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Population trend, breeding performance and diet of Saker Falcons *(Falco cherrug)* in Hungary between 1980 and 2024

János Bagyura[1], László Haraszthy[1], Tamás Szitta[1,2], Béla Solti[1], Dénes Jánossy[1†], Mátyás Prommer[3], József Fidlóczky[1] & Márton Horváth[1*]

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Abstract The Saker Falcon *(Falco cherrug)* is a globally threatened bird species, and Hungary hosts the second-largest population in Europe. The Hungarian population most likely reached its historical minimum by the 1970s, with an estimated number of 15–30 breeding pairs. Intensive monitoring and conservation efforts began in 1980 through the cooperation of MME BirdLife Hungary and the national park directorates. In this paper, we present the long-term natural history of the Hungarian Saker Falcon population from 1980 to 2024. Throughout the study period, both range expansion and breeding population size exhibited an increasing trend. The number of known territorial pairs grew at an average annual rate of approximately 8%. The population reached its historical maximum in 2024, when 200 territorial pairs were recorded, of which 177 successfully bred, producing 530 fledglings. A total of 4,429 breeding attempts were monitored in Hungary over 45 years, of which 3,467 were successful, yielding 10,319 nestlings. The breeding performance parameters of the population showed a generally stable trend with slight fluctuations throughout the study period. The annual mean (±SD) success rate was 0.76 (±0.14), and the mean brood size was 2.94 (±0.29), resulting in an overall productivity of 2.26 (±0.49). Following the socio-economic changes in Hungary in the 1990s, the breeding population of Saker Falcons shifted its range from the mountains to the lowlands. This shift was driven by decreased persecution of raptors, habitat changes and the subsequent decline in the availability of key prey species in the foothills. Between 1986 and 2015, 24,882 identifiable prey items of Saker Falcons were recorded, belonging to 164 different taxa. Diet analysis revealed that four species played a particularly significant role in the diet of Saker Falcons in Hungary: Feral Pigeon *(Columba livia* f. *domestica)*, European Ground Squirrel *(Spermophilus citellus)*, Common Starling *(Sturnus vulgaris)*, and Common Vole *(Microtus arvalis)*. Although Columbiformes remained the most common prey group, their abundance did not show a significant trend. In contrast, the proportion of Passeriformes increased significantly. A more pronounced change was observed among mammals in the diet. The previously common European Ground Squirrel declined dramatically, while the proportion of other Rodentia and Lagomorpha species increased significantly. The growth of the Hungarian Saker Falcon population halted after 2010. However, a slight increase has been observed in recent years (2018–2024), raising the hope that a gradual recovery may still be possible in the coming decades.

Keywords: endangered species, raptor, monitoring, conservation, prey composition

Összefoglalás A kerecsensólyom *(Falco cherrug)* egy globálisan veszélyeztetett madárfaj, és Magyarország ad otthont Európa második legnagyobb nemzeti állományának. Az állomány történelmi mélypontját valószínűleg az 1970-es évekre érte el, amikor a becslések szerint mindössze 15–30 pár élt az ország területén. Az intenzív állományfelmérési és természetvédelmi erőfeszítések 1980-ban kezdődtek a Magyar Madártani és Természetvédelmi Egyesület, valamint a nemzeti park igazgatóságok együttműködésével. Jelen tanulmányban a magyarországi kerecsensólyom-populáció helyzetét mutatjuk be 1980 és 2024 között. Az elterjedési terület terjedésével párhuzamosan a populáció mérete is növekedett, és az ismert territóriumok száma évente átlagosan 8%-kal emelkedett. Az ismert populáció történelmi csúcsát 2024-ben érte el, amikor 200 territóriumot fedeztünk fel, és 177 sikeres pár összesen

530 fiókát nevelt fel. Összesen 4429 költési próbálkozást követtünk nyomon Magyarországon a 45 év alatt, amelyek közül 3467 sikeres költés során 10319 fiókát regisztráltunk. A populáció költési sikerességi mutatói általában stabilak maradtak, kisebb ingadozásokkal. Az éves átlagos (±SD) sikerességi arány 0,76 (±0.14), míg az átlagos fészekaljméret 2,94 (±0.29) volt, ami összességében 2,26 (±0.49) produktivitást eredményezett. Az 1990-es években bekövetkezett társadalmi-gazdasági változásokat követően a kerecsensólymok költőállománya a hegyvidékekről az alföldi területekre helyeződött át. Ezt az elmozdulást a ragadozómadarak üldözésének csökkenése, az élőhely-változások, valamint a hegylábi területeken a kulcsfontosságú zsákmányfajok elérhetőségének visszaesése idézte elő. 1986 és 2015 között összesen 24882 zsákmányállatot sikerült azonosítani, amelyek 164 különböző taxonba tartoztak. A táplálkozási vizsgálatok eredményei alapján négy faj kiemelkedő szerepet játszott a kerecsensólymok étrendjében Magyarországon: a házigalamb *(Columba livia* f. *domestica)*, az ürge *(Spermophilus citellus)*, a seregély *(Sturnus vulgaris)* és a mezei pocok *(Microtus arvalis)*. A leggyakoribb zsákmánycsoportot alkotó galambfélék állománya nem mutatott jelentős változást, azonban az énekesmadarak aránya szignifikánsan növekedett. Még jelentősebb változás volt megfigyelhető az emlősök között, ahol az egykor gyakori ürgeállomány drámaian visszaesett, miközben más rágcsálók és nyúlalakúak aránya növekedett. A magyarországi kerecsensólyom-populáció növekedése 2010 után megállt, de az utóbbi években (2018–2024) ismét enyhe növekedésnek indult, ami reményre ad okot, hogy a következő évtized(ek)ben a populáció még további lassú erősödése lehetséges.

Kulcsszavak: veszélyeztetett faj, ragadozómadár, monitoring, természetvédelem, zsákmányösszetétel

[1] MME/BirdLife Hungary, 1121 Budapest, Költő utca 21., Hungary
[2] Bükk National Park Directorate, 3300 Eger, Sánc utca 6., Hungary
[3] University of Florida, 110 Newins-Ziegler Hall, 32611 Florida, United States of America
** corresponding author, e-mail: horvath.marton@mme.hu*

Introduction

The Saker Falcon *(Falco cherrug)* (hereinafter 'Saker') is a globally threatened bird species, of which Hungary hosts the second-largest population in Europe (BirdLife International 2021). The breeding pairs in Hungary form a common population within the Pannonian ecoregion, along with pairs in Austria (Zink *et al*. 2025), the Czech Republic (Škorpíková *et al.* 2025), Slovakia (Chavko *et al*. 2025), western Romania (Prommer *et al.* 2025), and Serbia (Puzović 2025).

The Saker is the national bird of Hungary and is widely considered the most probable origin of the "Turul," the mythical bird in Hungarian legends (Bagyura 2022). Probably, it was a relatively rare but regular breeding species in Hungary at the end of the 19th and the beginning of the 20th century. However, very few precise data are available from this early period. Based on the limited historical records (including published observations, hunting statistics, and falconry archives), it is estimated that the national population may have reached 300–400 pairs at the beginning of the 20th century (Bagyura *et al.* 2019b). However, the widespread persecution of raptors and carnivores, particularly through poisoning and shooting during the first half of the 20th century, led to the near disappearance of the Saker from the lowland open habitats of Hungary.

The first national survey of rare raptor species was conducted in Hungary by the Forestry and Hunting Authorities in 1949 and 1950. This extensive survey documented 28 nesting pairs of Sakers, almost exclusively in the mountainous and forested northern regions of the country (Pátkai 1954). These findings contributed to the strict legal protection of most falcon and eagle species in Hungary in 1954. However, no further national surveys were undertaken until the 1980s. The widespread use of DDT during the 1950s and 1960s likely had additional negative effects on raptor populations in Hungary, as was observed in many other regions worldwide (Peakall & Kiff 1979).

