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POST-FLEDGING BEHAVIOR AND OUTWARD MIGRATION OF A HYBRID GREATER × LESSER SPOTTED EAGLE
(*AQUILA CLANGA* × *A. POMARINA*)

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The palearctic Greater Spotted Eagle (*Aquila clanga*) and the Lesser Spotted Eagle (*A. pomarina*) are sister species that, as mtDNA studies have estimated, diverged approximately one million years ago (Seibold et al. 1996). The world population of the Greater Spotted Eagle consists of some few thousand pairs distributed sparsely over a vast area from the Baltic Sea to the Pacific Ocean (Meyburg et al. 2001a). The approximately twenty thousand pairs of the Lesser Spotted Eagle breed mainly in Central and Eastern Europe (Meyburg et al. 2001b). The ranges of the two species overlap in Eastern Europe, and the sympatric area covers a large proportion of the Greater Spotted Eagle's distribution range in Europe. Hybridization has recently been described in all countries in the sympatric area except Russia: Estonia (Lõhmus and Väli 2001), Latvia (Bergmanis et al. 2001), Lithuania (Treinys 2005), Poland (Meyburg et al. 2005c), Belarus (Dombrovski 2005) and Ukraine (Zhezherin 1969).

To the best of our knowledge, no raptor hybrid has been studied using telemetry, other than hybrid falcons bred and used by falconers. As Greater and Lesser Spotted Eagles have very different wintering locations (Christensen and Sorensen 1989, Meyburg 1994a, b), and as their migration and wintering behaviors are markedly different

(Meyburg 1994a, b), we were interested in determining whether the migration behavior of a young hybrid is intermediate between the two species.

The transition of birds of prey to independence is difficult to study (Brown and Amadon 1968), as both old and young birds stray ever farther from the nest site toward the end of the post-fledging period. There seems to have been only a single study in which the departure on migration, the break-up of the family, and the subsequent migration have been investigated by satellite tracking (Meyburg et al. 2005b).

METHODS

In northern Germany near Greifswald (54°03'N, 13°23'E), well outside the Greater Spotted Eagle's breeding range (600 km west of the westernmost known breeding pairs of the Greater Spotted Eagle), a female Greater Spotted Eagle was found breeding with a Lesser Spotted Eagle male in the period 2003–2006. The pair fledged a single young in each of 2003, 2005, and 2006. DNA analysis of the 2003 and 2005 nestlings proved them to be hybrids (Helbig et al. 2005, Väli pers. comm.).

On 23 July 2005, the fully-feathered nestling (mass = 1862 g) of the mixed pair was equipped with a solar-powered satellite transmitter (platform transmitter terminal, PTT; Microwave Telemetry, Inc., Columbia, MD U.S.A.) with a mass of 20 g, or 1.07% of the bird's body mass.

We used the dho-gaza method (Bloom 1987, Meyburg et al. 2005a) to trap the male Lesser Spotted Eagle parent, using an adult White-tailed Sea Eagle (*Haliaeetus albicilla*) as decoy. The male (mass = 1387 g) was fitted with a solar-powered GPS PTT (Microwave Telemetry, Inc., Columbia,

