

RRELATIONSHIP BETWEEN THE CENTRAL AND EAST EUROPEAN SAKER FALCON POPULATIONS BASED ON RESULTS OF RINGING SCHEMES AND SATELLITE-TRACKING

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Взаимоотношения между центрально-европейской и восточно-европейской популяциями балобана на основании результатов кольцевания и спутникового слежения. – Проммер М., Милобог Ю., Гаврилюк М., Ветров В., Багира Я. – На основе результатов кольцевания и спутниковой телеметрии проанализированы взаимоотношения и вероятность обмена генами между центрально-европейской и восточно-европейской популяциями балобана. Полученные данные позволяют предположить, что большинство балобанов из центрально-европейской и восточно-европейской популяций не достигают географических областей обитания друг друга. Несколько процентов балобанов из Центральной Европы в течение первого и второго года жизни посещают районы обитания восточно-европейских птиц во время послегнездовой дисперсии или кочевок летом второго года жизни; при этом их перемещения и места временного обитания перекрываются с гнездовым ареалом восточно-европейской популяции. Однако все центрально-европейские птицы, посещающие Восточную Европу, гибнут или возвращаются в район рождения, никто из них не приступал к гнездованию в Восточной Европе. Балобаны в возрасте старше 3-х лет, включая взрослых птиц после гнездования, вообще не посещают Восточную Европу. Не существует никаких доказательств, что восточно-европейские балобаны посещали Центральную Европу или здесь гнездились. Восточно-европейские балобаны демонстрируют подобное центрально-европейским птицам направление дисперсии и миграционных перемещений – в первую очередь на восток – северо-восток. Результаты подтверждают, что обмен генами между этими двумя популяциями отсутствует или незначителен и увеличение численности центрально-европейской популяции не имеет прямого влияния на восточно-европейскую.

The once continuous distribution range of the Saker Falcon (*Falco cherrug*) has become fragmented in the 20th century. The reasons are related to human activities such as transformation of land use, use of chemicals, development of infrastructure, and direct persecution. Despite the special

attention on the species from the researchers and conservationists, it has been unclear whether the recently separated populations are in contact with each other and if there is any gene exchange between them.

Recently there are two different populations of Sakers in Europe: the Central European population (with the vast majority of pairs nesting in the lowlands of Hungary, Slovakia and Serbia and with a few pairs in the Czech Republic, Austria, Croatia and western Romania) and the East European population (with the population centre in Ukraine, and with a few pairs in Moldova and eastern Romania). Both populations are estimated to hold a maximum of 400 pairs. The two populations are separated by the Carpathian Mountains. While – after its previous collapse – the Central European population has increased significantly in the past thirty years due to strong conservation efforts, the East European population has decreased significantly. The Russian (in the European part), Romanian and Bulgarian populations – once connected through the still stable Ukrainian population – have vanished except for a few pairs in Romania. Cross-breeding between the two populations has not yet been confirmed, and thus the likelihood of gene exchange has been unclear.

Saker ringing schemes and satellite-tracking programmes in the last years in Central Europe and in Ukraine have provided valuable information in understanding the relationship between the two populations. This article summarizes the results of ringing and tracking programmes and attempts to draw conclusions.

Material and method

Ringing and recovery data were collected and analyzed from databases, various articles, ringing atlases and reports. In the case of Hungary, raw data of the Hungarian Bird Ringing Centre were looked at in a very detailed way: more than 2500 ringing and 94 recovery data were analyzed. Special consideration was given to the relationship between age and recovery distance.