The population most likely reached its historical minimum by the 1970s, with an estimated number of 15–30 breeding pairs (Bagyura *et al.* 2022). Intensive monitoring and conservation efforts began in 1980 through the collaboration of MME BirdLife Hungary and national park directorates (Haraszthy & Bagyura 1993). This comprehensive conservation programme included nest guarding (Bagyura *et al.* 1994a), the installation of artificial nests on trees and high-voltage pylons (Fidlóczky *et al.* 2014), the reintroduction of European Ground Squirrels *(Spermophilus citellus)* (Szitta *et al.* 2021), the retrofitting of medium-voltage electric poles (Demeter *et al.* 2018), and anti-poisoning measures (Deák *et al.* 2021). The annual results of national Saker monitoring between 2004 and 2022 were published in population status reports (Bagyura *et al.* 2006, 2007, 2008a, 2009, 2010a, 2010b, 2012a, 2014, 2015a, 2015b, 2016, 2017, 2018, 2019a, 2023). In addition, various aspects of conservation efforts, population trends, and breeding biology have been documented (Bagyura *et al.* 1994a, 2004a, 2008b, 2012b, 2019b, 2022, Fidlóczky *et al.* 2014), alongside preliminary data on diet composition (Bagyura *et al.* 1994b, 2004b). However, these reports and periodical summaries were presented in different formats and used slightly varied definitions for breeding parameters, complicating direct comparisons and dataset integration.

In this paper, we harmonise a unique 45-year database to provide a comprehensive analysis of the Hungarian Saker population. Based on this dataset, we examine the development and geographical distribution of the population, as well as its diet composition. By applying standardised definitions, we present the long-term natural history of the Saker population in Hungary from 1980 to 2024.

Material and Methods

Population size and breeding performance

Over the last five decades, the methodology of the national Saker monitoring and conservation programme in Hungary has continuously improved (Bagyura *et al.* 2022). However, its primary aim has remained unchanged: to locate as many territorial pairs as possible and determine various parameters of their breeding performance.

In the beginning of the surveys in the early 1980s, monitoring the species required significant effort due to the low density of breeding pairs, the limited number of active raptor experts, the lack of reliable information, and the potential presence of Sakers across most of Hungary (~93,000 km^2). The initial surveys were based on published records (1890–1979) and anecdotal information (1945–1979) from ornithologists, falconers, hunters and foresters regarding known nesting sites and the potential distribution of the species. Intensive field surveys conducted between 1980 and 1984 likely identified most of the nesting pairs within the country. As the population expanded, the geographical coverage and intensity of population surveys also increased. Since the early 2000s, when the distribution area reached its present extent, the number of regular data providers within the *Saker Falcon Working Group* of MME and the national park directorates has exceeded 100 people annually.

Active territories were typically visited between three and six times to collect data, preferably from each breeding stage. The data analysis focused on three main breeding parameters, which were available for the entire study period: the *number of territorial pairs (TP)*, the *number of successful pairs (SP)*, and the *number of fledglings (NF)*. The exact field protocol, methodology, and definitions used for Saker population monitoring in Hungary are described in Bagyura *et al.* (2025), therefore, they are not detailed here.

TP were usually surveyed between mid-March and early April by investigating all previously known and potential nesting sites by traditional field surveys (i.e. by 4×4 cars, binoculars and field scopes), with a special emphasis on the surroundings of artificial nests and large stick nests. *SP* and *NF* were surveyed between mid-May and early June, in the frame of ringing activities (i.e. by climbing to the active nests), drone surveys (2020–2024) or by distant (500–1,000 m) observations with field scopes. Beside these two crucial surveys, an additional 1–4 surveys were also undertaken between February and July to collect more precise information on breeding performance, adult birds and potential threats, depending on the local capacity of observers. If no precise nest survey was undertaken to determine the number of large nestlings or fledglings (nestlings older than ca. 27 days), than *NF* was estimated by using the latest number of observed alive nestlings, or indirectly by extracting the detected number of dead large nestlings from the number of middle-aged nestlings (the later were surveyed usually for all detected breeding attempts). Similarly, in such cases *SP* was estimated by extracting the detected number of late breeding failures (i.e. mortality of the total brood of large nestlings) from rearing pairs (Bagyura *et al.* 2025).

Territorial pairs were defined as unsuccessful if: (1) they did not start breeding (i.e. did not lay eggs and started the incubation); (2) the breeding attempt failed during incubation (mortality of all laid eggs); or (3) the breeding attempt failed during rearing (mortality of the total brood of nestlings).

According to Bagyura *et al.* (2025), we used the following three parameters to assess breeding performance for long-term population monitoring: (1) *success rate* (*SP/TP*); (2) *brood size* (*NF/SP*); and (3) *productivity* (*NF/TP*).

Despite the maximised field effort of the Working Group, the dataset may be subject to slight biases due to the following scenarios:

- territorial pairs remained undetected by the national Working Group, leading to an underestimation of *TP*, *SP*, and *NF*;
- successful breeding attempts of known territorial pairs were missed due to changes in nesting sites or the absence of proper nest surveys later in the breeding season, resulting in an underestimation of *SP* and *NF*;
- the number of chicks was underestimated when assessed through distant observations, particularly when nests were not climbed for nestling ringing or inspected by drone, leading to an underestimation of *NF*;
- late nestling mortality or breeding failure went undetected if no precise nest survey was conducted to determine the number of large nestlings, potentially leading to an overestimation of *SP* and *NF*.

To assess the potential bias in the dataset, an expert opinion poll was conducted between March and October 2023, involving most of the experienced members of the *Saker Falcon Working Group* – i.e. those who had played a significant role in field surveys and data management over the past decades. The results of the poll indicated that the majority (93%) of experts estimated that 76–100% of the national breeding population (i.e. *TP*) of Sakers had been located and monitored annually in Hungary over the past decades (n=42). Similarly, 83% of experts estimated that breeding success (i.e. *SP* and *NF*) had been accurately surveyed for 76–100% of the national breeding population. Most of the remaining experts (5% and 17%, respectively) estimated survey coverage at 51–75%, while only a single person (2%) estimated that the national coverage for *TP* could be 50% or lower for some years.

In large-scale and long-term field surveys, it is important to acknowledge that such studies can rarely, if ever, achieve 100% coverage of the entire studied population. In case of the Saker population in Hungary, expert opinion suggests that annual monitoring effort likely covered more than 75% of the estimated population in all years after 1985. This level of coverage enabled accurate monitoring of long-term changes in breeding distribution, population trends, and breeding success. Nevertheless, it should be noted that during the first five years of the study (1980–1984), when the monitoring methodology was first developed and the network of experienced observers was established, surveys may have missed as much as 25–50% of the population.

Monitoring the diet composition

Prey remains found in or beneath active nest sites were collected during nest surveys, typically once or twice per year between 1986 and 2015. Sporadic data gathered outside this period were excluded from the present analysis due to their low annual sample size. The most comprehensive surveys were conducted in mid-May, when most known nesting sites in Hungary were visited, and many were climbed to ring the nestlings. Therefore, the presented data primarily represents the diet of rearing Sakers within the breeding season, while it cannot be applied for the non-breeding period or non-breeding specimens.

For the collection, identification, and management of prey remains, we followed the protocol detailed in Horváth *et al.* (2018). Prey remains found around a nest site were collected in the field, and items that could be unambiguously identified on-site were recorded on field datasheets. To minimise bias from indirect sampling, the following types of remains were excluded from the dataset, even if found beneath nest sites: (1) single feathers, which may have been shed by live birds; (2) full carcasses of large animals that could not have been physically transported by the falcons; and (3) old or deteriorated samples that may have originated from previous years.

Fresh prey items that still contained edible parts for the chicks were photographed but not removed from the nests. Food remains containing a significant amount of soft tissue and/or those that could be unambiguously identified in the field were left in place to prevent contamination and putrefaction before analysis. Pellets, bones, feathers, hairs, and dried skins of prey animals were collected and stored in plastic bags with ID labels until further analysis.

The collected samples were identified by comparison with museum reference materials, typically within one year of collection. Remains from the same nest site and year were categorised by species, sex (for species with clear sexual dimorphism), body size, and body part. A remain was classified as a separate prey specimen if it: (1) belonged to a different species or sex; (2) had a clearly different body size from the already listed specimens; or (3) included the same body part as another remain.

The same minimum estimation methodology was applied when merging field data (including both datasheets and photographs) with laboratory data. Consequently, in some cases, remains from different prey specimens may have been grouped as one, but the risk of multiple counting of the same specimen was eliminated.

