

## POPULATION INCREASE OF IMPERIAL EAGLE (*AQUILA HELIACA*) IN HUNGARY BETWEEN 1980 AND 2000

János Bagyura – Tamás Szitta – László Haraszthy – Gábor Firmánszky –  
Levente Viszló – András Kovács – Iván Demeter – Márton Horváth

### Abstract

**BAGYURA, J., SZITTA, T., HARASZTHY, L., FIRMÁNSZKY, G., VISZLÓ, L., KOVÁCS, A., DEMETER, I. & HORVÁTH, M. (2002): Population increase of Imperial Eagle (*Aquila heliaca*) in Hungary between 1980 and 2000. *Aquila* 107-108, p. 133-144.**

The Raptor Protection Group of BirdLife Hungary (MME) started an organised conservation programme on the Imperial Eagle (*Aquila heliaca*) in 1980. The work has been carried out in close collaboration with the national park directorates and with the financing support of the Nature Conservation Bureau. By 1990 the majority of the breeding territories in Hungary was located, and besides population monitoring, several types of conservation activities were conducted. During the 1990s the Hungarian population of Imperial Eagle increased significantly and many former lowland breeding habitats were reoccupied. In 2000 the Hungarian Imperial Eagle population consisted of approximately 55-60 breeding pairs. During the 21 years of study 473 breeding attempts were monitored out of which 348 (73,57%) were successful and a total of 525 chicks fledged. Mean breeding success was 1.11 chicks/breeding attempts and 1.51 chicks/successful breeding attempts. The high ratio of recoveries of birds ringed in the Carpathian basin indicate that the Hungarian and Slovakian breeding pairs form one continuous population.

**Key words:** birds of prey, *Aquila heliaca*, population dynamics, breeding success, conservation, Hungary.

### Authors' address:

BirdLife Hungary (MME), H-1121 Budapest, Költő u. 21.

### Introduction

Written documents on the breeding of the Imperial Eagle (*Aquila heliaca*) in the Carpathian basin reach back only to the end of the 19th century (e.g. Lázár, 1874, Madarász, 1884), partly because it was considered conspecific with the Golden Eagle by some of the authors. However, there are fossil findings on this species even from the Pleistocene (Jánossy, 1980). There is no available information on the population size from the end of the 19<sup>th</sup> century and the first half of the 20<sup>th</sup> century, but at that time the species was probably widely distributed in the Carpathian basin, including Hungary, Slovakia, Transylvania (Romania) and Voivodina (Yugoslavia) (Vasvári, 1938).

The situation changed after World War II, when the population decreased dramatically until it reached its lowest size by the late 70s and early 80s (Haraszthy et al., 1996). By that time the species had disappeared from most of the previously inhabited lowland areas (with

only one or two pairs left), and was also heavily declining in the hills. By 1980 the total Hungarian population probably consisted of 15-25 pairs as a maximum.

In 1980, volunteers of the Raptor Protection Group of BirdLife Hungary (MME) started an organised programme to save the Hungarian Imperial Eagle. Since the late 80s the work has been carried out in close collaboration with the national parks and with the financial support of the Nature Conservation Bureau. By 1990 most territories of the Hungarian Imperial Eagle population were located, and besides regular territory monitoring a number of conservation measures were introduced. During the 1990s the Hungarian population increased significantly reoccupying former lowland breeding habitats.

Shooting of eagles was banned by the Hungarian legislation in 1939, and the Imperial Eagle has been strictly protected since 1954. The species is included in the Hungarian Red Data Book (*Rakonczay, 1990*), and in Category 1 on the Red List of the BirdLife Hungary (*Tóth et al., 1999*). Conservation of the Imperial Eagle is of high priority in Hungarian nature conservation.

## Methods

The Raptor Protection Group of BirdLife Hungary formed regional working groups and nominated co-ordinators for each group. This system proved to be useful, since this way multiple surveys of the same nests, causing unnecessary disturbance, could be avoided. The systematic regional surveys carried out by the regional groups also minimised the chance of leaving eagle territories undetected. Continuous monitoring of the breeding population has been executed since 1980 with more than 100 volunteers. Many conservation measures have been implemented in close collaboration with national park directorates (Table 1).