Various projects in Central Europe and Ukraine have used solar powered, satellite-received transmitters (or PTTs – Platform Transmitter Terminals) to track the movements of Sakers. Most Sakers were tagged in the frame of the first Hungarian-Slovak Saker conservation LIFE project (LIFE06 NAT/HU/000096) between 2007–2010. Full grown juveniles were taken from the nest a few days prior to fledging, while adults were trapped. Maximum caution was taken not to injure the birds during the procedures;

consequently, no birds were harmed. Apart from five 20g PTTs, manufactured by NorthStar LLC (www.northstarst.com) and deployed in 2007, and a new unit, engineered and manufactured by Revir Nonprofit Kft. in Hungary and deployed in 2012, all PTTs were manufactured by Microwave Telemetry Inc. (www.microwavetelemetry.com). The latter two types enable researchers to locate the birds with an accuracy of a few meters. The Hungarian unit uses radio frequency; all other PTTs use Argos satellite system (www.argos-system.org) for communicating data. All of the units mounted on the birds with a harness were manufactured of tubular Teflon ribbon. Harnesses were tailor-made to adjust to the individual. Finishing was made by using dental floss and super glue [7]. All birds were tagged in the eyrie. Tagged juveniles were returned to the nest immediately; adults were released. There was only one case reported when the harness was too loose: this bird was re-trapped and the PTT was removed. No cases have been reported indicating that the tagging caused injuries or death of the bird. Sakers found dead or tagged were examined for any physical changes on the body due to the PTT. No pathological or irrevocable changes were found, unlike in other satellite-tracking studies [6].

In the frame of various programmes, 67 juveniles and 14 adults were tagged in Hungary, Slovakia, Romania, Ukraine and the Czech Republic between 2007 and 2012.

Results and discussion

Ringling data. Large-scale ringling of Sakers has been running only in three countries (Hungary, Slovakia and the Czech Republic). In all these countries, systematic ringling of Sakers started in the 1980s. Ringling activity has focused on ringling nestlings, which is occasionally complemented by trapping and ringling fledged juveniles and adults. In other countries, there are no systematic ringling projects for the species.

Czech Republic and Slovakia. Ringling in the Czech Republic and Slovakia started when the two countries still formed Czechoslovakia; therefore the ringling data from the two countries are discussed together.

Until 2002, 312 Sakers were ringed in the two countries [2]. In the Czech Republic, 151 Sakers were ringed between 1999 and 2009 [1]; and in Slovakia, 240 Saker nestlings were ringed between 2007–2010.

Most of the recoveries (including all ages) have been from the Czech Republic, Slovakia and the neighbouring countries, confirming the relationship

between the Czech and Slovak populations, and with the Hungarian and Austrian populations. There is only one recovery showing an eastern movement: a Saker ringed as a nestling on 14 May 2003 in eastern Slovakia was found electrocuted in November of the same year near Moscow, Russia, 1200 km away from its fledging place. The brother of this latter bird was also found on 20 January 2004 in Serbia, 450 km south of the nest [3]. Recoveries from the migration and wintering season show south/south-westerly movements.

Hungary. Between 1954 and 2010, 2570 Sakers were ringed in Hungary (more than 95 % as nestlings) and 94 recoveries have been recorded. Most of the recoveries occurred in Hungary and in the neighbouring countries, mainly in Slovakia. Recoveries are mainly from the post-fledging period (usually within 1–2 months after fledging), but before the migration season. There is only one record from the East: a juvenile Saker ringed as a nestling in eastern Hungary on 31 May 1996 and found dead on 26 July 1996 in Russia, 1478 km away from the place of ringing. Ring recoveries from the migration and wintering season suggest south/south-westerly movements of Hungarian Sakers.

Kazakhstan, Russia and Ukraine. Although sporadic ringing of Saker Falcons is happening in Eastern Europe, so far there have been no ring recoveries in Kazakhstan, Ukraine or Russia in Central Europe.

Two ring recoveries suggest that Sakers from North Kazakhstan migrate in a southwest direction using the East European flyways. One Saker ringed in Naurzum State Reserve was shot in Georgia in November, 2040 km southwest from the place of ringing. Another Saker ringed in the same area was shot three years later in the spring, near Chelkar railway station, 540 km southwest of Naurzum. However, these recoveries do not confirm the connection between the two European populations [5].

It must be noted here that ringing is not the most efficient way to study raptor movements due to the very low recovery rate (Table 1).

