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Breeding of the Imperial Eagle *Aquila heliaca* in Slovakia

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THE PAST

The Imperial Eagle is a typically Asian species which spread into the Carpathian basin only about 150 years ago (Jánossy, pers. comm.). In palaeontological findings, bones of this species are absent; moreover, according to the oldest data in the literature, it was not until the first half of the last century that this eagle started to occur in this region. It is clear that, in several cases during the early years of observation, it was often confused with the Golden Eagle *Aquila chrysaetos*, as is confirmed by Horváth's report (1867, in Mošanský 1975) that some time before 1867 (precise date not given) a Golden Eagle's nest was located in an oak tree in Eastern Slovakia containing three nestlings, north of the town of Košice, whereas the situation of the nest and the number of nestlings indicate that it must have belonged to an Imperial Eagle. If so, this could be the first published record of this eagle's breeding in Slovakia.

Further data from earlier times come from Ambros (in Hudec, Černý *et al.* 1977), citing that a pair was nesting in Pol'ana in the Slovenské Rudohorie mountains in 1905-1927 and in Strážovské vrchy (hills) in 1948-1955. However, there is no mention of these data by any other author and we therefore regard them as dubious. An evident increase in the Imperial Eagle population in Slovak territory first became evident in the 1940s, when it spread into the north-western tip of the present breeding range. A sufficient amount of suitable nesting biotopes together with right climatic conditions to provide an adequate trophic base created optimal circumstances for above all young birds to settle in this region.

The first documented case of breeding in the Slanské vrchy mountains in 1952 was published by Mošanský (1956), although it later turned out that breeding in individual mountain ranges had taken place even earlier, in the southern part of Slanské vrchy ever since 1945 (Vysokay, in Danko unpubl.). I.

Vysokay took up his job there as forester in that year and it is more than likely that the eagles had been nesting in that locality even earlier. In the Malś Karpaty mountains (Little Carpathians) they were probably breeding since 1947 (J. Brtek, in Kalivodová & Brtek 1977). The first active nest was located here by Tonhauzer (1954) in 1953. In the Tríbeč mountain range they have bred at least since 1949 (Konrád, in Sládek 1959). Figure 1 illustrates the chronology of occupation of individual mountain ranges in Slovakia according to the literature and our own data. Records of nesting increased above all in the 1950s and '60s and were published by Mošanský (1956), Sládek (1959) and Špaček & Kovář (1965). The breeding records in Eastern Slovakia up to 1965 were summarized by Mošanský (1972 and 1975). In Western Slovakia the species was studied by Feriancová and Brtek (1969), Varga (1969) - data up to 1966 - and Kalivodová and Brtek (1977) - data up to 1970.

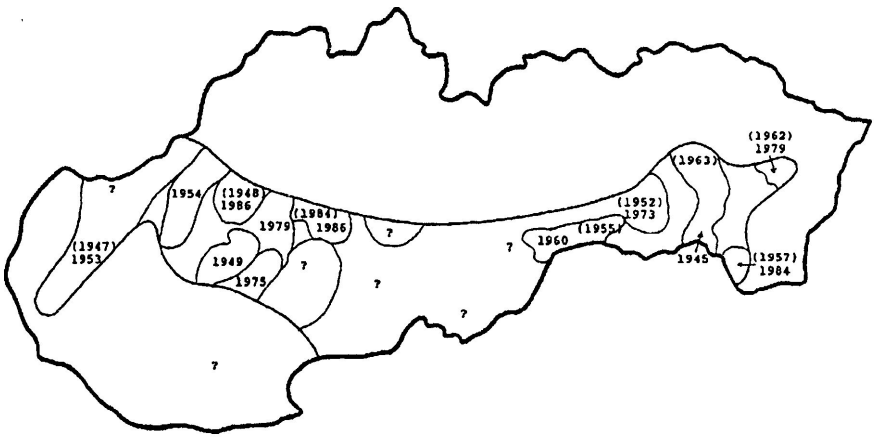
From these published data we found that, up to the end of 1969, active nests were known in Slovakia in the following mountain regions: Slanské vrchy (mountains), Slovak Karst, Tríbeč, Považský Inovec and Little Carpathians, with nine pairs in all. Based on observations, the presence of nine other breeding pairs was presupposed. Since no systematic research or nest monitoring etc. were carried out for the period 1952-1968, only the following could be ascertained: out of 28 cases of nesting, 12 were successful and fledged 19 young (6 x 1, 5 x 2 and 1 x 3). The remaining 16 cases failed, eight having the nestlings stolen, three being robbed of their eggs, two due to the felling of the nest tree, two having the eggs destroyed by hard weather, while in one case one of the pair was shot.