Camera traps were introduced as an alternative method for collecting data on the diet composition of Sakers in 2011 and became the primary method from 2016 onwards (Bagyura *et al.* 2025). Due to the fundamentally different methodology, which could bias comparisons between annual datasets, data obtained from camera traps were not included in the present analysis.

Visualization and trend analyses

Distribution maps of Saker breeding pairs and collected prey items was elaborated in QGIS 3.16.8. To analyse long-term trends in the population size, breeding performance, and diet composition of the Saker in Hungary, linear regression models were applied. The models were constructed to assess changes in key demographic parameters, as well as shifts in diet composition over the study period. Each parameter was regressed against time (year) using the ordinary least squares (OLS) method to determine the direction and rate of change. The coefficient of determination (R^2) was calculated for each model to quantify the proportion of variance explained by the linear trend. All statistical analyses were performed using Microsoft Excel (Microsoft Office Professional Plus 2016), ensuring consistency in data handling and visualization. The regression analyses assumed a linear relationship between the variables and time, with model fit assessed through R^2 values. While linear regression provided a general representation of trends, additional exploratory analyses were conducted to evaluate potential deviations from linearity.

Results

Population trend

The population grew significantly over the 45-year study period, with *TP* increasing by approximately 8% on average per year *(Figure 1a)*. The known population size reached its historical maximum in 2024, with 200 territorial pairs recorded, of which 177 successfully bred, producing 530 fledglings.

The long-term trends in the population parameters and diet composition of the Saker in Hungary were analysed using a linear regression model *(Figure 1a)*. The linear regression equations derived for key population parameters demonstrated a strong positive trend,

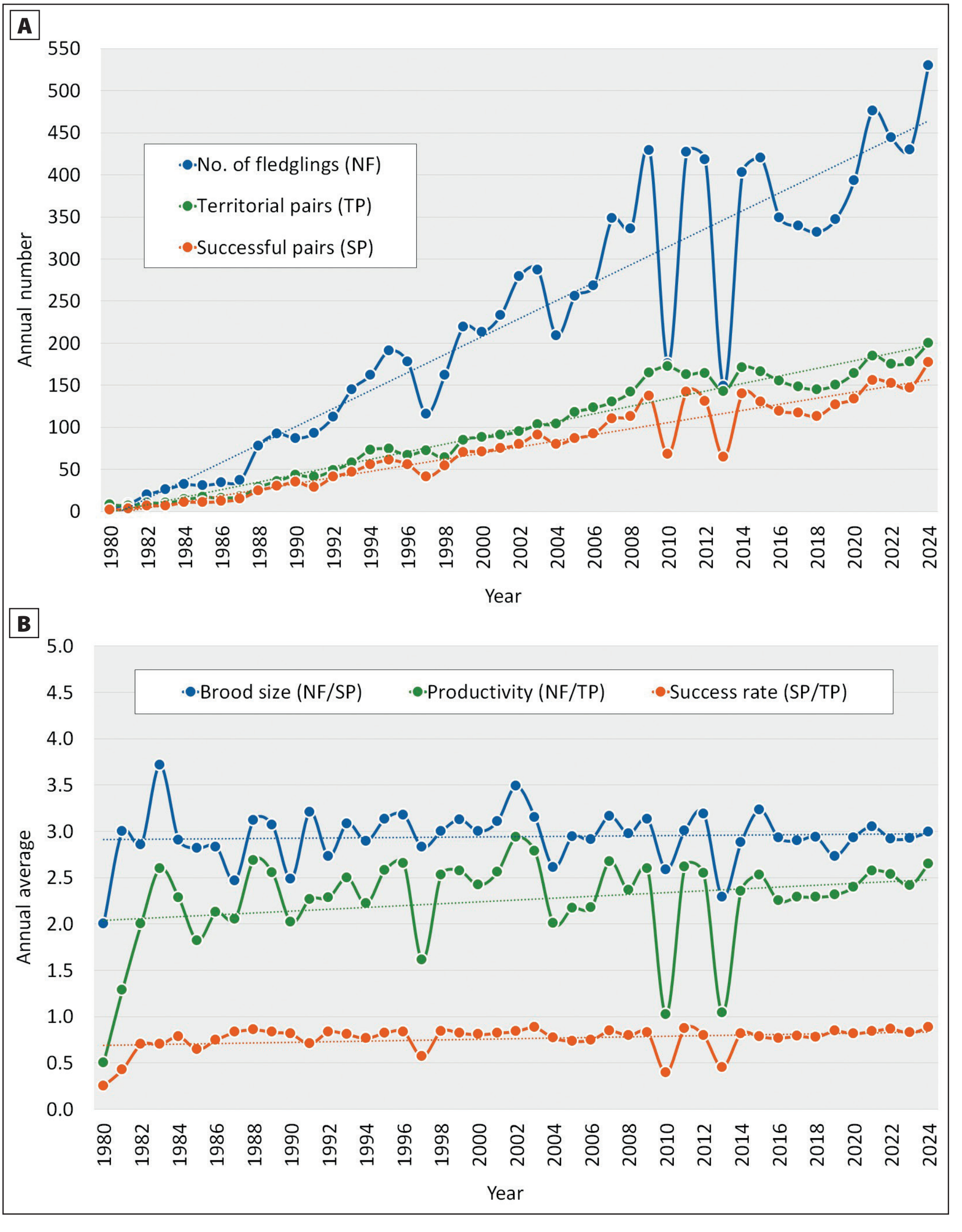

Figure 1. Trends in the demographic parameters of the Saker Falcon population in Hungary from 1980 to 2024. (a) Population size and number of fledglings, (b) Breeding performance parameters, Dotted lines: linear regression

1. ábra A kerecsensólyom költő populáció alakulása Magyarországon 1980 és 2024 között. (a) Költő populáció mérete. Kék: kirepült fiókák száma (NF); Zöld: territoriális párok száma (TP); Piros: sikeres párok száma (SP). (b) Költési siker paraméterek: Kék: fészekaljméret (NF/SP); Zöld: produktivitás (NF/TP); Piros: sikerességi arány (SP/TP). Pöttyözött egyenesek: lineáris regresszió with *TP* increasing at an annual rate of ca. 4.50 pairs (y=4.502x–5.123; R^2=0.951), *SP* at 3.65 pairs per year (y=3.653x–6.337; R^2=0.909), and *NF* at 10.69 fledglings per year (y=10.691x–16.574; R^2=0.863). These high R^2 values indicate that the linear models effectively capture the overall trend in population growth. However, it is important to note that while the R^2 statistic quantifies the proportion of variation explained by the model, it does not validate the appropriateness of the linear assumption itself. Given the fluctuations observed in the population trend – such as the plateau between 2010 and 2018 and subsequent resurgence from 2018 to 2024 – the model provides a useful but simplified representation of the broader trend rather than an exact predictive tool.

Breeding performance

A total of 4,429 breeding attempts were monitored in Hungary over the 45-year study period, of which 3,467 were successful, resulting in 10,319 recorded nestlings. The breeding performance parameters of the population exhibited a generally stable trend with slight fluctuations throughout the study period *(Figure 1b)*. Neither productivity (*NF/TP*; n=45; y=0.010x+2.029; R^2=0.072), brood size (*NF/SP*; n=45; y=0.001x+2.912; R^2=0.004), nor success rate (*SP/TP*; n=45; y=0.003x+0.685; R^2=0.102) showed any clear trend.

