

# The Lesser Spotted Eagle *Aquila pomarina* in the North Caucasus, Russian Federation: taxonomic status, genetic diversity, breeding density and nest site characteristics

ÜLO VÄLI, VIKTOR P BELIK & IGOR G BABKIN

We studied the Lesser Spotted Eagle population in a 55 km<sup>2</sup> study area near Kislovodsk, North Caucasus, in July 2007. Birds were observed on ten breeding territories while nests, distributed unevenly in the landscape in forested river valleys, were found and described for eight territories. Productivity in 2007 was 0.71 nestlings per occupied nest. The results of our mitochondrial DNA analysis indicate that the Caucasus region is inhabited by the same subspecies as occurs elsewhere in Europe. However, the genetic diversity within the Caucasian population was much higher than that of more northern European populations, suggesting that the Caucasian population is relatively old and not been subject to historical or recent 'bottlenecks'.

## INTRODUCTION

The Lesser Spotted Eagle *Aquila pomarina* is declining in many parts of its range, although listed in the IUCN Red List as a species of Least Concern (BirdLife International 2007). The prevailing view (eg Dickinson 2003) used to be that there are two subspecies of Lesser Spotted Eagle. The nominate *A. p. pomarina* breeds in central, eastern and southeastern Europe, the Caucasus and Turkey through northern Iran, and migrates to winter in southern regions of Africa. *A. p. hastata* (Indian Spotted Eagle) is a resident found only in the Indian subcontinent. Originally, *A. hastata* was described as a separate species (Lesson 1834), a position supported by recent morphological and genetic analyses, which suggest that it is indeed a different species from Lesser Spotted Eagle (Parry *et al* 2002, Väli 2006). This leads to the question whether *A. pomarina* is truly monotypic or whether there are



Figure 1. Location of Kislovodsk, North Caucasus, Russian Federation.



**Plate 1.** Adult Lesser Spotted Eagle *Aquila pomarina* in the study area, North Caucasus. © Ülo Väli

any previously unknown or even cryptic (distinguishable only or mostly through genetic analysis) subspecies to be found.

The status of the Lesser Spotted Eagle in Turkey, the Caucasus and northern Iraq and Iran is unclear. It is probable that these populations are isolated from the main European populations, possibly sufficiently for a separate subspecies to have developed. Furthermore, such isolated populations might harbour only limited genetic diversity and, therefore, have a reduced evolutionary potential. On the other hand, the Caucasus region has been suggested as a likely refugium for several vertebrate populations during the last ice age (Hewitt 2004). Should this be true for Lesser Spotted Eagle, we should find a larger genetic diversity compared to more northern populations in Europe.

Our main aim in the current study was to evaluate the taxonomic status and genetic diversity of the Caucasian population of Lesser Spotted Eagle (Plate 1). The project took place in a region of the North Caucasus, in a potential Important Bird Area (IBA), where existence of a substantial population was suspected (Belik & Tel'pov 2007). Therefore, our second aim was to seek evidence to verify, or otherwise, previous observations of high breeding densities there, by mapping territories and finding nests. Because the biology of and the threat factors for the species are poorly known in the North Caucasus (Belik *et al* 2008), our third aim was to study breeding biology and assess potential factors limiting the population.

## **STUDY AREA AND METHODS**

The fieldwork was performed in a rectangular 55 km<sup>2</sup> (10 × 5.5 km) study area near Kislovodsk (43° 54' N, 42° 36' E, Figure 1), on the border of Stavropol'skiy krai and Karachayev-Cherkessiya, southern Russian Federation. The majority of the study area, on the gently-sloping northern foothills of the Caucasus mountains, comprises a slightly



**Plate 2.** Breeding habitat of the Lesser Spotted Eagle *Aquila pomarina* in the study area, North Caucasus. © Ülo Väli

hummocky open landscape at altitudes of 1000–1200 m asl and is crossed by steep-sided valleys a few hundred metres wide and 50–100 m deep (Plate 2). It is characteristic for these valley slopes, on the northern or western sides, to be cliffs while the opposite slopes possess fragments of deciduous forests (birch *Betula*, elm *Ulmus* and ash *Fraxinus* being the main tree species) of varying sizes, some being large. These are the only forested parts of the study area and altogether comprise only c5–10% of it. About 50–60% is covered by steppe-like subalpine meadows, once used as pastures and hayfields but now abandoned. According to estimations of Tel'pov *et al* (2000), the region otherwise consists of: cliffs and valley sides (c20%), agricultural land (c5%) and other biotopes (c15%). There are very few human settlements in the study area, only a few farms and villages. However, there are densely populated areas, such as Kislovodsk town, just to the north of the study area.