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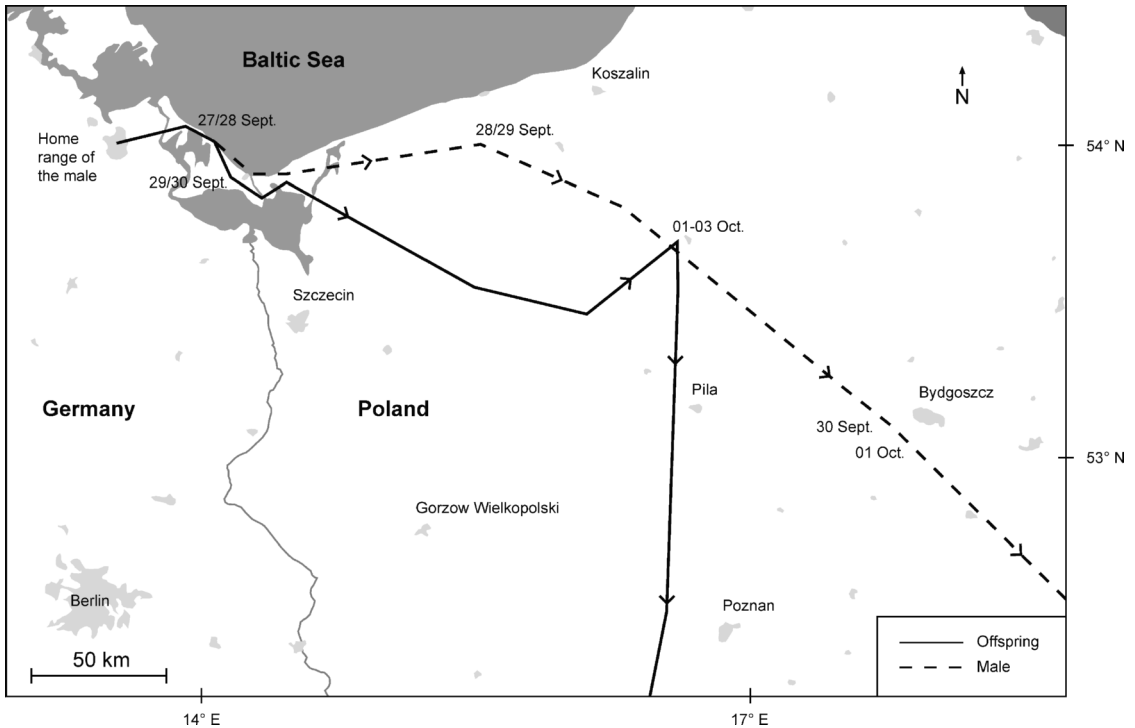


Figure 1. The autumn migration of the young hybrid Greater \times Lesser Spotted Eagle and its Lesser Spotted Eagle father in Germany and Poland as determined by satellite telemetry. Dates of arrival and overnight roosting points en route are indicated.

MD U.S.A.) with a mass of 35 g (2.52% of the bird's body mass) to study habitat utilization, daily activity and migration. Unfortunately, we failed to trap the female Greater Spotted Eagle.

The PTT of the young eagle was programmed to be in continuous operation, given sufficient light level to generate power for the transmitter. The PTT of the male was programmed for 16 consecutive hourly GPS fixes per day, transmitted to Argos every third day, depending on sufficient light level. Both PTTs were fitted as back-packs, using Teflon ribbon (Bally Ribbon Mills, Bally, PA U.S.A.) to attach them to the birds.

We used the ArcView 3.3 (ESRI, Redlands, CA U.S.A.) Geographical Information System (GIS) to manage and analyze geographical data, and imported Argos and GPS locations into ArcView. We also used Google Earth's satellite image program to plot locations, which were provided by Service Argos, Inc. (Toulouse, France), and to measure distances between locations. We attempted to determine the dependence of migratory behavior on the amount of precipitation, cloud cover, wind strength, and wind direction, by collecting weather data via the internet from the weather station nearest the birds at the time.

RESULTS

Post-fledging Behavior and Family Break-up. Until 13 August, the young eagle remained in the woodland eyrie and thereafter in its vicinity. As the first location was re-

corded on 23 September, the bird likely was there for most of the time but seldom in the open, so that the transmitter was not sufficiently charged.

On 24 September, at 2036 H, the bird was located 12.2 km east of the eyrie, clearly outside the male's home range; at 2218 H, however, it was only 8.6 km distant from the eyrie. On 25 September, at 1102 H, the young eagle circled with the female over the eyrie woodland. The young bird begged vehemently. When the fledgling approached too close to the female, the latter did a sideways roll, as when defending against an aggressor. A few minutes later the male was last observed directly at the breeding site (J. Schwanbeck pers. comm.). In the night of 25/26 September, the young eagle was located in the immediate vicinity of the eyrie, so it spent its penultimate night before departure there, if not on the nest itself. On the following morning it was located 5.3 km west of the eyrie on the westerly margin of the male's home range.