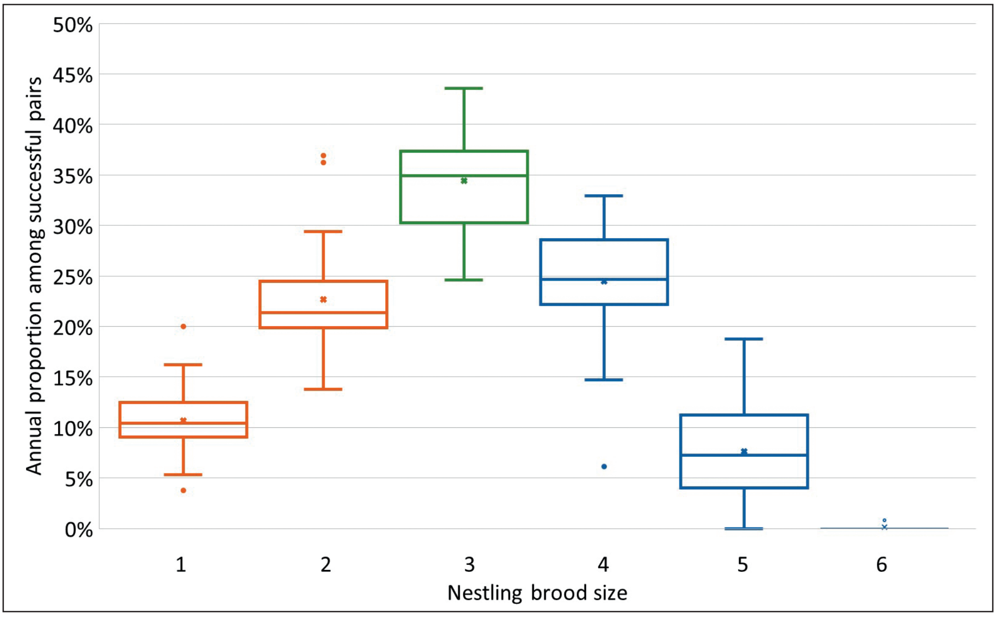

Figure 2. Distribution of nestling brood size among successful Saker Falcon breeding attempts in Hungary based on their annual proportions between 2001 and 2024 (n=24). Colours indicate if breeding performance was below (red), at (green) or above (blue) the most common (three-nestling) brood size

2. ábra Fiókás fészekalj-méret eloszlása a sikeres kerecsensólyom költések esetében Magyarországon az éves arányaik alapján 2001 és 2024 között (n=24). A színek azt mutatják, hogy a költések sikeressége a leggyakoribb (háromfiókás) fészekaljméret alatt (piros), azzal megegyező (zöld) vagy afeletti (kék) volt

The annual average (±SD) success rate was 0.76 (±0.14), and the average brood size was 2.94 (±0.29), resulting in an overall productivity of 2.26 (±0.49) (n=45). Productivity was low during the first two years of the study, when sample sizes were small, and monitoring activities were still being developed. In later years, when the population was much larger and well monitored, exceptionally low productivity was recorded in three specific years (1997, 2010, and 2013), when extreme spring weather conditions caused widespread breeding failure.

The distribution of nestling brood size was investigated for 2,783 successful breeding attempts between 2001 and 2024 based on their annual proportions *(Figure 2)*. Three-nestling broods were the most common (34.44±5.20%), followed by four-nestling (24.50±6.10%), two-nestling (22.69±5.77%), one-nestling (10.70±3.36%), and five-nestling broods (7.60±4.58%) (n=24). A natural six-nestling brood was recorded only once (in 2015), while in another instance (in 2008), an artificially raised chick was successfully adopted as a sixth nestling in a naturally occurring five-nestling brood.

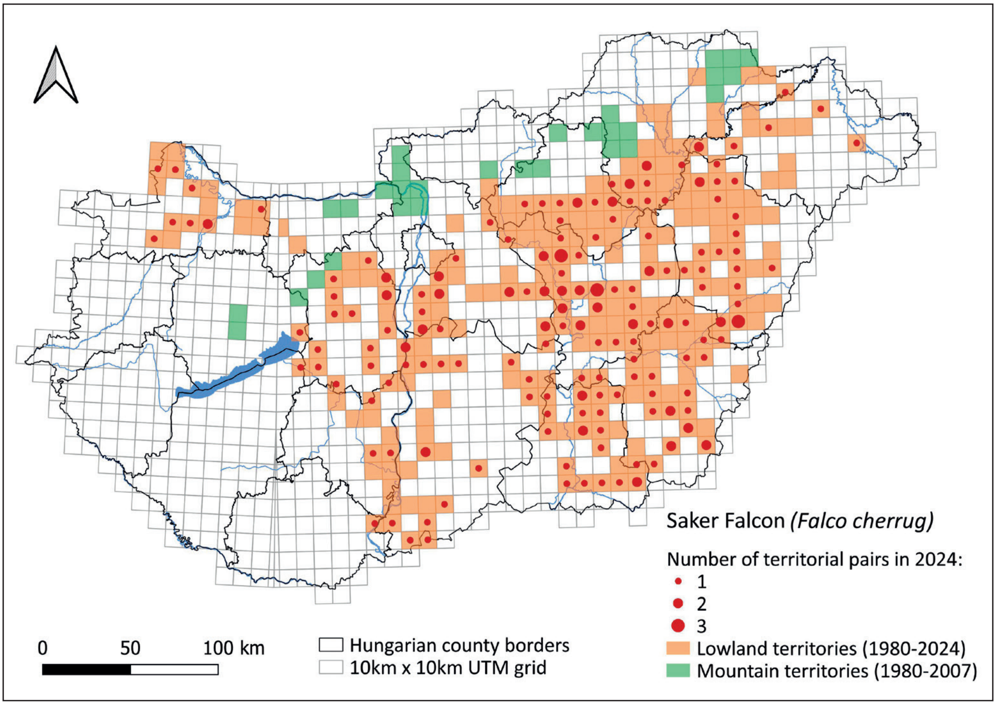

Figure 3. Breeding distribution of the Saker Falcon in Hungary from 1980 to 2024 and the number of surveyed territorial pairs in 2024

3. ábra A kerecsensólyom elterjedési területe Magyarországon 1980 és 2024 között, valamint a felmért territóriumok száma 2024-ben. Piros körök: territoriális párok száma 2024-ben; Narancs négyzetek: síkvidéki territóriumok (1980–2024); Zöld négyzetek: hegyvidéki territóriumok (1980–2007)

Distribution area

In the 1980s, the distribution of Sakers was primarily restricted to medium-elevation mountains (300–800 m a.s.l.) in the northern part of Hungary *(Figure 3)*. However, a few (<5) pairs also nested sporadically in lowland habitats, mainly along the Danube and Tisza rivers.

Sakers naturally bred primarily on cliffs, using ledges, cavities, or nests of Common Ravens *(Corvus corax)*. They also occupied abandoned tree nests of raptors, including Northern Goshawk *(Accipiter gentilis)*, Eastern Imperial Eagle *(Aquila heliaca)*, Golden Eagle *(Aquila chrysaetos)*, Common Buzzard *(Buteo buteo)*, Long-legged Buzzard *(Buteo rufinus)*, White-tailed Eagle *(Haliaeetus albicilla)*, and European Honey Buzzard *(Pernis apivorus)*, as well as nests built by corvids such as Raven and Hooded Crow *(Corvus cornix)*. In rarer cases, they nested in the abandoned nests of Great Cormorants *(Phalacrocorax carbo)* and White Storks *(Ciconia ciconia)* (Bagyura *et al*. 2022).

The population began expanding southward and northwestward towards open lowland habitats during the 1990s and 2000s. In these areas, Sakers initially occupied natural tree nests built by the aforementioned species, but later, most of the population preferred the meanwhile constructed artificial nests on trees and high-voltage transmission pylons (see notes in the Discussion). By the 2010s, the distribution range of Sakers had expanded across most of the Hungarian Plain, reaching the Serbian and Romanian borders in the east and south, and Austria in the northwest. Meanwhile, the Hungarian mountain population began to decline and had completely disappeared by 2007, when the last recorded breeding attempt was observed in the Gerecse Mountains (Bagyura *et al.* 2022).

Diet composition

A total of 24,882 prey items of Sakers were identified between 1986 and 2015. Of these, the year of collection was known for 24,776 items (99.57%), while the location (settlement) was recorded for 21,264 samples (85.46%). The missing data were primarily due to the deterioration of ID labels. The identified prey items belonged to 164 different taxa, including 124 species and an additional 40 taxa where identification was limited to a higher taxonomic level: Genus (22), Family (8), Order (7), or Class (3). The complete list of identified species and taxa is provided in *Appendix 1*.

The annual number of collected and identified prey items varied throughout the study period, however, in most years, it ranged between 200 and 2,000 *(Figure 4)*. This dataset was therefore suitable for detecting long-term trends among the most common taxa. Prey items were collected from 169 settlements, and their geographical distribution closely reflected the distribution of Sakers in Hungary *(Figure 5).*

The relative frequency of the most common taxa among the collected and identified prey items is presented in *Figure 6*. The Feral Pigeon *(Columba livia* f. *domestica)* accounted for 53.63% of all identified prey items. However, it is important to note that this species has significantly higher detectability than smaller prey species (e.g. rodents and Passeriformes). Consequently, its relative frequency among identified items is likely to be significantly overestimated compared to its actual proportion in the diet (see notes in the Discussion).