At the beginning of the breeding season (during February and March) the active nests of each breeding pair are searched for. If a nest is built on an endangered site (where the chances of successful breeding is low), and it is located in time, the nest is removed and usually an artificial nest is constructed nearby, at a safe location.

During the breeding season the breeding attempts is followed up until the chicks fledge. Special attention has been paid to the condition of nests and chicks after storms with strong wind and heavy rain. Nests damaged by storms are reinforced and chicks fallen out from nests out are placed back into renovated nests. If it is impossible to place the chicks back to the parents' nest, they are placed into another pair's nest with no more than two chicks of similar age. Injured birds are transferred for rehabilitation to the Hortobágy National Park raptor repatriation centre and they are released after successful recovery.

The species is very sensitive to direct disturbance (e.g. close watching of the nest site) comparing to indirect disturbance (e.g. agricultural workers walking in the proximity of the nest). Due to this, direct disturbance is avoided as much as possible while visiting nest sites. One needs to be particularly careful during the first half of the breeding period (preparation for breeding, egg laying, hatching and the period when the chicks are less than two weeks old), i.e. between March and late May in Central Europe. During this period eggs and chicks are particularly vulnerable to the effects of direct sunshine while shading is not provided by the parents. Thus, approaching the nest closer than about 500 meters should be

avoided. In some cases even greater precaution is needed, as there are considerable differences between individuals and nests regarding stress tolerance.

Conservation activities in Hungary Between 1980 and 2000		Number of cases
1.	Monitoring of breeding attempts	473
2.	Controlling nest sites	7095
3.	Strengthening of depreciated nests	ca. 35
4.	Replacement of nests built at endangered sites	ca. 30
5.	Setting out artificial nests / out of this occupied by Imperial Eagles	ca. 225 ca. 35
6.	Replacement of fallen nestlings to the nest	ca. 20
7.	Rehabilitation of fallen nestlings or birds found injured	ca. 30
8.	Captive treatment of injured birds not capable to fly	ca. 10
9.	Insulation of medium-voltage electric pylons	ca. 30 000
10.	Restriction of forestry operations	ca. 200
11.	Restriction of agricultural field work	ca. 15
12.	Restriction of hunting activities	ca. 15
13.	Restriction of bee-keeping activities	7
14.	Restriction of activities of tourism	3
15.	Restriction of mining activities	1
16.	Temporary restrictions of traffic on unpaved roads	15
17.	Confiscation of illegally kept birds	5
18.	Initiation of legal proceeding against nest robbers	3
19.	Voluntarily guarding of endangered nest sites	ca. 20
20.	Payment to game-keepers, hunters or dam-guards for guarding nest sites	ca. 25
21.	Suslik ( <i>Spermophilus citellus</i> ) reintroduction	ca. 25 (involving ca. 2500 individuals)
22.	Artificial feeding in wintertime	ca. 30
23.	Ringling of nestlings – foreign recoveries of birds ringed in Hungary – home recoveries of birds ringed in Hungary – Hungarian recoveries of birds ringed in other countries	236 6 5 6
24.	Satellite tracking	1
25.	Publicity (educational and awareness raising articles, leaflets, reports on TV and radio)	ca. 100
26.	Technical publications and theses dealing with Imperial Eagle conservation	7

**Table 1.** Conservation activities on the Imperial Eagle (*Aquila heliaca*) in Hungary between 1980 and 2000.

If no special problems appear, nest trees are directly approached only once during the breeding season. Chicks are usually ringed between their third and sixth weeks of age (juveniles older than 6 weeks tend to jump out of the nest when the nest is disturbed). Food remnants are collected from the ground beneath the nests and roosting trees, as well as from the nests themselves.

Susliks (*Spermophilus citellus*) were reintroduced to several grassland areas where they had become extinct earlier during the 20<sup>th</sup> century. Individuals for repatriation are captured on grass runways and dams, where the presence and hole-digging habit of the suslik threatens public safety.

In collaboration with electric companies more than 30 000 dangerous, medium voltage electric pylons have been insulated in Imperial Eagle territories up to now.

Forestry and agricultural activities are restricted at nest sites by national park directorates where necessary. Those nest are especially endangered are guarded by volunteers. When justified game-keepers, hunters or dam-guards are paid to look after nest sites. Illegally kept birds are confiscated when possible, and legal proceedings were started against nest robbers and illegal traders.

