrie checks would disturb the birds too much and lead to abandonment of the brood. To determine this all eyries were monitored from the ground, mostly at a great distance, subsequent to the climbing of the eyrie (e.g. transport of prey to the eyrie etc.). If the nests were indeed

flown to and the brood was lost at a later stage, it was concluded that there were other reasons for the brood loss rather than the eyrie climbing. Eyries were climbed only once to remove the second young birds and second eggs. Great care was taken thereby to ensure that the brood was disturbed as little as possible (rapid climbing and a short disturbance period of under 30 minutes, no climbing in bad weather, in the late afternoon etc.).

In only one case out of 45 were we unsure that the brood failure was not due to the nests being previously inspected. In all other cases this could be excluded by subsequent monitoring of still active nests from the ground. It is however very unlikely given the data presented (nest--climbing on more than one occasion, breeding success) that in this one example of nest inspection was the reason for abandonment. It was checked too late, however, to prove the contrary. In the case of the other abandoned broods, careful subsequent ground monitoring established that the abandonment was not connected to the nest-climbing. Our data provides no evidence of any negative influence due to nestling management. We believe therefore that the interference or manipulation is tolerable given the benefit for the Lesser Spotted Eagle population.

The managed pairs were on average more successful than the unmanaged ones. One possible explanation is that pairs that had lost their clutch prior to hatching could not of course be included in the nestling management scheme. Such a case was recorded during the video camera surveilance of an unmanaged pair in the 1990s in Mecklenburg-Western Pomerania. The female sat on the eggs less and less and left the clutch for longer and longer periods. Ultimately she abandoned the eyrie for reasons unknown and the eggs disappeared shortly afterwards. In other years the brood in the same eyrie were successful (Meyburg & Scheller unpublished).

Satellite telemetry of adult eagles to determine fitness

In order to determine whether the fitness of adult males suffers as a result of having to provide food over a two month period for two large young eagles as a result of nestling management, the migration speed of adult eagles as far as the southern edge of the Sahara (14 ° N) was compared. Earlier telemetry studies have shown that migration to this point is relatively swift (Meyburg unpublished); subsequently long rest periods are sometimes taken. A comparison was made between the departure times from the breeding areas and arrival at the southern edge of the Sahara of (1) two adults which had no young in 2007 (23196 did not start to breed and 36235 lost offspring), or (2) those which had two young to provide for (64614 und 74996), compared with males which had reared one young bird in previous years (Tab. 5). It was demonstrated that all adult and young eagles migrated more or less just as rapidly to the south edge of the Sahara – in the case of the adult males irrespective of whether they had to rear one, two or no offspring. All four males arrived almost simultaneously; from 17–19 October 2007 on the southern edge of the Sahara. It is concluded therefore that the rearing of two young birds does not affect the males' fitness.

Mortality of young eagles

The young eagle mortality rate appears high but was to be expected (Meyburg et al. 2005). It was less for the managed young eagles in 2007 (66 %, 4 of 6 birds lost) than for the unmanaged young birds 1992 and 1993 (75 %, 3 of 4 lost). Both figures may seem high but are well within the expected norm (Böhner & Langgemach 2005). Detailed satellite telemetry studies of the Golden Eagle (*A. chrysaetos*) in Alaska in 1997 and 1999 are available. The survival rate of the young eagles here, in the first 11 months of life, was only 0.34±0.10 (standard degree of error) or 0.19±0.07 (McIntyre et al. 2006).

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