THE PRESENT

In 1969 more systematic research began into the distribution, numbers and breeding success of Imperial Eagles in Eastern Slovakia, conducted by Š. Danko (with H. Švehlik up to 1978 and with J. Mihók up to 1987) and this is (with H. Švehlik up to 1978 and with J. Mihók up to 1987) and this is still continuing to-day. After 1975 the intensity of this research increased throughout Slovakia following the setting up of a special Group for Research and Protection of Birds of Prey and Owls in Czechoslovakia.

In Western Slovakia since 1977 above all J. Chavko, S. Harvančík and V. Mrlík have devoted their time to this species, assisted by L. Prešinský, L. Šnírer and J. Pavelka. Unfortunately, to date we have been unable to enlist co-workers from the southern part of Central Slovakia, where we lack the necessary data. During the ensuing years the work was concentrated on locating breeding territories and pinpointing active nests so that they could be monitored and managed. Through long-term research we acquired much

Figure 1. Chronology of occupation of inndividual mountain ranges in Slovakia by Imperial Eagles according to the literature and our own data.
Years in brackets indicate the date when first observed in a given mountain range. Other dates indicate when an occupied nest was first located. ? = localities where breeding not yet proved.



valuable knowledge which we have sought to put to practical use in devising protection measures. The initial results from Eastern Slovakia were published by Danko (1973) and Švehlík & Meyburg (1979). Other results have been published annually since 1975 in the Reports on Activity of the Group for Protection of Birds of Prey & Owls in the CSSR (see Danko 1975-1992).

Table 1 shows the progress of our increasing knowledge and results. During our 25 years of research we located 27 nest sites, including occupied nests. We found that, with few exceptions, nests located in the period 1945-1969 were regularly occupied each year. From the bird's presence during the breeding season we suspect a further eight breeding pairs. We also estimated several breeding pairs in the as yet uninvestigated southern part of Central Slovakia. Naturally the total number of pairs varies from year to year; for example, at the beginning of the 1970s one nest site was abandoned, in 1987 and 1990 two pairs moved into Hungarian territory, while one Hungarian pair bred one year in Slovakia and another pair breeds by turns in both territories. On the other hand, entirely new breeding sites have been occupied by new pairs still in immature plumage. Thanks to the plumage differences between young and old birds, we could thus verify the occupation of fresh territory and hence a gradual increase in the population. This is remarkable in view of the continual deterioration of the environment in general. Whilst at the start Slovakia's Imperial Eagles always bred in forest biotopes up to 700 m a.s.l., they began

Table 1. Breeding success of Imperial Eagles in Slovakia in the years 1969-1993.