A number of artificial nests have been set out, mainly for Saker Falcons (*Falco cherrug*), but Imperial Eagles often occupy them also. These artificial nests are mainly located in lowland habitats, because in these areas the shortage of suitable nest sites can be a serious limiting factor. Hills usually hold relatively much more undisturbed nest sites, so only about 10 % of the artificial nests were put out there. In some cases additional food supply is delivered for the eagles in winter, to keep them on safe areas.

## Results

### *Breeding biology*

The traditional Hungarian breeding habitats in hilly areas are found between 400 and 1000 m a.s.l. These areas are mainly covered by Oak (*Quercus petraea*, *Q. cerris*) and Beech (*Fagus sylvatica*) forests with mosaics of Pine (*Pinus nigra*, *P. sylvatica*, *Larix decidua*) plantations. Recently reoccupied lowland habitats (between 100 and 150 m a.s.l.) are mainly cultivated agricultural lands with Poplar (*Populus* sp.) and Black Locust tree (*Robinia pseudoacacia*) windbreaks. Nest had been found exclusively on trees near the top of the above mentioned tree species.

If weather conditions are good, the breeding season of the Imperial Eagle in Hungary starts at the end of January, when the birds already may show display flights and build their nest. Both parents take part in nest building, but as egg-laying period is coming the female spends more time in the nest. The earliest date of egg-laying recorded in Hungary took place 14 March, and the latest occurred in mid-May. According to our observations the second or third eggs of the brood usually completed between 4 to 20 April, and incubation takes 42-45 days. The chicks remain in the nest for further 55-60 days, and fledging usually takes place in the second half of July. The family remain together until the juveniles migrate south to their winter quarters.

### ***Population dynamics***

Between 1980 and 2000 the Hungarian breeding population of the Imperial Eagle increased significantly, especially in lowland breeding habitats (Figure 1). Based on the available data, the Hungarian population was estimated at about 15-25 breeding pairs in 1980, and increased to about 55-60 pairs by 2000. While the Hungarian population approximately tripled during the last 20 years, the distribution of the Imperial Eagle also expanded, doubling the inhabited area during this period (Figure 2). Both the increase of the population and expansion have been much more intensive in lowland habitats.

### ***Breeding success***

Data on breeding success are summarised in Table 2. During the period of 21 years known territories were occupied in 605 cases (pairs were observed regularly in the territory during the breeding season), out of which active nests were found and hatching took place in 473 cases (78.18%). From 473 monitored breeding attempts 348 (73.57%) were successful and a total of 525 chicks fledged. Mean breeding success was 1.11 chicks per all breeding attempts and 1.51 chicks per successful breeding attempts. Out of 348 successful breeding attempts, one eaglet fledged in 188 cases (54.02%), 2 fledglings were observed in 143 cases (41.09%) and 3 fledglings in 17 cases (4.89%).

In parallel with the increase in population size, the number of fledglings and the proportion of broods with 3 chicks also increased between 1980 and 2000 (Figure 3). Breeding success improved during the 1990s as well (1.19 chicks/breeding attempts) compared to that of the 1980s (0.84 chicks/breeding attempts) (Figure 4). Mean annual breeding success varied between 0.38 (in 1983) and 1.44 (in 1999) chicks/breeding attempts.