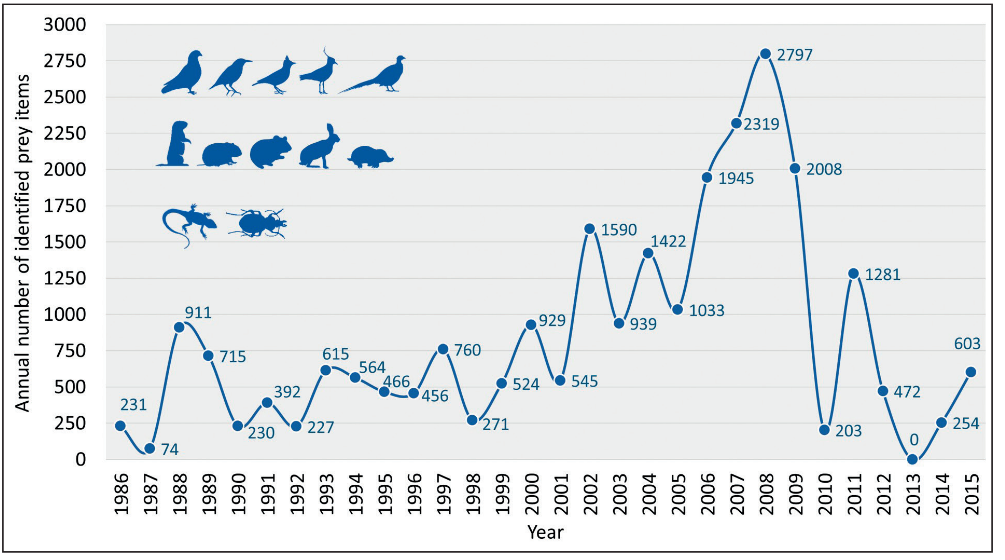

Figure 4. Number of collected and identified prey items of Saker Falcons in Hungary from 1986 to 2015 (n=24,776)

4. ábra Évente begyűjtött és meghatározásra került kerecsensólyom zsákmányállatok száma Magyarországon 1986 és 2015 között (n=24776)

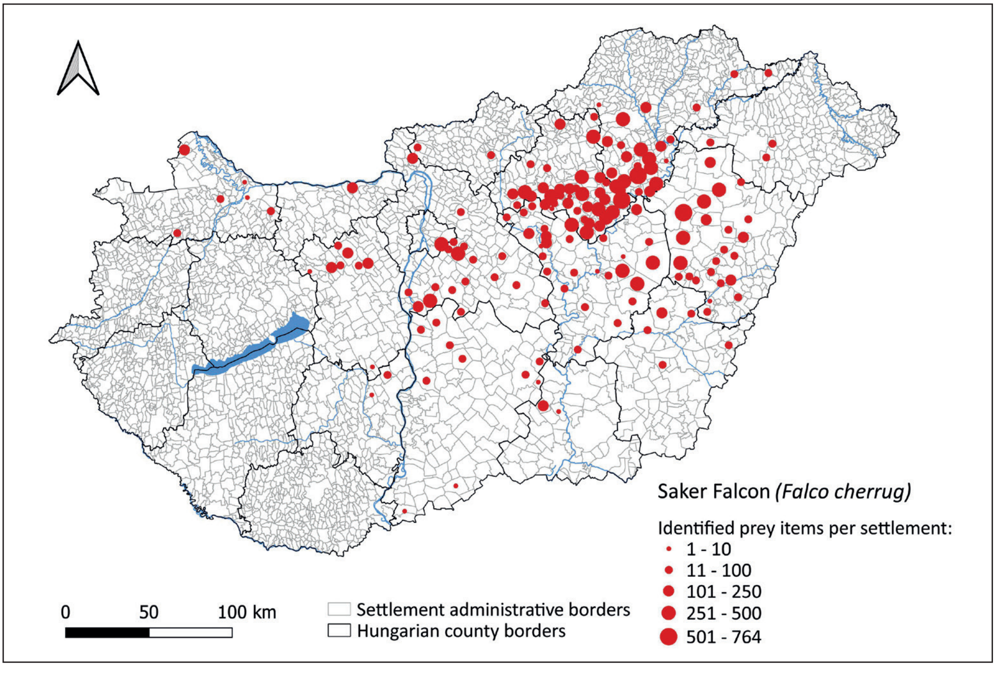

Figure 5. Geographical distribution of collected and identified prey items of Saker Falcons by the administrative borders of settlements in Hungary from 1986 to 2015 (n=21,264)

5. ábra Begyűjtött és meghatározásra került kerecsensólyom zsákmányállatok térbeli eloszlása településhatáronként Magyarországon 1986 és 2015 között (n=21264)

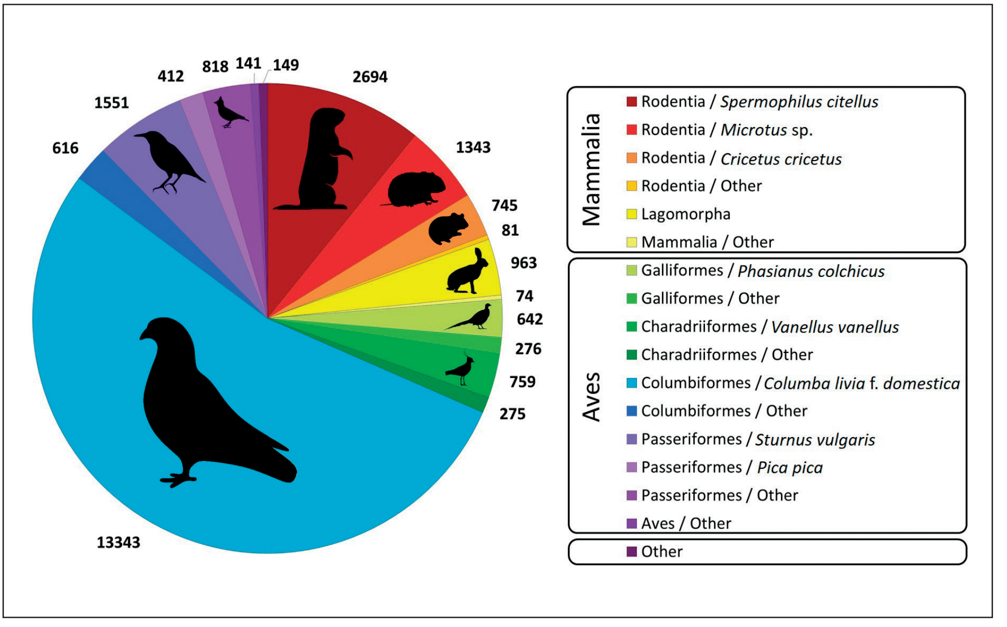

Figure 6. Distribution of the most common taxa among the collected and identified prey items of Saker Falcons in Hungary from 1986 to 2015 (n=24,882). The proportion of different taxa found among prey remains may significantly differ from their actual proportion among prey items delivered to the nest (see text)

6. ábra Begyűjtött és meghatározásra került kerecsensólyom zsákmányállatok eloszlása a leggyakoribb taxonok között Magyarországon 1986 és 2015 között (n=24882). Az egyes taxonok maradványokból kimutatott gyakorisága jelentősen eltérhet a fészekbe hordott zsákmányok valódi arányától (ld. szöveg)

Three additional species exceeded 5% of the identified prey items: the European Ground Squirrel (10.83%), the Common Starling *(Sturnus vulgaris)* (6.23%), and the Common Vole *(Microtus arvalis)* (5.25%). Additionally, five further species accounted for more than 1% of the identified prey items: the Brown Hare *(Lepus europaeus)* (3.87%), the Northern Lapwing *(Vanellus vanellus)* (3.05%), the Common Hamster *(Cricetus cricetus)* (2.99%), the Common Pheasant *(Phasianus colchicus)* (2.58%), and the Eurasian Magpie *(Pica pica)* (1.66%).