Departure on migration took place in the midday hours of 27 September; at 0920 H, the young was last located in the vicinity of the eyrie and at 1431 H at 26 km from the nest in an ENE direction, at least one day ahead of the female, which was last sighted on 28 September at 1158 H near the nest (J. Schwanbeck pers. comm.). The exact departure date of the male was not documented. The first



Figure 2. The autumn migration route of the young Greater \times Lesser Spotted Eagle hybrid from Germany to southern Italy as determined by satellite telemetry. Dates of resting and overnight roosting are indicated.

location of the male after departure from the breeding territory, already at 142 km from the eyrie, was during the night of 28/29 September. It possibly departed immediately after the young eagle on the afternoon of 27 September, but more likely on the morning of 28 September (Fig. 1). The female probably departed on the afternoon of 28 September.

Migration Route. The young eagle and the adult male both migrated at first about 200 km in an easterly direction on similar flight paths, but not together (Fig. 1). Some 207 km east of its birthplace, the young eagle swung to the south and, after a further 130 km, towards the

southwest. It held this course relatively unswervingly for 1277 km until it arrived in the neighborhood of Genoa and the coast (Fig. 2). Only during its crossing of the Alpine chain, in a region in Austria with mountains greater than 3000 m, did it take the shorter north-south route. From Genoa onwards, the migration followed the west coast of Italy to its southernmost point near Catanzaro in Calabria, where the bird arrived after a migratory flight of 2430 km on 27 October. The young eagle remained there until 31 October 2005, after which time no more locations were received, although the transmitter continued to transmit signals until 5 November, when transmissions ceased entirely.

Migration Speed. The young eagle flew for 25 d and rested on 6 d. On 17 d for which the overnight roosts could be located, the average distance covered was 99.5 km/d (range 23–209 km/d). Including the 8 d for which the daily flight distance could not be established in the overall calculation, we calculated an average of 97 km/d. If we include the six resting days, the young eagle migrated on average 78.4 km/d. We found no relationship between distance traveled and the weather conditions (wind speed, wind direction, cloud cover, and precipitation). Relatively good flying weather also prevailed on the rest days. The crossing of the Alps caused no delay.

DISCUSSION

Post-fledging Behavior and Family Break-up. Little is known about the distances young eagles move away from their nest during the post-fledging period. This aspect has never been studied in the two species considered here. In our study, the young hybrid eagle ventured considerably outside the home range of its father (54.4 km² in size, furthest distance located from the nest 6.2 km, Meyburg et al. 2006) at the end of the post-fledging period.

Concrete data on the family break-up are rare for eagles. In this mixed pair, the female was the last to depart, whereas the female was the first in a Greater Spotted Eagle family in Poland (Meyburg et al. 2005b). In both cases, all members of the family departed within a few days. Another satellite-tracked female in Poland departed on 13 September 2005. The male and its offspring, however, were still observed near the nest on 16 September 2005. In 2006, the same female already departed on 17 August (B.-U. Meyburg unpubl. data).

Migration Route. Very little has been published on whether adult eagles and their offspring migrate together or separately. The male and the young hybrid clearly migrated separately, even over the first 200 km where they followed similar flight paths.

A southwesterly migration direction in autumn is relatively common for Greater Spotted Eagles; for Lesser Spotted Eagles, however, it is extremely uncommon. Only very small numbers of Lesser Spotted Eagles are recorded in Italy on migration (e.g., Bijlsma 1987, Giordano 1991, Zalles and Bildstein 2000, Zenatello 2002). In contrast to Lesser Spotted Eagles, which winter almost without excep-

Table 1. The migration of hatch year Lesser and Greater Spotted Eagles was determined by satellite telemetry and compared to the hybrid eagle.