Data from satellite-tracking of the Central European birds. In the frame of the projects “*Conservation of Falco cherrug in the Carpathian Basin*” (LIFE06 NAT/H/000096 running 2006–2010) and “*Conservation of Falco cherrug in NE Bulgaria, Hungary, Romania and Slovakia*” (LIFE09 NAT/HU/000384 running 2010–2014) supported by European Union’s LIFE-Nature fund, a few dozen Sakers have been tagged with satellite-received transmitters in Hungary, Slovakia and Romania. In addition, further birds have been tagged in other projects in Hungary, Ukraine and the Czech Republic (Table 2).

Table 1

Recovery rates of ringed birds of prey 1951–2006
according to the Hungarian Ringing Centre

Таблица 1

Частота возвратов окольцованных соколообразных птиц за период 1951–2006 гг.
по данным Венгерского центра кольцевания

Species Вид	Recovery rate (%) Частота возвратов (%)	Species Вид	Recovery rate (%) Частота возвратов (%)
<i>Accipiter gentilis</i>	7,6	<i>C. pygargus</i>	0,6
<i>A. nisus</i>	3,1	<i>Falco cherrug</i>	3,6
<i>Aquila heliaca</i>	9,5	<i>F. columbarius</i>	3,5
<i>A. pomarina</i>	2	<i>F. peregrinus</i>	6
<i>Buteo buteo</i>	3,4	<i>F. subbuteo</i>	0,6
<i>B. lagopus</i>	4,1	<i>F. tinnunculus</i>	1,2
<i>B. rufinus</i>	8,5	<i>F. vespertinus</i>	1,3
<i>Circus aeruginosus</i>	2	<i>Haliaeetus albicilla</i>	7,6
<i>C. cyaneus</i>	1	<i>Milvus migrans</i>	2,4
<i>Circus aeruginosus</i>	2,2	<i>Pernis apivorus</i>	3,4

Notes. Recovery rates of ringed birds of prey 1951–2006 according to the Hungarian Ringing Centre. The higher ratios can be explained by colour-ring readings (Imperial Eagle (*Aquila heliaca*), White-tailed Eagle (*Haliaeetus albicilla*), Peregrine Falcon (*Falco peregrinus*)), «special» conditions (juvenile Peregrines and Goshawks (*Accipiter gentilis*) often found in pigeon cages or injured when attacking prey) or low number of samples in a well-studied area (Long-legged Buzzard (*Buteo rufinus*)) Source: Hungarian Bird Migration Atlas [3].

Примечание: более высокие показатели частоты возвратов могут объясняться лучшей заметностью птиц с цветными кольцами (орел-могильник, белохвостый орлан, сапсан), «особыми» причинами (молодых сапсанов и тетеревятников часто находят в клетках голубей или же раненными при атаке добычи) или малым объемом выборки на хорошо изученной территории (курганник). По: Hungarian Bird Migration Atlas [3].

Table 2

Distribution of the tagged Sakers in the various countries by age and sex

Таблица 2

Половозрастное распределение меченых балобанов в разных странах

	Hungary Венгрия		Slovakia Словакия		Romania Румыния		Ukraine Украина		Czech Republic Чехия		Total Всего
	M	F	M	F	M	F	M	F	M	F	
Juvenile / Молодые особи	24	22	0	10	0	2	5	3	1	0	67
Adult / Взрослые особи	10	2	0	0	0	0	0	2	0	0	14
Total / Всего	34	24	0	10	0	2	5	5	1	0	81

Notes. M – Male, F – Female.

Примечания: M – самцы, F – самки.

Captive-bred juvenile Sakers were released with PTTs also in an Austrian and a Bulgarian project – three and ten respectively – in 2009–2010

and in 2011–2012 [4; Ragyov pers. comm.). However, these data are not considered in this article as the tagged birds were not of wild origin.

Out of 67 juvenile Sakers tagged in Europe, 59 were tagged in Central Europe and 8 were tagged in 2012. The latter were still around the nest at the time of writing of this article. Therefore, data only from the remaining 51 juveniles are considered here. Adults are not considered in the calculations, but they are mentioned in certain cases below. Data from the Central European countries are analysed together.