The annual proportion of the most common taxa among the collected and identified prey items of Sakers is shown in *Figure 7*. The overall proportion of birds (n=30; y=0.003x+0.702; R^2=0.075), mammals (n=30; y=-0.003x+0.297; R^2=0.082), and other species (n=30; y=0.000x+0.001; R^2=0.067) did not show clear trends *(Figure 7a)*.

Columbiformes also did not exhibited any clear trend (n=30; y=-0.003x+0.615; R^2=0.050). However, the proportion of Passeriformes increased (n=30; y=0.003x+0.051; R^2=0.438), while a slight increase was observed among other non-Passeriformes (n=30; y=0.003x+0.036; R^2=0.313) *(Figure 7b)*.

A more pronounced change was detected among mammal species. The initially common European Ground Squirrel showed a dramatic decline (n=30; y=-0.011x+0.325; R^2=0.539),

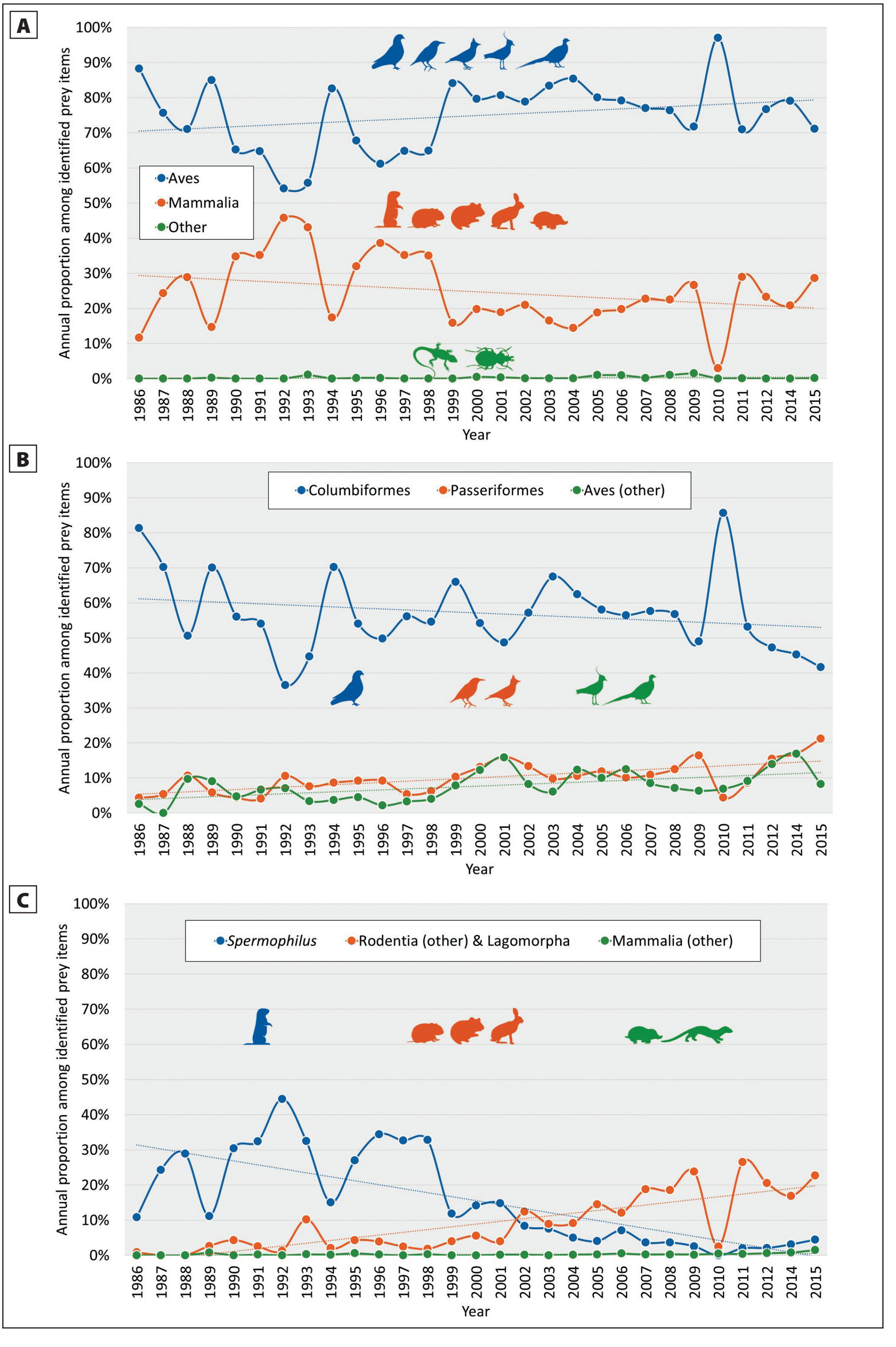
A
Aves
Mammalia
Other
Annual proportion among identified prey items
Year
B
Columbiformes
Passeriformes
Aves (other)
Annual proportion among identified prey items
Year
C
Spermophilus
Rodentia (other) & Lagomorpha
Mammalia (other)
Annual proportion among identified prey items
Year

Figure 7. Proportion of the most common taxa among the collected and identified prey items of Saker Falcons in Hungary from 1986 to 2015 (n=24,765): (a) proportion of bird (Aves) and mammal (Mammalia) species; (b) proportion of the most common mammal taxa; (c) proportion of the most common bird taxa. The proportion of different taxa found among prey remains may significantly differ from their actual proportion among prey items delivered to the nest (see text for details). Dotted lines: linear regression

7. ábra Begyűjtött és meghatározásra került kerecsensólyom zsákmányállatok arányának éves alakulása a leggyakoribb taxonok között Magyarországon 1986 és 2015 között (n=24765): (a) madarak (Aves) és emlősök (Mammalia) aránya; (b) leggyakoribb emlős taxonok aránya; (c) leggyakoribb madár taxonok aránya. Az egyes taxonok maradványokból kimutatott gyakorisága jelentősen eltérhet a zsákmányolás valódi arányától (ld. szöveg). Pöttyözött egyenesek: lineáris regresszió

whereas the proportion of other Rodentia and Lagomorpha species increased (n=30; y=0.008x–0.028; R^2=0.668). The proportion of other mammal species within the diet remained low and showed no significant change (n=30; y=0.000x+0.000; R^2=0.249) *(Figure 7c)*.

Discussion

The well-known collapse of Peregrine Falcon *(Falco peregrinus)* populations across the Northern Hemisphere by the 1960s (Cade *et al.* 1968, Newton 1979, 2017), along with the significant decline of other raptor populations, prompted governments and non-governmental organisations worldwide to initiate conservation programmes focused on raptors. Hungary was no exception. As the largest westernmost European outpost of eastern steppe habitats, species associated with these habitats received special attention. The Saker Falcon, Red-footed Falcon *(Falco vespertinus)*, and Eastern Imperial Eagle have served as flagship species for nature conservation in Hungary since then. Several decades of targeted conservation efforts, carried out through the collaboration of governmental, non-governmental, and for-profit organisations, as well as private individuals, have led to tangible results for raptor populations in Hungary.

In the case of the Saker, the official ban on DDT, introduced in Hungary in 1968 (the first such ban in the world) (Bagyura *et al.* 2004a, Fidlóczky *et al.* 2014, Bagyura *et al.* 2019b), followed by comprehensive conservation efforts – including nest guarding, the installation of artificial nests, insulation of mid-voltage power line poles, and combating raptor persecution – has contributed to the remarkable recovery of the population over the past 45 years. In addition, a standardised monitoring methodology was established, along with a well-organised network of more than 100 field experts and ornithologists, enabling the effective monitoring of population size and breeding success (Bagyura *et al.* 2025). These efforts have likely resulted in the most comprehensive long-term dataset on the species globally, encompassing data on more than 4,000 breeding attempts and 10,000 nestlings.

The lowest point of the Saker population in Hungary occurred in the 1980s when the species was on the brink of extinction. In the first year of the study only four nestlings were detected from eight known nesting pairs, with an estimated total population of no more than 15–30 pairs. After more than four decades of dedicated conservation efforts, the population reached 200 nesting pairs in 2024, producing over 500 nestlings, making it one of the largest national populations in Europe. As of 2012, the only larger population on the continent was in Ukraine, estimated at 285–312 pairs. However, as this population has not been systematically monitored, it may have declined significantly over the past decade, similarly to the nearest Russian populations (Prommer *et al.* 2025). Consequently, the conservation of the Saker population in Hungary is of critical importance for the species' preservation in Europe. The central role of the Hungarian population is further supported by population trends in neighbouring countries. Before the 2000s, breeding Sakers were either absent or recorded only sporadically in most neighbouring countries, with the exception of Slovakia. By 2024, however, Austria, western Romania, Serbia, and Slovakia had established considerable populations (Chavko *et al.* 2025, Prommer *et al.* 2025, Pužović 2025, Zink *et al.* 2025), likely influenced by the growth and expansion of the Hungarian population.