### ***Migration, dispersion***

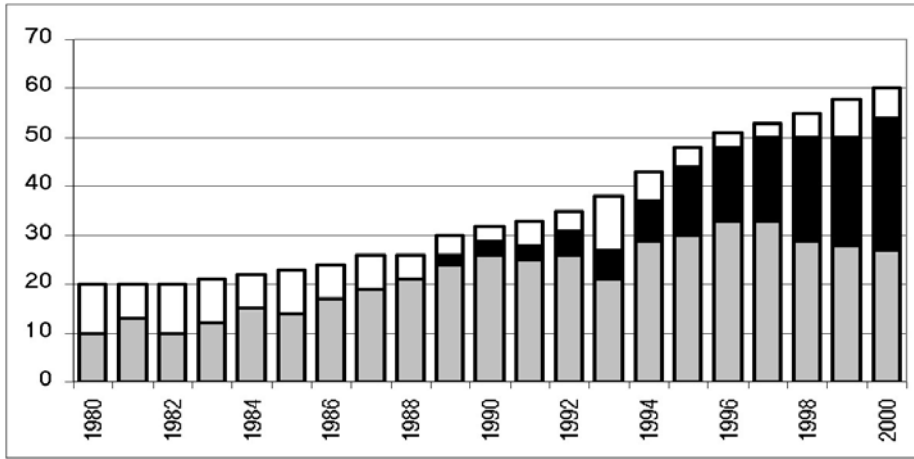
Between 1980 and 2000 altogether 236 individuals of Imperial Eagle (232 nestlings and 4 juveniles) were ringed in Hungary with metal rings (*MME Bird Ringing Centre database*). During this period, 11 ringed birds (5 with Hungarian, 5 with Slovakian and 1 with Yugoslavian ring) were recovered in Hungary, and 6 birds ringed in Hungary were recovered abroad (3 in Greece, 2 in Slovakia and 1 in Romania). Out of 17 recovered birds 12 were in their first calendar year, 1 was in its second year, 3 were in their third year and 1 was in its fourth year. For the result of an experiment where a first-year juvenile eagle was mounted with a satellite telemetry transmitter and followed during its movement see *Meyburg et al. (1995)*.

According to Hungarian and Slovakian observations, adult birds are usually resident, staying around the vicinity of their breeding territory throughout the year, while juveniles disperse into areas outside the Carpathian basin during the autumn. In harsh winters breeding pairs show an altitudinal movement to lowlands. Based on foreign recoveries of Imperial Eagles ringed in the Carpathian basin, it is likely that the majority of juvenile birds migrate southwards in direction of the Balkan peninsula (especially to Greece), and, since

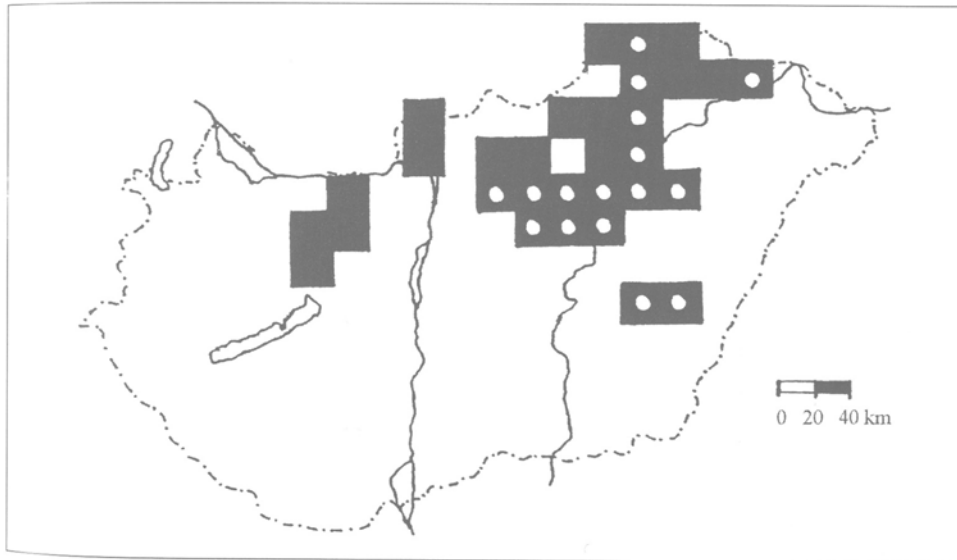
there is also one record from Israel (*Danko, 1996*), probably further south-east to the Middle East.