SPECIES AND PTT ID NUMBER	TOTAL DISTANCE TRACKED (km)	DURATION OF MIGRATION (d)	AVERAGE DAILY FLIGHT DISTANCE (km)	SOURCE AND REMARKS
Lesser Spotted Eagle 02911	2125	14	151.8	Meyburg et al. 1993. Reached the extreme southwest of the Peloponnese (Greece). Shot or perished crossing the Mediterranean.
Lesser Spotted Eagle 20648	2921	30	97.3	Meyburg et al. 1995. Shot. PTT with bullet inside was returned from Lebanon.
Lesser Spotted Eagle 20649	2654	42	63.1	Meyburg et al. 1995. Most probably shot in Lebanon.
Lesser Spotted Eagle 20643	7178	95	75.5	Meyburg et al. 1995. Migrated from Latvia to Tanzania where transmitter failed.
Greater Spotted Eagle 19626	1687	35	48.2	Meyburg et al. 2005b.
Greater Spotted Eagle 20648	1009	30	33.6	B.-U. Meyburg and C. Meyburg unpubl. data
Hybrid eagle 13289	2430	31	78.4	This study

tion south of the equator (Christensen and Sorensen 1989, Meyburg 1994a), Greater Spotted Eagles sometimes winter in Italy (Zenatello 2002), France (Francois 1992) and on the Iberian peninsula (Barrientos and Bolonio 2002), where a possible hybrid of these two species has been observed (Gutiérrez and Villa 2002). One of the very few ringing recoveries of a juvenile Greater Spotted Eagle dates from 1988, when a nestling ringed in that same year in Estonia was found in December in Massa Carrara, northern Italy (Väli and Lohmus 2000).

In our previous studies, we have fitted satellite transmitters to three nestling and 26 adult Lesser Spotted Eagles in northeastern Germany, within a radius of 70 km around the mixed pair's eyrie (Meyburg et al. 1993, 1995, 2005c, 2006 and unpubl.). All of these eagles departed on migration in a southeasterly direction to Africa via the Bosphorus and all adults returned again in spring from the same direction.

A young Greater Spotted Eagle, fitted with a transmitter by us on the western edge of the species' range in eastern Poland, migrated in a south-southwest direction some 1687 km to Albania (Meyburg et al. 2005b). However, another young eagle from the same region migrated to the south in the direction of the Bosphorus, flying 1009 km to the Black Sea coast near Odessa in the Ukraine, until transmission ceased (Table 1). One adult Greater Spotted Eagle also migrated south-southwest and wintered in northwestern Greece on the Adriatic coast, while all other nine adult Greater Spotted Eagles fitted with transmitters migrated to Turkey or to Africa (Meyburg and Meyburg 2005).

The hybrid eagle, therefore, took a not atypical migration direction for a Greater Spotted Eagle, in contrast to that of all Lesser Spotted Eagles, although the initial departure in an almost easterly direction and abrupt change

of direction to the southwest after 200 km migration were surprising. The young eagle's direction on departure was perhaps influenced at first by that of other migrating Lesser Spotted Eagles.

Migration Speed. The average daily flight distance (74 km/d) of the hybrid corresponded more closely to that of four young Lesser Spotted Eagles (63, 75, 97, and 152 km/d) than to that of two young Greater Spotted Eagles (34 or 48 km/d) also fitted with transmitters (Table 1). Its migratory behavior could therefore be described as being intermediate between the two species'. Additional tracking of juvenile and adult hybrid eagles is necessary for us to better understand their migration and wintering behavior.

COMPORTAMIENTO POSTERIOR AL EMPLUMAMIENTO Y MIGRACIÓN DE IDA DE UN HÍBRIDO ENTRE *AQUILA CLANGA* Y *A. POMARINA*

RESUMEN.—Una cría híbrida entre un macho de *Aquila pomarina* y una hembra de *A. clanga* fue marcada con un transmisor satelital en el norte de Alemania. El águila joven se desplazó hasta 12.2 km desde su nido durante el período posterior al emplumamiento, y partió un poco antes que sus padres. El águila joven parece haber mostrado un comportamiento migratorio intermedio entre las dos especies. El híbrido escogió una ruta migratoria de salida hacia el sur-oeste que no es inusual en *A. clanga*, pero que es inusual en *A. pomarina*, a pesar de que la migración inicial tuvo una dirección hacia el este. Sin embargo, después de 200 km ocurrió un cambio abrupto en la dirección. El 27 de octubre, después de recorrer una distancia de 2430 km, el águila joven alcanzó la punta más sureña de Italia, donde la transmisión terminó. La distancia diaria promedio de vuelo observada (78.4 km)

se asemejó más a la de juveniles de *A. pomarina* (63, 75, 97 y 152 km/d) que a la de juveniles de *A. clanga* (34 y 48 km/d).