The demographic parameters of the Hungarian pairs were generally stable and similar to other parts of the Pannonian population in the neighbouring countries (Chavko *et al.* 2025, Prommer *et al.* 2025, Puzović 2025, Škorpíková *et al.* 2025, Zink *et al.* 2025), which indicates that there are probably no significant recent problems in nesting or foraging possibilities for the species. There were three breeding seasons in which the proportion of successful breeding pairs, and consequently the number of fledglings, was considerably lower than average. In each case, the poor breeding outcomes could be attributed to an unusually wet and cold spring and could also contribute to the halt of the population increase between 2010 and 2018. However, mean brood size in Hungary was lower than in Mongolia, which may not be independent from the higher proportion of mammals in the diet of the Mongolian Saker population (Zhang *et al.* 2024).

The Saker inhabits open areas, which are essential for hunting. However, this does not mean that the species is restricted solely to lowland habitats, as observed in Hungary today. For example, in Central Asia, Sakers also breed at high elevations (>3,000 m a.s.l.) in mountain ranges such as the Altai-Sayan region and the Tibetan-Qinghai Plateau. Although the species is absent from the alpine regions of Europe (e.g. the Alps and the Carpathians), and satellite-tracked individuals have consistently avoided high mountains (Prommer *et al.* 2012), historical records indicate that Sakers bred in lower mountain ranges and plateaus, provided that suitable open habitats and a stable prey base were present.

The breeding distribution of the Saker in Hungary has shifted dramatically over the past 45 years. As the population expanded, breeding pairs moved from mountainous and hilly areas to the lowlands. They first occupied foothills before spreading further, while mountain populations gradually disappeared, culminating in the last (failed) breeding attempt in 2007 (Bagyura *et al.* 2022), interestingly in the same year when the last mountain breeding pair bred in western Slovakia (Chavko 2010).

This range shift was driven by political and economic changes following the collapse of communism. The transition reshaped agriculture, making traditional free-ranging grazing unviable (Biro *et al.* 2013). As pastures – critical habitats for the European Ground Squirrel, the Saker's primary mammalian prey – were abandoned, scrub encroachment and afforestation followed, particularly in mountainous regions where no alternative prey base was available.

This marked the culmination of a 150-year-long process, during which Hungary's grassland area – within its current borders – shrank from over 2.5 million hectares to approximately 800,000 hectares. The decline accelerated between 1985 and 2000, with an annual loss rate of 1.13% (Biró *et al.* 2011). Although national park directorates later reintroduced grazing, European Ground Squirrel populations did not recover. Meanwhile, cliffs abandoned by Sakers were recolonised by the recovering Peregrine Falcon (Prommer & Bagyura 2022), further limiting the chances of reoccupation due to potential interspecific competition.

In contrast, the lowlands offered abundant prey, and conservation efforts boosted corvid and raptor populations, providing ample nesting sites. A similar range shift was observed in Slovakia (Chavko *et al.* 2025). The significant decrease in the previously widespread persecution (poisoning and shooting) of predators and the ban of DDT were also essential factors, which enabled several raptor species to recolonise the Pannonian lowlands (Haraszthy & Bagyura 1993). Moreover, MME BirdLife Hungary and its partner organisations began installing artificial nests (stick nests and nest platforms) on trees in the late 1980s to facilitate the species' colonisation. This conservation measure proved highly effective, and artificial nests soon became more frequently used by the falcons than natural nests (Bagyura *et al.* 1994a).

Probably the most significant step in the colonisation process occurred in the late 1980s when Sakers began occupying natural stick nests built by corvids on high-voltage transmission pylons. However, as Sakers – like other falcon species – do not build or maintain nests, it was not uncommon for overused Corvid nests to deteriorate and eventually collapse, often resulting in the loss of eggs or nestlings. These incidents prompted MME BirdLife Hungary and national park directorates to collaborate with transmission and distribution system operators. As part of this effort, they developed a specialised nest box prototype and established an extensive network of more than 300 nest boxes along the high-voltage (120–700 kV) power grid between 1991 and 2010 (Fidlóczky *et al.* 2014, Bagyura *et al.* 2022). These nest boxes on pylons proved highly attractive to Sakers, and they had a fundamental importance in the recovery of the species, since the 2010s more than 80% of the national population has been breeding in them.

The shift of the breeding habitats also affected directly and indirectly the diet composition of Sakers. The results of the diet analysis indicated that four species played a dominant role in the diet of Sakers in Hungary during the study period: the Feral Pigeon, European Ground Squirrel, Common Starling, and Common Vole. The most striking finding from the trend analysis was the dramatic decline in the proportion of European Ground Squirrels within the diet, while the proportion of Rodentia (particularly the Common Vole), Lagomorpha (notably the Brown Hare), and Passeriformes (especially the Common Starling) increased significantly. A similar and concerning decline in European Ground Squirrels has also been observed in the diet of sympatric Eastern Imperial Eagles in Hungary (Horváth *et al.* 2018). These dietary shifts were primarily driven by two parallel and interrelated processes.

- *Decline of European Ground Squirrel colonies*: European Ground Squirrel populations in Hungary experienced a sharp decline between 1964 and 2012, affecting both foothill and open lowland habitats (Cserkész *et al.* 2025).

- *Regional variation in prey availability*: In contrast to the foothills and mountains, lowland habitats supported a greater abundance of alternative prey species, such as Brown Hares and Common Voles. Consequently, while the decline of Ground Squirrel colonies in mountainous regions was a key driver of the Saker's shift to lowland habitats, this habitat shift also resulted in significant changes to the population's diet.

Although the expanding distribution and stable productivity of Saker Falcons suggest that they have been able to compensate for the loss of Ground Squirrels in the short term by utilising alternative prey species, it remains unclear whether this dietary shift will have long-term consequences for population viability. The relationship between diet and demography is a potential subject for further investigation, especially given that a recent study demonstrated the impact of diet composition on the demographic parameters of Sakers (Zhang *et al.* 2024). A few other examples of potential future research topics:

- *Effects of fluctuating population dynamics of Common Voles on Sakers' productivity*: The population size of Common Voles fluctuates drastically in 3–5-year cycles, and their body mass (30–40 g) is significantly smaller than that of European Ground Squirrels (150–300 g). These differences influence their reliability and energetic value as a food source for predators, particularly during years of low vole abundance.
- *Possibility of secondary poisoning due to increased predation on Common Voles:* Farmers widely use pesticides in the lowlands to control vole populations, and their misuse (especially the illegal use of brodifacoum) is frequently causing secondary poisoning of raptors in Hungary (Deák *et al.* 2024), and a similar alarming trend of rodenticide poisoning has been reported for Sakers from Slovakia as well (J. Chavko *pers. comm.*).
- *Sakers' predation on young Brown Hares and potential persecution*: Increased predation on young Brown Hares may lead to greater persecution of raptors by game managers, as has been documented in the case of the Eastern Imperial Eagle (Kovács *et al.* 2016, Deák *et al.* 2018).
- *Increased avian prey and disease risk*: A rising proportion of avian prey in the diet may elevate the risk of infectious diseases, as avian pathogens are more easily transmitted to raptors than mammalian pathogens (van den Brand *et al.* 2015).

Although our diet analysis provides valuable insights into the prey base of Sakers in Hungary, it has certain limitations. The detectability of larger prey species (e.g. Feral Pigeon) *versus* smaller ones (e.g. Common Vole) differs significantly when using prey remains and/or pellets as a data source (Redpath *et al.* 2001, Sánchez *et al.* 2008). As a result, such studies tend to underestimate the proportion of smaller prey species relative to larger ones, leading to potential inaccuracies when comparing the relative proportions of different-sized prey taxa. Therefore, the frequency data presented should be interpreted with this limitation in mind.