25 Years	1	2	3	4	5	6	7	8	9
		Number of nests					No of young		
Year	BP	F	P	NP = %	NB	NFY	1 2 3	ØP	ØO
1969	2	2		2 100.0				0.00	0.00
1970	1	1		1 100.0				0.00	0.00
1971	2	2	1	1 50.0		2	1	2.00	1.00
1972	4	4	2	2 50.0		4	2	2.00	1.00
1973	6	4	3	1 25.0		4	2 1	1.33	1.00
1974	6	2	1	1 50.0		1	1	1.00	0.50
1975	6	3	2	1 33.3	1	3	1 1	1.50	1.00
1976	7	5	2	3 60.0		3	1 1	1.50	0.60
1977	8	5	3	2 40.0		5	1 2	1.67	1.00
1978	9	7	4	3 42.9		7	1 3	1.75	1.00
1979	10	8	4	4 50.0		6	2 2	1.50	0.75
1980	12	6	2	4 66.7	1	3	1 1	1.50	0.50
1981	12	8	5	3 37.5		7	3 2	1.40	0.88
1982	14	12	8	4 33.3		12	4 4	1.50	1.00
1983	15	13	5	8 61.5		6	4 1	1.20	0.46
1984	17	13	7	6 46.2	3	10	4 3	1.43	0.77
1985	18	15	11	4 26.7	1	14	9 1 1	1.27	0.93
1986	20	14	12	2 14.3		15	9 3	1.25	1.07
1987	19	14	13	1 7.1		19	7 6	1.46	1.36
1988	21	15	11	4 26.7	1	18	6 3 2	1.64	1.20
1989	21	18	11	7 38.9	1	17	5 6	1.55	0.94
1990	20	19	11	8 42.1		19	3 8	1.73	1.00
1991	20	15	10	5 33.3	4	16	5 4 1	1.60	1.07
1992	21	17	12	5 29.4	3	18	6 6	1.50	1.06
1993	24	20	12	8 40.0	3	24	3 6 3	2.00	1.20
Total		242	152	90 37.2	18	233	78 67 7	1.53	0.96

1 - BP : Number of located breeding sites
2 - F : Number of occupied nests with eggs
3 - P : Number of productive nests from which young fledged
4 - NP : Number of non-productive nests
5 - NB : Number of non-breeding pairs (without eggs
6 - NFY: Total number of young fledged per productive nest
8 - OP : Average number of young fledged per productive nest

after 1986 to nest in Eastern Slovakia in open agricultural land also. In the early stages some adult pairs shifted from the hills to the lowlands, building their nests in isolated trees or in trees planted as windbreaks. More recently, entirely new pairs of young eagles have occupied this open biotope, with the prospect of a special lowland population being formed. The shortest distance between nesting pairs in both biotopes is, as a rule, in excess of 5km. To date, only one instance has been found in Eastern Slovakia of two occupied nests a mere 1600 m apart.

In Table 1, Column 1 gives the total number of known breeding places as we located them over the years. Column 2 gives the total number of occupied nests with eggs, leading to the number of productive (Col. 3) and non-productive pairs (Col. 4), also expressed as percentages. Column 5 gives the number of non-productive pairs, i.e. pairs occupying a nest site but failing to lay eggs and thus not classed as breeders. According to our findings, this was due to 1) sexual immaturity, 2) loss of one member of a pair, and 3) unknown causes (including so-called "rest" years in older pairs). When the combined totals from Column 2 and 5 do not reach the value given in Column 1, the remaining nests were not inspected, due above all to lack of time and also of financial means.

BREEDING SUCCESS

To avoid any possible disturbance, we have controlled neither the clutch size nor the number of nestlings hatched, but carried out a direct control only once a year, at a time when nestlings are already half grown (second half of June). During this visit we check the stability of the nest, number of nestlings (plus any infertile eggs), and prey remains and we ring the fledgings. The number of young finally fledged is controlled once more at the end of July. In this way, during the 25 years of our activity, we confirmed 233 successfully fledged young from 152 productive nests (78 x 1, 67 x 2 and 7 x 3) (see Table 1). Thus in Slovakia we get 1.0-2.0 young fledged per productive nest (Col. 8), with an average of 1.53 (in the first years of research we have no precise figure, due to the small number of nests as yet located). With the Imperial Eagle we regard values between 1.5 and 2.0 as good, and above 2.0 as excellent. More pertinent, however, are the data given in Column 9, showing the average number of young fledged from all occupied nests including those that failed. For the Imperial Eagle, those years when the average number of young fledged from all occupied nests exceeded 1.0 should be regarded as successful. Human intervention can positively influence these values by reducing the number of unsuccessful breedings (see below).