We mapped Lesser Spotted Eagle breeding territories and searched for their nests, 10–17 July 2007. We described the nests and evaluated occupancy and breeding results. Nests were often on trees growing obliquely on relatively steep slopes, therefore we also estimated the direction the slope faced and measured nest height both from the ground and from the tree base. From each of five successful nests, a nestling was ringed and a blood sample taken from it for genetic analysis. We also collected moulted feathers of adult birds from all nest sites in case they were needed for genetic analysis. Only one sample, blood (preferable) or feather, per nest site was used in the analysis (feather data only used for the three unsuccessful nest sites).

In the genetic analysis, we sequenced 520 base-pairs from the cytochrome b gene and 847 base-pairs from the pseudo-control region of the mitochondrial DNA (see Väli 2002). Each individual bird has only one type of each mitochondrial gene sequence, a haplotype.

The more distantly related two populations are the more differences (mutations) can be found when individuals originating from different populations are compared. A large number of differences between individuals from the same population indicates high genetic diversity within the population. Sequences and the calculated indices describing genetic diversity were compared with those from two northern populations of Lesser Spotted Eagle (Estonian, n=20, and Lithuanian, n=20; reduced sample from Väli *et al* 2004).

## RESULTS

We analysed DNA samples from eight birds, each from a different breeding territory. In the variable pseudo-control region, three different haplotypes were found. The most common haplotype, containing two nucleotide substitutions not yet found elsewhere in Europe (Ü Väli unpub), was found in four individuals. A second haplotype was found in three and a third in a single individual. The average number of nucleotide substitutions per site between the North Caucasus population and the sample from Estonia was only  $0.00177 \pm 0.00078$  (SD), and between North Caucasus and Lithuania  $0.00194 \pm 0.00069$ . The average number of substitutions within the North Caucasus population was  $0.00194 \pm 0.00049$ , which is much higher than in the northern populations in Estonia ( $0.00059 \pm 0.00033$ ) or Lithuania ( $0.00094 \pm 0.00028$ ). Finally, a part of the cytochrome b gene was sequenced in four individuals, representing three pseudo-control region haplotypes, and no variation was found. These sequences were identical to that found in the two Baltic countries (Väli *et al* 2004).

During the study, we observed Lesser Spotted Eagles on ten breeding territories in the 55 km<sup>2</sup> of the study area, equivalent to a breeding density of 18 territories/100 km<sup>2</sup>. In seven territories we found occupied nests (two in territory 7) and in an eighth territory

**Table 1.** Nest data for Lesser Spotted Eagle *Aquila pomarina* nests found in 2007 in the vicinity of Kislovodsk, North Caucasus. \* no evidence of breeding.

Nest	Date examined	Nest tree	Nest height above				Slope Direction facing	Nest age	Occupancy
			Tree height (m)	Ground (m)	Tree base (m)	Distance to nearest nest (m)			
1	11 Jul 07	Common alder <i>Alnus glutinosa</i>	17	11	10	2780	N	2y+	1 nestling, 25 days old
2	11 Jul 07	Common ash <i>Fraxinus excelsior</i>	10	6	5	1040	N	1st y	1 nestling, 20 days old
3	12 Jul 07	Wych elm <i>Ulmus glabra</i>	10	7	6	980	W	1st y	Occupied*
4	12 Jul 07	Silver birch <i>Betula pendula</i>	15	5	5	1040	NW	1y+	Not occupied
5	14 Jul 07	Wych elm <i>Ulmus glabra</i>	10	8	6	?	NE	2y+	1 nestling, 30 days old
6	15 Jul 07	Goat willow <i>Salix caprea</i>	12	10	7	2400	N	2y+	1 nestling, 30 days old
7a	15 Jul 07	Aspen <i>Populus tremula</i>	15	5	5	?	NW	1y+	Occupied*
7b	15 Jul 07	Silver birch <i>Betula pendula</i>	10	8	5	?	NW	1st y	Built 2007, occupied*
8	11 Jul 07	Wych elm <i>Ulmus glabra</i>	20	12	10	980	N	2y+	1 nestling, 45 days old
Average			13.2	8.0	6.6	1540			