The findings on the movements of the Central European Sakers in relation to East European populations are the following:

- In total, 10 juveniles (19.6 % of the cohort of 51 tagged juvenile Sakers) visited Eastern Europe (regions east from the Carpathian Mountains), but if we consider that some of the birds perished before leaving the natal eyrie, the percentage is higher;

- Five of those (3 males and 2 females) visiting Eastern Europe were 1cy and five (3 males and 2 females) were 2cy birds;

- Sakers from their 3rd cy – including tagged adults – did not roam to the East any more, but stayed in Central Europe, even if previously they had visited Eastern Europe;

- The typical roaming period for the tagged birds visiting Eastern Europe is from July (1cy birds) and May (2cy birds) to late September;

- All ten birds visiting Eastern Europe visited Ukraine, and 9 of them (17.6 %) established temporary settlement area (TSA) in the country spending at least a few days in the TSA;

- Only one Central European Saker visited the Crimea, which is known as the centre of the Ukrainian Saker population, and even that bird stayed only a few days there;

- Eight Sakers visited Russia and most of them established TSAs in the country (15.7 %);

- Only 1 juvenile male (1.9%) that left the natal eyrie very early made it to Kazakhstan; however he perished within a few days after crossing the Kazakh border;

- Two Sakers perished in Russia; one of them was found electrocuted (Karyakin, pers. comm.);

- One bird vanished in Ukraine, and probably perished;

- One bird perished in eastern Bulgaria;

- All the other satellite-tracked birds returned to Central Europe;

- Two additional tagged juveniles out of 51 (3.9%) showed long-distance post-fledging dispersal, but to the West (Spain and France), and both perished during the first autumn migration;
- No 2cy or older Sakers roamed to the West;
- All other satellite-tracked juveniles stayed in the Carpathian Basin in the post-fledging period;
- Data from the migration and wintering season show clear south/south-westerly autumn migration in the case of all migrating juvenile Central European Sakers.

As data show, juveniles remain in the natal eyries for about one and a half months after fledging. This is the time they need to collect basic knowledge for their survival. Some of the birds, however, leave the parental eyries sooner – about one month after fledging – but these birds are very likely to perish, as satellite-tracking records suggest.

After leaving the natal eyrie, juveniles disperse various directions and spend the time until the migration season in one or more TSAs. They stay in the TSAs from a few days to two months and typically discover the area by using the TSAs as a base. The distance of the post-fledging dispersal varies, but most of the birds stay in Central Europe, within the natural borders of the Carpathian Basin. Some of the birds, however, cross these borders. Dispersal eastward is the most common for juvenile Sakers, both for those staying within and crossing the borders of the Carpathians. Only very few birds disperse in a westerly direction and typically, they fledge in the western part of the Central European population (western Hungary, western Slovakia). Figure 1 shows the main dispersal directions of juvenile Central European Sakers.

Only first and second calendar year birds travel to Eastern Europe. Older birds do not roam to the East even if they have visited Eastern Europe earlier. In the autumn, a large percentage of the juvenile Sakers show a south-westerly movement, however the distance of those movements varies from a few dozen to a few thousand kilometres. Second calendar year Sakers continue the «discovery roaming» after returning from the wintering sites, and a part of the 2cy cohort visit Eastern Europe. Almost all of the 1cy and 2cy Sakers that spend the summer in Eastern Europe leave the region for the winter. There was only one exception to this: a female that arrived in southern Ukraine from Hungary in the post-fledging period, wintered in the same area and returned to Hungary late spring of the next year [7].