Year	Estimated size of population			Number of known occupied territories			Number of known breeding attempts			Number of successful nests			Number of young fledged		
	H	LL	Σ	H	LL	Σ	H	LL	Σ	H	LL	Σ	H	LL	Σ
1980	15-20	0-3	15-23	10	0	10	6	0	6	4	0	4	7	0	7
1981	15-20	0-3	15-23	13	0	13	6	0	6	4	0	4	6	0	6
1982	15-20	0-3	15-23	10	0	10	7	0	7	5	0	5	6	0	6
1983	18-22	0-3	18-25	12	0	12	8	0	8	2	0	2	3	0	3
1984	18-22	0-3	18-25	15	0	15	10	0	10	6	0	6	8	0	8
1985	20-25	0-3	20-28	14	0	14	13	0	13	8	0	8	11	0	11
1986	20-25	0-3	20-28	17	0	17	16	0	16	13	0	13	16	0	16
1987	22-27	0-3	22-30	19	0	19	16	0	16	11	0	11	13	0	13
1988	22-27	0-3	22-30	21	0	21	16	0	16	9	0	9	13	0	13
1989	24-30	2-5	26-35	24	2	26	18	2	20	11	1	12	16	2	18
1990	26-30	3-5	29-35	26	3	29	21	2	23	17	1	18	28	2	30
1991	26-30	3-5	29-35	25	3	28	22	2	24	14	2	16	26	4	30
1992	26-30	5-8	31-38	26	5	31	25	4	29	20	3	23	28	6	34
1993	26-30	6-8	32-38	21	6	27	20	4	24	15	2	17	24	3	27
1994	30-33	8-12	38-45	29	8	37	22	5	27	13	3	16	13	6	19
1995	30-33	15-17	45-50	30	14	44	23	12	35	20	7	27	26	10	36
1996	30-33	15-18	45-51	33	15	48	20	11	31	18	9	27	30	18	48
1997	30-33	18-20	48-53	33	17	50	22	14	36	10	10	20	10	19	29
1998	28-30	21-25	49-55	29	21	50	24	18	42	22	12	34	30	22	52
1999	28-30	24-28	52-58	28	22	50	21	18	39	25	11	36	28	28	56
2000	28-30	27-30	55-60	27	27	54	26	19	45	24	16	40	34	29	63
<b>Σ</b>	-	-	-	462	143	605	362	111	473	271	77	348	376	149	525

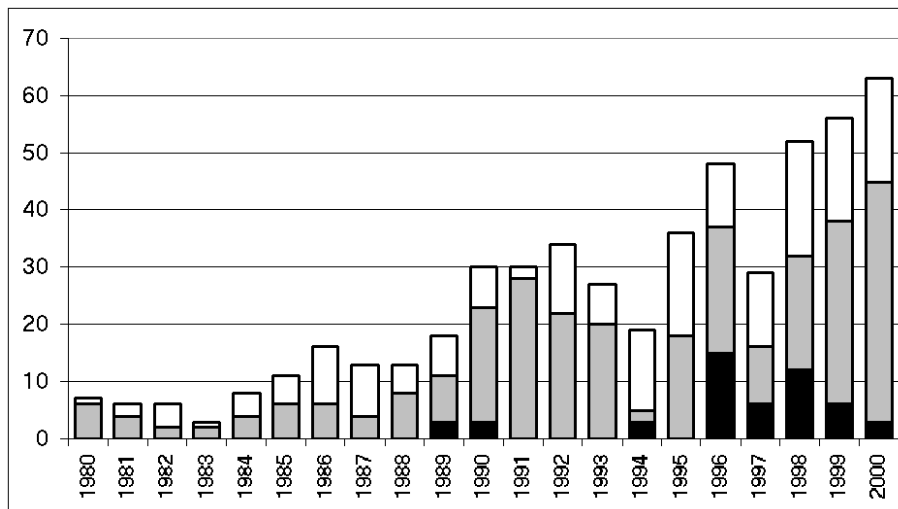
**Table 2.** The population dynamic and the breeding success of the Hungarian Imperial Eagle (*Aquila heliaca*) population between 1980 and 2000 (H: hill territories, LL: lowland territories)