It should be noted that the percentage of failed breeding attempts for the

Imperial Eagle is relatively high in Slovakia, reaching an average of 37.2% over the 25 years of study. Since 1987, however, the situation has been far more satisfactory, with the rate of losses being lower than 20%. Since, from the viewpoint of protection, the number of failures is of great importance, we tried to analyse the causes, although in many cases we were unable to find direct reasons, above all during the incubation period, and so could only guess at them. Our results were as follows: -

1.	37 nests abandoned during incubation (most for unknown reasons)	41.1%
2.	13 nests robbed of their nestlings	14.5%
3.	11 nests collapsed (poor construction + wind)	12.5%
4.	9 nests abandoned after hatching (mostly for unknown reasons)	10.0%
5.	9 nests with infertile clutches	10.0%
6.	5 nests deserted due to human activity (photographers, frequent visits, etc.)	5.6%
7.	3 nests victims of natural causes (a bough fell on one; two predated by Marten & Goshawk)	3.3%
8.	2 nests abandoned due to death of partner	2.2%
9.	1 parent shot off the nest	1.1%
	90	100.0%

From the above, it is noteworthy that losses due to natural causes form only 15.5% of the total (Points 3 and 7). All the rest are attributable to either direct or indirect human activity. Nor do we possess any data regarding mortality outside the breeding season. In the case of Point 1 we suppose that nest abandonment was most often due to disturbance (whether intentional or unintentional) for such a length of time or of such frequency that the eggs chilled. The same applies to Point 4, when the Imperial Eagle is particularly sensitive to disturbance or when the parents are absent for so long that the nestlings succumb to cold or to excessive exposure to the sun. But we not infrequently found the remains of nestlings in the nest or below it for no apparent reason; alternatively, the nestlings simply disappeared with, in most cases, the parents remaining in the vicinity.

SOLVING PROTECTION PROBLEMS

Given the negative factors influencing the breeding success of the Imperial Eagle, it follows that it is above all necessary to eliminate the adverse effects of human intervention, whether deliberate or otherwise. Thus we need

1. to continue intensive search for active nests, so that all pairs can be permanently controlled,
2. to monitor and manage all nest sites yearly, so as to identify possible negative factors and ensure their elimination,

3. to locate each occupied (old or new-built) nest before egg laying, i.e. in March, to contact the relevant landowner and, after mutual agreement, in co-operation with the State Nature Protection employees and environmental authorities, to ensure tranquillity in the nest area for a period of four months (April - July), and above all to ban any forestry or agricultural work in the vicinity during incubation and post-hatching (April - May). Also, in June and July, to regulate such work so as to minimise any possible disturbance. In this way the major causes of loss will be substantially reduced,
4. to warden nests in places where they are systematically robbed (above all in Western Slovakia) so as to prevent further robbing and possibly catch the robbers. Also to guard the exposed nests in open agricultural land from disturbance by people (since the birds are already accustomed to agricultural machinery). A further serious problem of recent years has been an increased interest in captive breeding of the eagle for commercial purposes, which is not only undesirable but also directly in opposition to the interests of the species and its protection. Protection of nests from robbery in Slovakia engenders considerable financial and physical demands.
5. to prevent losses from collapsing nests and secure these before egg-laying; to adapt suitable trees for nest construction, ensuring that they have a firm base; also to start erecting bases for nests on high-voltage electricity pylons where, if adopted, the eagles would be safer from disturbance.

The negative factors in Points 1-4 together make up 77.7% of nest losses. If these can be eliminated, this should lead to substantially higher productivity and the Imperial Eagle will in future be able not only to maintain its present population level but also accelerate an increase which has of late become evident in Slovakia and neighbouring Hungary.

CONCLUSION

In 1990 we drew up a project for the monitoring, management and protection of the Imperial Eagle's breeding population in Slovakia. This project was immediately accepted and financially supported by organisations in other countries, above all by WWF International (Switzerland), FIR (Belgium), DB/INV (Germany) and ÖGV (Austria). In Slovakia the State Nature Protection and the Slovak Union of Nature & Landscape Protectors contributed financially. Thanks to this help we have been able since 1991 to regularly monitor and manage known nest sites and to warden selected nests which, since then, have been continuously successful. We hope that, with the continued support of the above organisations, we shall be able to expand and intensify our efforts to enable our Imperial Eagles to fledge as many young as possible every year.

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