

Conservation of Eastern Imperial Eagle in the Slovak Part of the Carpathian Basin – Results of the EU LIFE-Nature Project (2003-2007)

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Abstract: Between 2003 and 2007 a LIFE-Nature project ‘Conservation of Eastern Imperial Eagle *Aquila heliaca* SAVIGNY 1809 in the Slovak part of the Carpathian basin’ was carried out. In 2004 38 nesting pairs were found, which number increased to 42 pairs in 2007. The number of successful nestlings was 26 in 2004 and 31 in 2007. There were 212 fledglings between 2004 and 2007. There were more cases of successful breeding in 2007 than in 2004, and the pairs breeding in the mountains were more successful than the lowland pairs. One hundred seventy-three nestlings were ringed during the four year period. The main prey species of the eagles were Hare (*Lepus europaeus* PALLAS 1778), Common Pheasant (*Phasianus colchicus* LINNAEUS 1758), European Hamster (*Cricetus cricetus* LINNAEUS 1758) and Feral Pigeon (*Columba livia f. domestica* GMELIN 1789). The Eagles preference for the hunting areas were the following: corn stubbles (38%), colza (14%), grassland (10%), barley (10%), ploughed field (10%), wheat (3%) and other cultures (13%). Concerning the landscape structures especially the treelines and patches (81%), broadleaf forest (14%), ploughed field (4%) and grassland (1%) were preferred for roosting.

Key words: *Aquila heliaca*, LIFE project, radio telemetry, satellite telemetry

Introduction

Eastern Imperial Eagle is an essential element of the Slovak nature. In the Carpathian ecosystems, it ranks among the top predators of great importance. This raptor species is globally classified as vulnerable and on the European scale as endangered. The population is declining, in Europe it is estimated to be 1110-1624 pairs (HORVÁTH *et al.* 2002). In Slovakia, there are approximately 40-45 pairs nesting predominantly in the southeast, but also in the southwest part of the country (CHAVKO, DANKO 2008). The Slovak population breeds primarily in mountains and agricultural lands. In the western part of distribution, some pairs were nested in the meadows and in alluvial forests (MIKUŠ *et al.* 2008, HORAL 2006). The Hungarian and Slovakian populations comprise 45-65% of the European population (outside the countries of the former Soviet Union). Most of the world population of the species nests in Russia and Kazakhstan, where the number of breeding pairs is estimated to be between 6500 and 7500 (KARYAKIN *et al.* 2008 a). Conservation of the Eastern Imperial Eagles in Slovakia was supported

by the LIFE-Nature project “Conservation of *Aquila heliaca* in the Slovak part of the Carpathian basin” between 2003 and 2007. This project was focused on the increasing and monitoring of the population in Slovakia, monitoring dangerous 22 kV power lines, reintroduction of European Soudjiks (*Spermophilus citellus* LINNAEUS 1766) to historical sites, protection of the nests and breeding pairs, habitat protection, monitoring of the migration routes of the juveniles using satellite and radio telemetry.

Study area

The population of Eastern Imperial Eagles in Slovakia is concentrated in southeast and southwest part of the country. In these parts there are low and medium elevation mountains, highlands and lowlands. The project actions were implemented in eight sites in East Slovakia (Slanské vrchy Mts, Volovské vrchy Mts, Vihorlatské vrchy Mts, Čierna hora Mts, Východoslovenská pahorkatina Mts, Bodvianska pahorkatina Mts, Košická kotlina basin, Východoslovenská rovina lowland) and ten sites in West Slovakia (Považský Inovec Mts, Tribeč Mts, Malé Karpaty Mts, Štiavnické vrchy Mts, Pohronský Inovec Mts, Hronská pahorkatina Mts, Ipelská pahorkatina Mts, Nitrianska pahorkatina Mts, Trnavská pahorkatina Mts, Podunajská rovina lowland).

Material and Methods

Monitoring of the population

The monitoring of the Slovakian Imperial Eagle population was carried out by members of Raptor Protection of Slovakia. The pairs were searched in the historical sites and in the sites with suitable habitats. The nests were searched in mountains and agricultural land during the winter and spring by observing the breeding behaviour of the eagles. Binoculars and monoculars with variable magnification were used. Successful nesting and number of chicks were recorded several times before the fledglings left the nest. Most of the chicks were ringed with both ornithological and coloured plastic rings. The use of plastic rings has been carried out in accordance with the international ringing programme. In line with this agreement, we used the orange rings with black codes assigned for Slovakia. Some nestlings were

marked with microchips. During the non-breeding season we identified some temporary settlement areas, where eagles were observed in high concentration. Most of these sites were determined by using satellite and radio telemetry.