an unoccupied nest, probably from 2006 (Table 1). Nest sites were located only in forested river or rivulet valleys, thus distributed unevenly in the landscape. In the area of highest nest density, four nests had a nearest-neighbour distance of less than 1 km. Five nests contained a nestling (Plate 3), and two nests, though occupied, showed no signs of breeding. Productivity in 2007 was thus 0.71 nestlings per occupied nest (*ie* per breeding territory). According to the estimated nestling age (Table 1) and average incubation time (Cramp & Simmons 1980), the eggs had been laid in late April or early May, hatching occurring by mid-June.



**Plate 3.** Lesser Spotted Eagle *Aquila pomarina* nest 2 (Table 1), North Caucasus. © Ülo Väli

## DISCUSSION

The results of our mitochondrial DNA analysis indicate that the Caucasus region is inhabited by the same subspecies as found elsewhere in Europe. There were no differences in the cytochrome b gene, and differentiation in the pseudo-control region was far too small to define a new subspecies. The high genetic diversity within the Caucasian population is remarkable because we collected samples in only a small study area, where inbreeding and reduced genetic diversity is possible. This suggests that the Caucasian population of Lesser Spotted Eagle is relatively old and has not been subject to historical or recent genetic ‘bottlenecks’. Furthermore, the Caucasus may well have held a refugial population of this species during the last ice age. More populations will have to be compared with each other before any final conclusions on the historical and current relationships between Lesser Spotted Eagle populations can be made.

This study confirms the high current breeding density of the Lesser Spotted Eagle in the vicinity of Kislovodsk. Indeed, this site seems to be the most densely populated in the entire North Caucasus (Belik *et al* 2008), equalling the highest densities recorded in other parts of Europe (Dombrovski & Ivanovski 2005, Bergmanis *et al* 2006). The Kislovodsk region is clearly well worth assessing for designation as an IBA (Belik & Tel’pov 2007). The nearest-neighbour distances between different eagle territories were variable, which may indicate that in areas of apparent lower occupation, we may not have discovered all nests. For example, because our study took place in July, we would not detect unsuccessful territories abandoned earlier that year. Actual overall breeding density may be somewhat higher than we recorded, but probably not by much, because we recorded greater (>2 km) nearest-neighbour distances in less forested localities, against the c1 km measured between 4 nests in a continuous forest belt. As in the other regions of the North Caucasus (Belik *et al* 2008), all nests were found on deciduous trees. The majority of nests were built on relatively weak branches or on the arched top of a young tree, which means one could expect many of them to be destroyed in bad weather after the breeding season. We believe that even these weak nest substrates, by being very abundant, are attractive to the eagles during the nest-building season, even though older trees and stronger nest substrates are available as well. Availability of nest sites, therefore, may limit numbers of eagles somewhat in the study area, but it is likely that the high breeding density itself is already at the limit for this territorial species.

Other potential threat factors such as limited availability of foraging area and disturbance by humans are probably not significant in the study area because the area of

grasslands is very high, and existing meadows seem to remain suitable for foraging Lesser Spotted Eagles even after abandonment, whereas human settlements are scarce in the study area. In the North Caucasus, the Lesser Spotted Eagle seems to breed mainly in the larger dense forest patches where its nests are probably not easily found by nest-robbers, whose raptors and owls are often kept illegally in captivity and exhibited in Kislovodsk and other towns. However, we did find some nests (Table 1: 4, 7a, 7b) in a narrow tree row on a gentle lower slope and so the species probably is vulnerable, particularly outside its primary habitat. Local authorities, with the assistance of conservation bodies, need to implement more efficiently local and national laws concerning protected species.