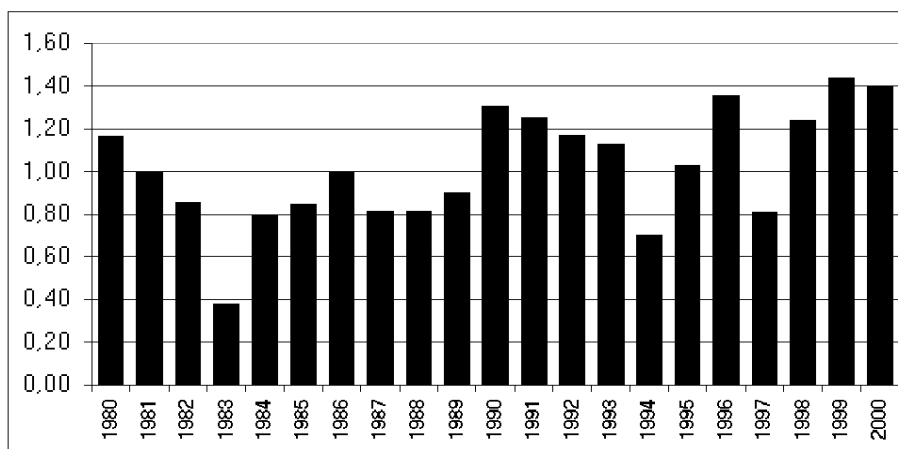
**Figure 1.** Population size of the Imperial Eagle (*Aquila heliaca*) in Hungary between 1980 and 2000. Grey: known hill territories; Black: known lowland territories; White: estimated number of unknown territories



**Figure 2.** The distribution of the Imperial Eagle (*Aquila heliaca*) in Hungary in 2000. Black squares: traditional hill breeding territories; Black squares with white patches: lowland breeding territories occupied after 1989



**Figure 3.** The number of Imperial Eagle (*Aquila heliaca*) fledglings in Hungary between 1980 and 2000. Black: fledglings from 3-chick broods; Grey: fledglings from 2-chick broods; White: fledglings from 1-chick broods.



**Figure 4.** Mean breeding success (fledglings / all breeding attempts) of the Imperial Eagles (*Aquila heliaca*) in Hungary between 1980 and 2000.



### ***Feeding habits***

Between 1980 and 1993 16 bird and 13 mammal species were identified as parts of the diet of the Imperial Eagle in Hungary. According to the analysis of 610 prey remnants the most frequent prey species were the Hamster (*Cricetus cricetus*), the Brown Hare (*Lepus europaeus*) and the Pheasant (*Phasianus colchicus*). The Suslik, previously thought to be the main prey of the Imperial Eagle, was only the fourth in the list of prey species concerning frequency (Haraszthy et al., 1996).

### **Main threats**

Most of the birds found injured or dead are juveniles in their first calendar year. Juvenile birds of the Carpathian basin presumably migrate southwards, especially to Greece. Out of 10 Imperial Eagles recovered in Greece and ringed in the Carpathian basin seven were shot (Sakoulis et al., 1997). Based on these data it seems that one of the main threats of the population in the Carpathian basin is hunting during passage and wintering.

Another crucial mortality factor is electrocution. About 100 000 out of approximately one million medium-voltage electric pylons in Hungary pose threat to larger birds. The most dangerous 30 000 pylons were already insulated with plastic insulators, while the rest of the pylons (ca. 68 000) can still cause serious damage in the populations of larger, rare bird species. In Hungary poisoning and illegal trade were probably not significant causes of mortality during the last decades. In a few cases freshly fledged juveniles were hit and injured or killed by cars.

Beside direct mortality, habitat alteration composes serious problems in Hungary. Recent forest management practices and illegal tree cutting can reduce significantly the number of suitable nest sites in the near future. In some lowland areas a shortage of suitable nest sites can already be observed. In such habitats pairs are sometimes forced to nest on young black locust trees making the nests extremely vulnerable to windstorms.

EU accession is also expected to compose several unpredictable changes in agricultural policy, which could cause long term decline in the populations of the Imperial Eagle and other threatened species living in cultivated agricultural lands (e.g. Saker Falcon, Red-footed Falcon /*Falco vespertinus*/, Roller /*Coracias garrulus*/, Great Bustard /*Otis tarda*/).