Analyses of prey

The prey of the Eastern Imperial Eagles was identified using two methods: direct observations of the nests and identification of the prey brought to the nest by eagles, as well as the determination of remains of prey collected from the nests and their pellets. The results from the analyses of prey were processed for Western and Eastern Slovakia separately.

The remains of the food were collected from the nests during the ringing, or after the young had left the nest. The items found under the nests or under pairs' resting sites close to the nest were also analysed.

DNA analyses

During the project the DNA was analysed for determination of the subpopulations in Western and Eastern parts of Slovakia and for protection against nest robbing. Blood samples were obtained from 128 nestlings and from 138 adults (clot from feather shafts was used). Unfortunately most of the blood samples collected did not provide usable DNA (fragmented DNA) (VILI *et al.* 2009).

Radio and satellite telemetry

For identification of the temporary settlement areas and collecting of the information about movement and migration of juveniles satellite and radio telemetry was used. Small, battery-powered satellite-telemetry tags (wt. 90 g) transmitted signals about the birds' position. Five satellite tags were fixed on the backs of young specimens (one male and four females) before they flew from their nests. Signals were recorded for 4-9 months. One position per day was received on average before the abandonment the breeding place. After abandonment of the breeding place, the positions were received approximately every 10 days. The data from transmitters contained number of the transmitter, coordinates in WGS-84 format, date, time and altitude. The positions, which had incorrect or incomplete data were not used for the evaluation.

Two young eagles were tagged with radio transmitters and for a period of about 2-6 months the data about their movements in Slovakia was collected. The radio transmitters were mounted on the back of the eagles. One radio tag was mounted on a two years old male, which was found injured and treated in a rehabilitation centre. The second transmitter was fitted on a female chick in the nest. The eagles were searched with radio receivers and the location was determined by direct observation or by triangulation. Both specimens were monitored, during their movements in Slovakia. Direct observations lasted from some minutes to seven hours. The distance from the individuals was between 700 and 1500 meters, they were observed with 20-60 magnification monoculars. From the two radio transmitters we achieved 137 fixes (99 from female and 38 from male).

Analyses of habitat use

The two eagles with the radio transmitters were continuously monitored and observed directly. During these controls the positions were recorded, as well as the date, time, activity and type of habitats (Kovács *et al.* 2005). We analyzed the activity and habitat preference when hunting. Flights were recorded in habitats comprising up to two plant cultures. Passive hunting (attacks from elevated positions or roosts) and resting was recorded in monoculture areas.

Nests guarding

Between 2004 and 2007 three nests were guarded each year. Different methods were used. The first nest was monitored with closed-circuit television (CCTV), the second nest with the GSM motion system, and the third nest by volunteers. The GSM system contained four parts: motion sensor, microphone, GSM receiver and battery. As the system recorded any movement, it sent an SMS using the GSM network to the mobile phone of the operator. The operator could call the mobile phone of the GSM motion system and could listen to the noises around the nest.

Monitoring and insulated 22kV power lines

The monitoring of 22 kV power lines was carried out together with the volunteers and ZSE (Západoslovenská Energetika). The power lines in the potential and active breeding sites were moni-

tored and insulated. Dead and injured birds found under the pylons were recorded, and the locations of problematic pylons were sent to ZSE.

Reintroduction of Suslik

The reintroduction of European Suslik to historical and other suitable sites was another part of the project. The individuals were captured at airports as their presence is attracting birds of prey, which could cause serious plane accidents. Susliks were captured especially in spring (from March to late April) with different methods, such as live-traps, snares, pouring the holes with water and special loops (HAPL *et al.* 2006). After capturing the Susliks were transported to the new sites where they were released. At such sites, where Susliks were not present before the introduction, the individuals were released to artificial holes. The new sites were monitored and guarded for at least 2-3 days during the first phase of release and 24 hours after each next release. Guards recorded all digging efforts of the Susliks, the movements of individuals in the area, scared away the predators and protected the Susliks against any other negative factors and impacts (e.g. illegal catching). The area has been monitored at least once a month to get information on predators, site management by land-owners and users, other human activities and the situation of the colony (movements, abandoned holes, etc.) (HAPL *et al.* 2006).