## ACKNOWLEDGEMENTS

We are grateful to KA Lyubimova, EV Gugueva, SYu Metkalova and VA Tel'pov for their support in the field, and to Rimgaudas Treinys for comments on the manuscript. Fieldwork was financed by the Ornithological Society of the Middle East and the Critical Ecosystem Partnership Fund. Genetic studies were supported by the Estonian Science Foundation, grant 7593.

## REFERENCES

- Belik, VP & VA Tel'pov. 2007. Results of the inventory and monitoring of IBAs in Central Caucasus in 2006. *Strepet* 5: 71–84.
- Belik, VP, Ü Väli & IG Babkin. 2008. [The Lesser Spotted Eagle in the Northern Caucasus]. In: Melnikov, VN. [Research and Conservation of the Greater and Lesser Spotted Eagles in the Northern Eurasia]. Izdatel'stvo Ivanovskogo Gosudarstvennogo Universiteta, Ivanovo, Russia, pp47–69. [In Russian]
- Bergmanis, U, A Petrins, V Cirulis, J Matusiak & J Kuze. 2006. Lesser Spotted Eagle *Aquila pomarina* in Latvia—current status, endangerment and perspectives. *Populationsökologie Greifvögel- und Eulenarten* 5: 95–115.
- BirdLife International. 2007. *IUCN Red List of Threatened Species*. www.iucnredlist.org.
- Cramp, S & KEL Simmons. 1980. *Birds of the Western Palearctic*. Vol 2. Oxford University Press, Oxford, UK.
- Dickinson, EC. 2003. *The Howard & Moore Complete Checklist of the Birds of the World*. 3rd edition. Christopher Helm, London.
- Dombrovski, VC & VV Ivanovski. 2005. New data on numbers and distribution of birds of prey breeding in Belarus. *Acta Zoologica Lituanica* 15: 218–227.
- Hewitt, G. 2004. Genetic consequences of climatic oscillations in the Quaternary. *Philosophical Transactions of the Royal Society London B* 359: 183–195.
- Lesson, R-P. 1834. Oiseaux. In: Behnger, C. *Voyage Aux Indes Orientales*. Bertrand, Paris, p217.
- Parry, SJ, WS Clark & V Prakash. 2002. On the taxonomic status of the Indian Spotted Eagle *Aquila hastata*. *Ibis* 144: 665–675.
- Tel'pov, VA, AN Hohlov & MP Ilyuh. 2000. [Surroundings of Kislovodsk]. In: Sviridova, TV & VA Zubakin. [Key Ornithological Territories in Russia]. Vol 1. Russian Bird Conservation Union, Moscow, pp351–352. [In Russian]
- Väli, Ü. 2002. Mitochondrial pseudo-control region in old world eagles (genus *Aquila*). *Molecular Ecology* 11: 2189–2194.
- Väli, Ü. 2006. Mitochondrial DNA sequences support species status for the Indian Spotted Eagle *Aquila hastata*. *Bulletin of the British Ornithologists' Club* 126: 238–242.
- Väli, Ü, R Treinys & K Poirazidis. 2004. Genetic structure of Greater *Aquila clanga* and Lesser Spotted Eagle *A. pomarina* populations: implications for phylogeography and conservation. In: Chancellor, RD & B-U Meyburg. *Raptors Worldwide*. WWGBP/MME. Budapest, pp473–482.
- Ülo Väli, Department of Evolutionary Biology, Uppsala University, Norbyvägen 18D, 75236 Uppsala, Sweden & Institute of Agricultural & Environmental Sciences, Estonian University of Life Sciences, Riia 181, 51014 Tartu, Estonia. ulo.vali@ebc.uu.se
- Viktor P Belik & Igor G Babkin, Department of Zoology, South Federation University, 344065 Rostov-on-Don, Russia. vbelik@mail.ru