**Хищные птицы в динамической среде III тысячелетия:
состояние и перспективы**

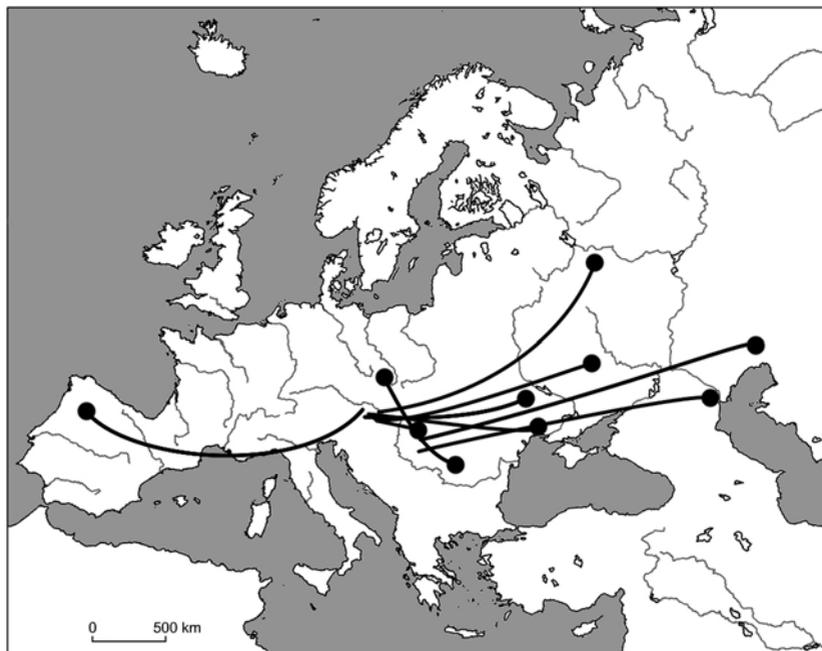


Fig. 1. Main directions of long range post-fledging (but pre-migration) dispersal of Hungarian satellite tracked juvenile Sakers. Dispersal starts one and a half month on average after fledging and although most juveniles stay within the Carpathian Basin, certain percent of young Sakers covers a considerable distance after leaving the natal area and before starting autumn movements.

(Black circles show the first summer TSAs after dispersing from the natal eyrie.)

Рис. 1. Главные направления дальней послегнездовой (но: предмиграционной) дисперсии венгерских балобанов, меченных спутниковыми передатчиками. Дисперсия начинается в среднем через полтора месяца после вылета птенцов из гнезда и, хотя большая часть молодых особей продолжает держаться в пределах Карпатского бассейна, часть молодых балобанов преодолевает значительные расстояния с момента отлёта с территории гнездования и до начала осенних перемещений.

(Черные кружки показывают расположение первых летних «временных мест проживания» птиц после дисперсии с территорией гнездования).

Third calendar year birds did not roam any more during the summer, but remained in Central Europe. Non-established adults remain in a certain area, mostly in the wider region of the fledging area, making occasional short-distance «discovery routes». Established adults are focusing on breeding. Established males stay near the nest even if the breeding is not successful, while females may do occasional short-distance roaming especially if the breeding failed because of the death of the male.

Data from satellite-tracking of the Ukrainian birds. In 2011, eight juvenile Sakers (5 males and 3 females) were tagged in Ukraine: 3 males and 3 females in the Crimea and 2 males in the Kherson region. Two adult females were tagged in 2012. The movements of the Ukrainian juvenile Sakers can be summarised as below:

- Two males in the Kherson region stopped sending signals within a few days after tagging for some unknown reason ;
- All the remaining 6 birds continued transmitting in the subsequent months;
- Four of the six birds remained one or two weeks longer in the natal eyrie than the average Central European juveniles (one and a half months); one stayed about the same time and one left within one month;
- All of the birds dispersed to the east/northeast from the natal eyrie;
- Two of the birds flew around the Azov Sea as the first post-fledging dispersal move, but returned to the Crimea;
- All the 6 birds established TSAs in the Crimea during the dispersal time;
- In late summer, a juvenile male roamed to Cyprus from the Crimea where he returned from mainland Turkey in the same migration period and was electrocuted;
- All the other birds remained in the Crimea for the winter;
- Four tagged Sakers perished in the Crimea for unknown reasons in the autumn/winter period;
- One juvenile spent the winter in the Crimea and started to roam northeast in the beginning of June; at the time of the writing of this article, he is in Kazakhstan, about 400 km north of the Caspian Sea;
- None of the satellite-tracked Sakers dispersed to the west, in the direction of the range of the Central European population.