Results

Monitoring of the population

The population of Eastern Imperial Eagles in Slovakia is monitored since 1985 (Fig. 1).

During the project the population increased from 38 pairs in 2004 to 42 pairs in 2007, equal to 11 % increase during the four years (Table 1). In Slovakia Imperial Eagles were breeding in two habitats, such as mountains and lowlands. The number of fledglings increased from 45 in 2004 to 57 in 2007, equal to 27% increase (Table 1).

During the four years of the project 212 juveniles fledged from the nests (Table 2), the breeding success was lower in the lowlands than in the highlands (DEMETER *et al.* 2007).

According to our results the pairs nesting in the lowlands are more influenced by storms and hu-

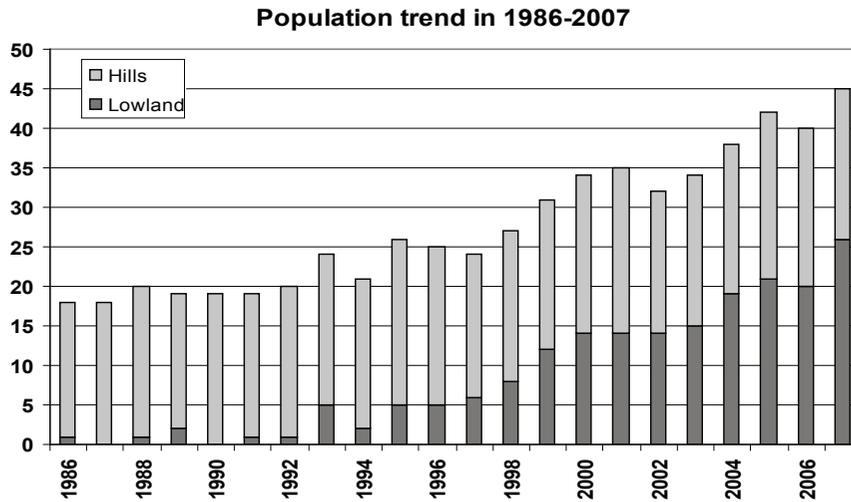


Fig. 1. Population trend in 1986-2007

Table 1. Population of Imperial Eagles in Slovakia during the period 2004-2007

	2004	2005	2006	2007
Occupied territories	39	41	39	45
Incubating pairs	38	38	39	42
Successful nesting	26	27	35	31
Number of fledglings	45	44	66	57
Unsuccessful breeding attempts	12	11	4	11

Table 2. Breeding success of Imperial Eagles during the period 2004-2007

	2004	2005	2006	2007
Breeding success/ occupied territories	1.15	1.07	1.69	1.27
Breeding success/ nesting pairs	1.18	1.16	1.69	1.36
Breeding success/ successful/ successful nesting	1.73	1.63	1.89	1.84

man activities (DEMETER *et al.* 2007). One hundred seventy-three nestlings were ringed with aluminium rings and 133 (in 2005-2007) with coloured plastic rings with alphanumeric codes. A total of 114 nestlings were tagged with microchips from 2004 to 2006. DNA samples were obtained from 128 (125 usable) nestlings and 138 (119 usable) adults. The samples from western and eastern part of Slovakia were compared. It was not proven that the western and eastern populations were genetically separated. The distance of 150 km between the western and eastern Slovak breeding groups is too small to consider them as different subpopulations (VILI *et al.* 2009). During 2003-2007 25 individuals of Eastern Imperial Eagles from Slovakia were found injured or dead. The reason for the injuries was electrocution (32%), poisoning (20%), shooting (4%), collisions with power lines (8%), exhaustion (4%), traffic (4%) and unknown factors (28%). The majority of

the dead individuals (64%) were juveniles and immatures (0-4 years old) (Demeter *et al.* 2007).

Diet of the Imperial Eagle

All together 1086 prey items were identified in Slovakia, out of which 562 prey items (belonging to 33 species) were collected from Western Slovakia (1978-2005) and 524 prey items (belonging to 30 species) were from Eastern Slovakia (1971-2005). The dominant species in Western Slovakia were *L. europaeus* (40.2%), *P. colchicus* (17.3%), *C. livia f. domestica* (11.7%) and *C. cricetus* (11.6%). In Eastern Slovakia the main prey species were *L. europaeus* (29%), *C. cricetus* (27.7%), *P. colchicus* (8.4%) and *Columba* sp. (8.2%) (see details at CHAVKO *et al.* 2007 a). Suslik was one of the most common prey of the eagles until the end of the 20th century, but nowadays it is important only for some pairs breeding in eastern part of the country.