[Traducción del equipo editorial]

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LITERATURE CITED

- ARGOS. 1996. User's manual. CLS/Service Argos, Toulouse, France.
- BARRIENTOS, R. AND L. BOLONIO. 2002. Registros de Aguila Moteada *Aquila clanga* en la Peninsula Iberica. *Ardeola* 49:293–296.
- BERGMANIS, U., A. PETRINS, A.M. STRAZDS, AND I. KRAMS. 2001. Probable case of hybridization of Greater *Aquila clanga* and Lesser Spotted Eagle *A. pomarina* in Eastern Latvia. *Acta Ornithoecol.* 9:297–304.
- BJLSMA, R.G. 1987. Bottleneck areas for migratory birds in the Mediterranean region: an assessment of the problems and recommendations for action. International Council for Bird Preservation, Cambridge, U.K.
- BLOOM, P.H. 1987. Capturing and handling raptors. Pages 99–123 in B.A. Giron Pendleton, B.A. Millsap, K.W. Cline, and D.M. Bird [Eds.], Raptor management techniques manual. Natl. Wildl. Fed., Washington, DC U.S.A.
- BROWN, L. AND D. AMADON. 1968. Eagles, hawks and falcons of the world, Vol. 1. Country Life Books, Feltham, U.K.
- CHRISTENSEN, S. AND U.G. SORENSEN. 1989. a review of the migration and wintering of *Aquila pomarina* and *Aquila nipalensis orientalis*. Pages 139–150 in B.-U. Meyburg and R.D. Chancellor [Eds.], Raptors in the modern world. World Working Group on Birds of Prey, Berlin, Germany.
- DOMBROVSKI, V.C. 2005. Hybridation entre les Aigles criard *Aquila clanga* et *A. pomarina* en Biélorussie: conséquence taxonomique. *Nos Oiseaux* 52:27–30.
- FRANCOIS, J. 1992. Observation sur la presence hivernale de l'aigle criard (*Aquila clanga*) en Moselle. *Ciconia* 16: 117–125.
- GIORDANO, A. 1991. The migration of birds of prey and storks in the straits of Messina. *Birds Prey Bull.* 4:239–250.
- GUTIÉRREZ, R. AND S. VILLA. 2002. A possible hybrid Spotted Eagle × Lesser Spotted Eagle in Spain. *Birding World* 15:104–105.
- HELBIG, A.J., I. SEIBOLD, A. KOCUM, D. LIEBERS, J. IRWIN, U. BERGMANIS, B.-U. MEYBURG, W. SCHELLER, M. STUBBE, AND S. BENSCH. 2005. Genetic differentiation and hybridization between Greater and Lesser Spotted Eagles (*Accipitriformes: Aquila clanga, A. pomarina*). *J. Ornithol.* 146:226–234.
- LÖHMUS, A. AND Ü. VÄLI. 2001. Interbreeding of the Greater *Aquila clanga* and Lesser Spotted Eagle *A. pomarina*. *Acta Ornithoecol* 4:377–384.
- MEYBURG, B.-U. 1994a. Lesser Spotted Eagle *Aquila pomarina*. Pages 192–193 in J. del Hoyo, A. Elliott, and J. Sargatal [Eds.], Handbook of the birds of the world. Lynx Edicions, Barcelona, Spain.
- . 1994b. Greater Spotted Eagle *Aquila clanga*. Page 193 in J. del Hoyo, A. Elliott, and J. Sargatal [Eds.], Handbook of the birds of the world. Lynx Edicions, Barcelona, Spain.
- , T. BELKA, Š. DANKO, J. WÓJCIAK, G. HEISE, T. BLOHM, AND H. MATTHES. 2005a. Geschlechtsreife, Ansiedlungsentfernung, Alter und Todesursachen beim Schreiadler (*Aquila pomarina*). *Limicola* 19: 153–179.
- , L. HARASZTHY, M. STRAZDS, AND N. SCHÄFFER. 2001a. European species action plans for Greater Spotted Eagle (*Aquila clanga*). Pages 1–16 in N. Schäffer, and U. Gallo-Orsi [Eds.], European Union action plans for eight priority bird species. European Commission, Luxembourg.
- , ———, ———, AND ———. 2001b. European species action plans for Lesser Spotted Eagle (*Aquila pomarina*). Pages 1–24 in N. Schäffer, and U. Gallo-Orsi [Eds.], European Union action plans for eight priority bird species. European Commission, Luxembourg.
- AND C. MEYBURG. 2005. Tracking the endangered Greater Spotted Eagle. *Tracker News* 6(2): 4.
- , ———, J. MATTHES, AND H. MATTHES. 2006. GPS satellite tracking of Lesser Spotted Eagle *Aquila pomarina*: home range and territorial behaviour in the breeding area. *Vogelwelt* 127:127–144.
- , ———, T. MIZERA, G. MACIOROWSKI, AND J. KOWALSKI. 2005b. Family break up, departure, and autumn migration in Europe of a family of Greater Spotted Eagles (*Aquila clanga*) as reported by satellite telemetry. *J. Raptor Res.* 39:465–469.
- , T. MIZERA, J. MATTHES, K. GRASZYNSKI, J.P. SCHWANBECK, G. MACIOROWSKI, AND W. SCHELLER. 2005c. Hybridisation of Greater (*Aquila clanga*) and Lesser Spotted Eagle (*A. pomarina*) in Poland and Germany. Pages 115–118 in T. Mizera and B.-U. Meyburg [Eds.], International meeting on Spotted Eagles: proceedings of an international symposium. Biebrza National Park, Osowiec, Poland.
- , W. SCHELLER, AND C. MEYBURG. 1993. Satelliten-Telemetrie bei einem juvenilen Schreiadler (*Aquila pomarina*) auf dem Herbstzug. *J. Ornithol.* 134:173–179.