Legal protection of Suslik since 1982 still could not prevent its population decline throughout Hungary. The number of grazing livestock was reduced significantly during the last decades, which caused decrease in short grasslands forming the only breeding habitats of the Susliks in Hungary. However, in certain areas the Suslik still plays an important role as a prey item in the diet of eagles. Thus, further decrease in Suslik populations could also have negative effects on the Imperial Eagle population in the future. Imperial Eagles will probably have to abandon some areas, where no sufficient food sources are available or shifting in their prey composition to Hare and Pheasant could raise confrontation with hunting communities

## Discussion

The Imperial Eagle population of the Carpathian basin situated on the western limit of the distribution of the species. As a result of the 20 years population monitoring conducted by the Hungarian and Slovakian Imperial Eagle Working Groups almost 60 % of the known European nest sites are found in the Carpathian basin (*Horváth et al., 2002*). This increasing population therefore is of great importance in the preservation of this species in Central and Southern Europe. Following the increase of the Hungarian and Slovakian populations, in 1998 the species started to breed in the Czech Republic (*Mrlik, pers. comm.*) and in 1999 in Austria (*Ranner, pers. comm.*).

Since the late 1980s a part of the Hungarian-Slovakian population has reoccupied open agricultural lands, where the species breeds in solitary trees, row of trees and isolated patches of woods (*Danko & Haraszthy, 1997*). The reoccupation of lowland habitats resulted in significant expansion in the breeding range during the 1990s. By 2000, the ratio between highland and lowland breeding pairs became almost equal in both Hungary and Slovakia (*Danko, pers. comm.*).

The introduction of market economy in Hungary (1990) resulted many changes in land use practices. Great agricultural fields were parcelled out, which increased the mosaic structure of the landscape, and the ratio of uncultivated fields increased, too. The amount of chemicals (pesticides and artificial fertilisers) used by landowners also decreased significantly during the last decade and the structure and membership composition of hunting associations changed. In 1967 the use of DDT was banned in Hungary (for the first time in the world), and in the late 1970s the non-selective poisoned baits, which were used to control the populations of crows (*Corvus* sp.), Magpies (*Pica pica*) and Foxes (*Vulpes vulpes*), were also banned. These changes made lowland areas more optimal for the Imperial Eagle and contributed to the population increase. Besides favourable changes in land use practices, conservation measures implemented in the Carpathian basin during the last 20 years likely played an important role in the increase of the population.

The expansion of the population is expected to continue in the Carpathian basin, because large areas containing suitable habitats for the species are not inhabited yet. In order to help expansion of the species conservation activities should be carried on and be improved concerning their effectiveness, the long-term conservation management plan for the species should be developed and researches in close collaboration with the Slovakian, Czech and Austrian colleagues should be conducted. Within the frame of the International Imperial Eagle Working Group data sharing and joint actions regarding the conservation of the species could move forward recent positive trends in local Imperial Eagle populations.

## Acknowledgement

The Hungarian Imperial Eagle Working Group was formed in Budapest with the active participation of *Dénes Jánossy, László Haraszthy* and *János Bagyura* from Hungary and *Stefan Danko* and *Jozef Mihók* from Slovakia in 1980. The regional co-ordinators of the Hungarian Imperial Eagle Working Group between 1980 and 2000 were: *Péter Csonka*,

László Darányi, Miklós Dudás, Gábor Firmánszky, Zoltán Ilonczai, Róbert Kazi, Zoltán Petrovics, Tamás Szitta, Imre Tóth, Zsolt Varga and Levente Viszló. During the 1960s and 1970s the following persons collected data on the species promoting and helping further research: László Bécsy, Dénes Jánossy, Jenő Győry, Sándor Nagy, Péter Somogyi, László Vilmos Szabó and Dezső Tapfer.

The Nature Conservation Bureau of the Ministry of Environment and the national park directorates have continuously supported the conservation program on the species both financially and by other means. The continuous effort of Zsolt Kalotás and Gábor Magyar to facilitate the successful cooperation has been invaluable.

Special thanks goes to those whose strenuous fieldwork and data collection made the execution of the programme possible. Some of them are: János Balogh, László Bank, Zoltán Barta, Ferenc Becsei, András Békefi, István Béres, László Bence Besenyei, Árpád Bezeczký, Sándor Boldogh, Péter Borbáth, Tamás Brellos, János Czikora, Csaba Czirle, Attila Czumpf, Gábor Domboróczky, Tibor Ézsöl, Imre Fatér, István Fodor, Balázs Forgách, István Harangi, István Homoki Nagy, Róbert Horváth, György Kállay, András Kleszó, László Kozma, Ferenc Kunrád, Viktor Lázár, László Losonczy, Tibor Markovics, Csaba Megyer, István Lotár Molnár, József Ott, Tamás Pécsy, Ádám Pongrácz, László Puskás, István Sándor, Nándor Seres, József Serfőző, Béla Solti, Sándor Suta, Zsolt Szegedi, Antal Szél, Géza Szentendrey, János Tar, László Tóth, László Tóth, János Tőgye, László Urbán, Miklós Vácz, Zoltán Vámos, Róbert Ványi and András Vasas. Without listing their names we are also indebted to all those volunteers of BirdLife Hungary and those national park employees whose help was invaluable in the progress of our Imperial Eagle programme.