As the data suggest, Crimean Sakers do not disperse as far as the Central European birds and the main direction of dispersal is similar to their westerly counterparts: east/northeast (Fig. 2). This decreases the likelihood that

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Crimean Sakers reach the western Saker population. Although it must be noted that these data are based only on the movements of six birds and all of them were tagged in a well-defined geographical area (Crimea). Information on more Sakers tagged in a wider geographical area (e.g. throughout southern Ukraine) may give different results. The relations between the Crimean and the mainland Ukrainian populations are yet to be understood as well.

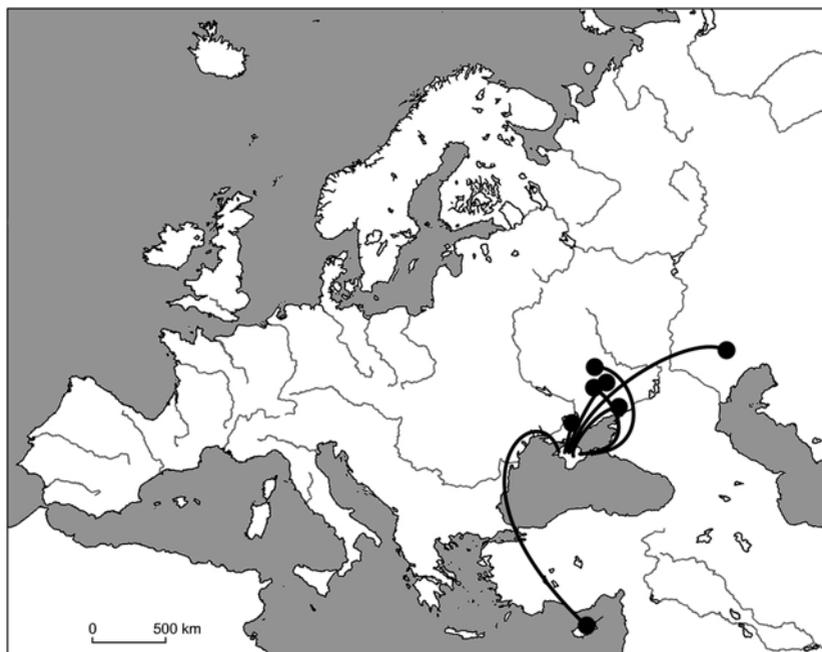


Fig. 2. Main directions of long range post-fledging dispersal and movements in Ukrainian satellite tracked juvenile Sakers of the first and second calendar years. (Black circles show the farthest place after dispersing from the natal eyrie.)

Рис.2. Главные направления дальней послегнездовой дисперсии и перемещений украинских балобанов второго года жизни, меченных спутниковыми передатчиками. (Черные кружки показывают расположение самых дальних мест разлета птиц после дисперсии с территорий гнездования).

Conclusions

Regarding the findings above, it can be seen that satellite-tracking and ringing schemes have not confirmed the occurrence of cross-breeding between the Central European and the East European Saker populations. Although the possibility of cross-breeding and thus gene exchange between the two populations cannot be excluded entirely, as the sample size is low, it is very likely that the number of such cases is negligible. Even if such events occur, they do not have a significant impact on the populations. Apparently, the high level of the individual's philopatry and the distance between the ranges of the two populations prevent the regular and significant gene exchange and the two populations may be considered genetically isolated from each other.

This was certainly not the case when the two recently separated populations belonged to one continuous population, spanning from southern Hungary across northern Serbia, northern Bulgaria and southern and eastern Romania to southern Ukraine and the European part of Russia. While in such a continuous population, gradual – step-by-step – spreading of new genes was possible, now it is unlikely that a new gene can spread from one population to the other.

In conservation practice, these results also mean that a growing Central European Saker population will not feed the decreasing East European population, even though the movement ranges of the individuals of the two populations overlap. Instead of direct impact, therefore, the Central European population may have an effect on the East European population if it expands gradually and the Sakers re-conquer the former northern Bulgarian and southern Romanian habitats in the coming decades. Therefore, local conservation measures focusing on the existing core breeding areas and their edges, as well as conservation measures on the former and thus potential breeding grounds are the keys to bringing back the species to its ancient range.

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