In Western Slovakia the Eastern Imperial Eagle pairs hunted more birds during breeding season, than pairs nesting in the eastern part (CHAVKO *et al.* 2007a). Besides active hunting, eagles also obtain food by kleptoparasitism or from carcasses (DANKO, MIHÓK 2007, HORVÁTH 2008, MARIN *et al.* 2004).

Telemetry and habitat preferences

The migration radius of two eagles with the radio transmitters was 80 km from the release site of the male and 150 km from the natal nest site of the female. The male was monitored from 29.4.2006 to 25.5.2006, until it flew to Hungary. The female was recorded from 25.7.2006 to 10.12.2006 in Slovakia, than left to Bakonybank in Hungary. From the satellite and radio telemetry, the temporary settlement areas in Podunajská nížina and Trnavská pahorkatina were identified. Important areas are situated between the towns of Trnava – Sereď – Senec, where minimum six individuals were observed. Other temporary settlement areas are in vicinity of the villages Palárikovo, Kollárovo and Jaslovské Bohunice. In Eastern Slovakia the information from satellite telemetry about the presence of temporary settlement areas were not confirmed. From the results of the radio telemetry preferences of the foraging and roosting habitats were identified. The two individuals preferred the corn stubbles (38%), rape (14%), grassland (10%), barley (10%), ploughed field (10%), wheat (3%) and other cultures (13%) for hunting. Concerning the landscape structures especially the treelines and patches (81%), broad-leaf forest (14%), ploughed field (4%) and grassland (1%) were preferred for roosting (see details at DEMETER *et al.* 2007).

Monitoring and insulated power lines

A total of 244 volunteers participated in the power line surveys, and all together they found 313 dead birds. Together with ZSE (West Slovakian Energetics) and VSE (East Slovakian Energetics) 851 km power lines were insulated within the frame of the project. On the new pylons special insulators, which protect the birds against electrocution, were installed. During the project 353 pylons (29.5 km) were built with a new 'Anti-bird' console type, which hinders the birds to roost on the pylons, therefore significantly decreasing the chance of electrocution.

Discussion

Results from project LIFE affirmed the increase of the Eastern Imperial Eagle population in Slovakia during the project period. Similar results were achieved in Hungary. In 2008 the Hungarian Eastern Imperial Eagle population was 88 nesting pairs, where 71 pairs (81%) was nesting in the lowlands (HORVÁTH *et al.* 2008 a). During 2003 and 2005, a 35% increase of nominal population was recorded (11% increase in the Slovakia during 2004-2007). All the new Hungarian pairs occupied lowland territories in predominantly agricultural areas (KOVÁCS *et al.* 2008). In Eastern Slovakia the majority of the pairs (62.5% by 2004) were breeding in agricultural lands (DANKO, BALLA 2007). In this part of the country there is lower pressure from hunters and human disturbances than in western part, where more pairs are breeding in the mountains (DEMETER *et al.* 2007). The increase of the Eastern Imperial Eagle population in Slovakia is related to the increase of the Hungarian population. The conservation actions, such as the declaration of protected zones around the nests, insulation of power lines, nest guarding and improvement of prey resources probably also had significant role in the increase. Nevertheless only a small increase was observable in western Slovakia, where many pairs were not successful due to illegal shooting, poisoning and human disturbance. Therefore protected zones have an especially important role here, as 121 such zones were declared during the 4 years with a minimum range of 300 meters around the nest sites. These zones protected the nests against disturbance of the human activities, and were agreed by hunters, farmers and the Slovak State Nature Conservancy.

Eagles roosted on the tree lines and groups of trees, but juveniles in particular used also 22 kV pylons (DEMETER *et al.* 2007). Electrocution is one of the most negative factors, representing 38% of all negative factors found in Slovakia and 19% in Hungary (HORVÁTH *et al.* 2008 a). There are interesting results from Kazakhstan (KARYAKIN 2008) where 1% of all raptors found under the power lines were Imperial Eagles, and a higher number of the electrocuted Steppe Eagles (*Aquila nipalensis* HODGSON 1833), Long-legged Buzzards (*Buteo*