We are grateful to *Andreas Ranner* (Austria), *Vojtech Mrlik* (Czech Republic) and the MME Bird Ringing Centre for providing their information on the species.

Besides the MME and the nine Hungarian national park directorates (especially the Bükk National Park Directorate) the following organisation helped our work: National Authority of Nature Conservation, regional electric companies, Regional Environmental Centre for Central and Eastern Europe (REC) and WWF Austria.

We received a lot of valuable information on the conservation of the species with the Slovakian Working Group on Research and Protection of Birds of Prey and Owls (SVODAS), especially with *Stephan Danko*, *Jozef Chavko* and *Jozef Mihók*.

## References

- Danko, S. (1996):* Beringungsergebnisse am Kaiseradler *Aquila heliaca* im Nordwesten des Brutareals. In: *Meyburg, B. U. & Chancellor, R. D. (eds.) (1996):* Eagle Studies. World Working Group on Birds of Prey (WWGBP), Berlin, London & Paris. p. 389-403.
- Danko, S. & Haraszthy, L. (1997):* Imperial Eagle (*Aquila heliaca*). In: *Hagemeyer, W. J. M. & Blair, M. J. (eds.):* The EBCC Atlas of European Breeding Birds: Their Distribution and Abundance. T & A D Poyser, London. p. 168-169.
- Haraszthy, L., Bagyura, J., Szitta, T., Petrovics, Z. & Viszló, L. (1996):* Biology, Status and Conservation of the Imperial Eagle (*Aquila heliaca*) in Hungary. In: *Meyburg, B.-U. & Chancellor, R. D. (eds.):* Eagle Studies. WWGBP: Berlin, London & Paris. p. 425-428.

- Horváth, M., Haraszthy, L., Bagyura, J. & Kovács, A. (2002):* Eastern Imperial Eagle (*Aquila heliaca*) populations in Europe. *Aquila* **107-108**, p. 193-204.
- Jánossy, D. (1980):* Plio-Pleistocene bird remains from the Carpathian basin VI. Systematical and Geographical Catalogue. *Aquila* **87**, p. 9-21.
- Lázár, K. (1874):* Hasznos és kártékony állatainkról. I. rész: Emlősök, madarak, hüllők. Szent István Társulat, Budapest. 132 p.
- Madarász, J. (1884):* Die Raubvögel Ungarns.
- Meyburg, B. U., Haraszthy, L., Meyburg, C. & Viszló, L. (1995):* Satelliten- und Bodentelemetrie bei einem jungen Kaiseradler *Aquila heliaca*: Familienauflösung and Dispersion. *Vogelwelt* **116**, p. 153-157.
- Rakonczay, Z (ed.) (1990):* Vörös Könyv – A Magyarországon kipusztult és veszélyeztetett növény- és állatfajok (Hungarian Red Data Book). Akadémiai Kiadó, Budapest. 360 p.
- Sakoulis A., Bourdakis, S., Hallmann, B. & Alizivatos, H. (1997):* The status of the Imperial Eagle (*Aquila heliaca*) in Greece. Hellenic Ornithological Society, Athens. 23 p.
- Tóth, L., Nagy, Sz. & Haraszthy, L. (1999):* Vörös Lista – Magyarország fészkelő madarainak védelmi helyzete. MME BirdLife Hungary, Budapest. 8 p.
- Vasvári, M. (1938):* Die Verbreitung und Oekologie des Kaiseradlers (*Aquila heliaca* Sav.). In: Festschrift für Prof. Dr. Embrik Strand. Vol. 5. Riga. p. 290-317.