- , ———, AND ———. 1995. Zug und Überwinterung des Schreiadlers *Aquila pomarina*. Satellitentelemetrische Untersuchungen. *J. Ornithol.* 136:401–422.
- SEIBOLD, I., A.J. HELBIG, B.-U. MEYBURG, J.J. NEGRO, AND M. WINK. 1996. Genetic differentiation and molecular phylogeny of European *Aquila* eagles according to cytochrome b nucleotide sequences. Pages 1–15 in B.-U. Meyburg and R.D. Chancellor [EDS.], Eagle studies. World Working Group on Birds of Prey and Owls, Berlin, Germany.
- TREINYS, R. 2005. The Greater Spotted Eagle (*Aquila clanga*): previous and current status and hybridisation in Lithuania. *Acta Zool. Lituanica* 15:31–38.
- VÄLI, Ü. AND A. LÖHMUS. 2000. The Greater Spotted Eagle and its conservation in Estonia. *Hirundo* Suppl. 3.
- ZALLES, J.I. AND K.L. BILDSTEIN [EDS.]. 2000. Raptor watch: a global directory of raptor migration sites. BirdLife International and Hawk Mountain Sanctuary, Cambridge, U.K. and Kempton, PA U.S.A.
- ZENATELLO, M. 2002. *Aquila anatraia* maggiore. Pages 44–45 in M. Spagnesi and L. Serra [EDS.], Iconography of Italian birds, Vol. 2. Ministero dell'Ambiente - Servizio Conservazione Natura e Istituto Nazionale per la Fauna Selvatica, Rome, Italy.
- ZHEZHERIN, V.P. 1969. [On taxonomic interrelation of *Aquila clanga* Pall. and *Aquila pomarina* Brehm]. *Zbirn. Prats Zool. Muz.* 33:91–97 (In Ukrainian with English summary).

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