rufinus CRETZSCHMAR 1829) and other birds of prey were recorded. The high voltage pylons can also be potential breeding places in the future, as these breeding places are used in Kazakhstan, Azerbaijan, Turkey, Russia, and Macedonia (KARYAKIN *et al.* 2008 b, HORVÁTH *et al.* 2008 b, DEMERDZHEV *et al.* 2011, HALLMAN 2008). Eastern Imperial Eagle nest robberies were also recorded in the past in Slovakia, but fortunately, no attempt of robbery was recorded at any of the three nests, where monitoring systems were installed. The monitoring system also helped to increase breeding success, as juveniles fall from the nests during windstorms, and could be placed back after recording (CHAVKO *et al.* 2007 b). Windstorms also caused damage in some nests, which were stabilized afterwards. On the suitable and potential breeding places all together 45 artificial nests have been installed during the project, but no breeding attempt was recorded there. For the reintroduction of the European Suslik historical and other suitable sites were identified. On three sites (Malé Karpaty, Pontrie, Slovenský kras) 833 individuals were released from three donor sites (airports in Bratislava, Kosice, Moldava nad Bodvou).

In Slovakia four important temporary settlement areas were identified, all are in the western part of Slovakia. The most important area is in Trnavská pahorkatina, where a minimum of six individuals were observed. In this area a high density of hamsters and voles has been recorded. Temporary settlement areas (TSA) in eastern Slovakia have been identified by direct observations in Koľická kotlina (MIHÓK, DANKO ex DEMETER *et al.* 2007). Juveniles and immatures from the Carpathian basin often occupy TSAs in Hungary, where there are six important areas (with 5 and more individuals) (KOVÁCS *et al.* 2008), and also in western Austria (WICHMANN 2008). During the non-breeding season eagles move to lowlands, rich in food, primarily on the corn stubbles where there is a high concentration of rodents and injured or dead animals.

Conclusions

The Eastern Imperial Eagle is a species which can effectively adapt to agricultural habitats. This potential is higher in western part of Slovakia, particularly in Podunajská nížina, where there are good

breeding habitats and food resources. In some cases eagles can also accept a higher disturbance of the lowland habitats; these cases were confirmed in East Slovakia (DANKO, BALLA 2007). On the other hand birds of prey are intensively persecuted in West-Slovakian lowland habitats, and the breeding success in these territories is low. Despite the problems, the population of the Eastern Imperial Eagle is increasing slowly in Slovakia, which is also supported by the significant increase of the Hungarian population. Further increase of the population is dependent on the breeding success of the species in the lowlands (especially in Podunajská nížina). Project LIFE offered us great resources for the protection of the species, which helped to increase the ratio of successful breeding attempts, to obtain important information about biology, migration, food and habitat preferences. The information gathered during the project will promote the further conservation of the Eastern Imperial Eagle in Slovakia and neighbouring countries, as well as the protection of other related species.

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Опазване на Източния Царски орел в Словашката част на Карпатския басейн – резултати от проект по програма LIFE-Nature на ЕС (2003–2007)

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(Резюме)

В периода 2003-2007 г. е изпълнен проект „Консервация на Източния Царски орел *Aquila heliaca* SAVIGNY 1809 в словашката част на Карпатския басейн“ по програма LIFE-Nature. През 2004 г. са открити 38 гнездящи двойки, достигайки до 42 двойки през 2007 г. Броят на успешните двойки е 26 през 2004 г. и 31 през 2007 г. През периода 2004-2007 г. са регистрирани 212 успешно излетели малки. Случаите на успешно размножаване през 2007 г. надвишават тези през 2004 г., а двойките размножаващи се в планините са с по-висок успех от тези в равнините. През 4-годишния период са опръстенени 173 малки. Основните видове плячка на орлите включват Дивият заек (*Lepus europaeus* PALLAS 1778), Фазанът (*Phasianus colchicus* LINNAEUS 1758), Обикновеният хомяк (*Cricetus cricetus* LINNAEUS 1758) и Домашният гълъб (*Columba livia* f. *domestica* GMELIN 1789). Идентифицирани са територии за временно пребиваване посредством използването на сателитна и радио телеметрия, както и на преки наблюдения. Предпочитанията към местообитания за хранене и почивка са определени чрез радио телеметрия. Предпочитаните от орлите ловни територии включват царевични стърнища (38%), рапица (14%), пасища (10%), ечемик (10%), разорани ниви (10%), пшеница (3%) и други култури (13%). За почивка особено предпочитани са ландшафтни структури като дървесни пояси и групи дървета (81%), широколистни гори (14%), разорани ниви (4%) и пасища (1%).