Despite their limitations, large datasets remain highly effective in identifying the overall importance of key prey species within a region. Common prey species are consistently detected, whereas rare species appear only occasionally (Katzner *et al.* 2005, Bedrosian *et al.* 2017). Additionally, since the detectability of individual species or taxa does not change significantly over time, temporal trends in prey frequency can be considered reliable indicators of actual dietary shifts (Horváth *et al.* 2018).

In the case of Feral Pigeons, it is important to note that homing pigeon races coincide with the nestling period of Sakers. During this time, many pigeons are regularly present in addition to the resident pigeon and other prey populations that are available throughout the year (J. Bagyura *pers. comm.*). As a result, while Feral Pigeon remains provide a reliable estimate of their trend within the diet in the breeding season, these results should not be interpreted as representing the species' frequency in the annual diet. Moreover, e.g. Stock Doves *(Columba oenas)* are rarely reported from prey remains during the rearing period of Sakers, while they are frequently predated in wintertime, when the large flocks of wintering Stock Doves provide a significant prey source for falcons in the Pannonian lowlands (J. Chavko *pers. com.*).

Conservation implications

The growth of the Saker population in Hungary halted after 2010 and experienced a slight decline in some years. However, since 2018, the population has shown a modest increase again (2018–2024), raising hopes that further gradual population strengthening may still be possible in the coming decades. Nevertheless, the species remains highly dependent on direct conservation measures, including the installation and maintenance of artificial nests (Fidlóczky *et al.* 2014), the retrofitting of dangerous medium-voltage power line poles (Demeter *et al.* 2018), and efforts to mitigate raptor persecution (Deák *et al.* 2018).

Moreover, habitat loss due to urban expansion, infrastructure development, and the intensification of agriculture poses a significant threat to the entire ecosystem, including top predators of the Pannonian Plains. Therefore, the long-term future of the Saker depends not only on the continuation of direct conservation efforts but also on the capacity to advocate for the preservation and potential expansion of natural and semi-natural habitats within the agricultural landscape. Additionally, the transformation of agricultural policies to support biodiversity – both within and beyond protected areas – will be essential for maintaining a suitable prey base for Sakers and, consequently, ensuring the species' long-term survival.

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Appendix

Appendix Proportion of all identified prey taxa of Saker Falcons in Hungary in the study period
Melléklet Valamennyi meghatározott taxon eloszlása a kerecsensólymok magyarországi táplálékában a vizsgálati időszakban

Class	Order	Species	Number	% *N*
Amphibia			**13**	0.05%
	Anura		**13**	0.05%
		Anura indet.	3	0.01%
		Pelobates fuscus	1	0.00%
		Pelophylax sp.	9	0.04%
Aves			**18833**	75.69%
	Accipitriformes		**7**	0.03%
		Circus cyaneus	4	0.02%
		Circus pygargus	3	0.01%
	Anseriformes		**31**	0.12%
		Anas crecca	1	0.00%
		Anas platyrhynchos	13	0.05%
		Anas querquedula	15	0.06%
		Anas sp.	1	0.00%
		Anser anser f. *domestica*	1	0.00%
	Bucerotiformes		**2**	0.01%
		Upupa epops	2	0.01%
	Charadriiformes		**1034**	4.16%
		Actitis hypoleucos	1	0.00%
		Charadriiformes indet.	3	0.01%
		Charadrius hiaticula	1	0.00%
		Chroicocephalus ridibundus	195	0.78%
		Gallinago gallinago	1	0.00%
		Himantopus himantopus	1	0.00%
		Ichthyaetus melanocephalus	1	0.00%
		Larus cachinnans	1	0.00%
		Limosa limosa	8	0.03%
		Numenius arquata	5	0.02%
		Numenius phaeopus	3	0.01%
		Philomachus pugnax	19	0.08%
		Sterna hirundo	1	0.00%
		Tringa erythropus	1	0.00%
		Tringa glareola	6	0.02%
		Tringa sp.	6	0.02%

Class	Order	Species	Number	% N
		Tringa totanus	22	0.09%
		Vanellus vanellus	759	3.05%
	Columbiformes		**13959**	56.10%
		Columba livia f. *domestica*	13343	53.63%
		Columba oenas	39	0.16%
		Columba palumbus	239	0.96%
		Streptopelia decaocto	50	0.20%
		Streptopelia sp.	246	0.99%
		Streptopelia turtur	42	0.17%
	Coraciiformes		**4**	0.02%
		Coracias garrulus	3	0.01%
		Merops apiaster	1	0.00%
	Falconiformes		**17**	0.07%
		Falco tinnunculus	16	0.06%
		Falco vespertinus	1	0.00%
	Galliformes		**918**	3.69%
		Coturnix coturnix	140	0.56%
		Galliformes indet.	1	0.00%
		Gallus gallus f. *domesticus*	8	0.03%
		Perdix perdix	127	0.51%
		Phasianus colchicus	642	2.58%
	Gruiformes		**24**	0.10%
		Crex crex	4	0.02%
		Fulica atra	10	0.04%
		Gallinula chloropus	3	0.01%
		Porzana porzana	1	0.00%
		Rallus aquaticus	6	0.02%
	Passeriformes		**2781**	11.18%
		Acrocephalus sp.	1	0.00%
		Aegithalos caudatus	1	0.00%
		Alauda arvensis	196	0.79%
		Alaudidae indet. *(Alauda arvensis/Galerida cristata)*	33	0.13%
		Anthus campestris	1	0.00%
		Anthus sp.	2	0.01%
		Carduelis carduelis	5	0.02%
		Carduelis chloris	9	0.04%
		Coccothraustes coccothraustes	5	0.02%

Class	Order	Species	Number	% *N*
		Coloeus monedula	8	0.03%
		Corvus cornix	40	0.16%
		Corvus frugilegus	199	0.80%
		Corvus sp. *(cornix/frugilegus)*	120	0.48%
		Cuculus canorus	1	0.00%
		Emberiza calandra	8	0.03%
		Emberiza citrinella	1	0.00%
		Emberiza schoeniclus	2	0.01%
		Erithacus rubecula	1	0.00%
		Galerida cristata	4	0.02%
		Garrulus glandarius	13	0.05%
		Hirundo rustica	2	0.01%
		Lanius collurio	7	0.03%
		Lanius minor	21	0.08%
		Linaria cannabina	1	0.00%
		Motacilla alba	5	0.02%
		Motacilla cinerea	1	0.00%
		Motacilla flava	5	0.02%
		Muscicapa striata	1	0.00%
		Oenanthe oenanthe	4	0.02%
		Oriolus oriolus	3	0.01%
		Panurus biarmicus	1	0.00%
		Parus major	3	0.01%
		Passer domesticus	4	0.02%
		Passer montanus	18	0.07%
		Passer sp. *(domesticus/montanus)*	7	0.03%
		Passeriformes indet.	45	0.18%
		Pastor roseus	1	0.00%
		Pica pica	412	1.66%
		Saxicola rubicola	2	0.01%
		Sturnus vulgaris	1551	6.23%
		Sylvia curruca	1	0.00%
		Sylvia sp.	2	0.01%
		Turdus merula	5	0.02%
		Turdus philomelos	9	0.04%
		Turdus sp.	18	0.07%
		Turdus viscivorus	2	0.01%

Class	Order	Species	Number	% N
	Pelecaniformes		**21**	0.08%
		Ardeola ralloides	1	0.00%
		Nycticorax nycticorax	20	0.08%
	Piciformes		**3**	0.01%
		Dendrocopos major	2	0.01%
		Dendrocopos sp.	1	0.00%
	Podicipediformes		**3**	0.01%
		Podiceps grisegena	1	0.00%
		Podiceps nigricollis	1	0.00%
		Tachybaptus ruficollis	1	0.00%
	Psittaciformes		**1**	0.00%
		Melopsittacus undulatus	1	0.00%
	Strigiformes		**28**	0.11%
		Asio flammeus	15	0.06%
		Asio otus	9	0.04%
		Strix aluco	4	0.02%
Gastropoda			**3**	0.01%
	Pulmonata		**3**	0.01%
		Zebrina detrita	3	0.01%
Insecta			**115**	0.46%
	Coleoptera		**74**	0.30%
		Carabidae indet.	3	0.01%
		Cassida sp.	1	0.00%
		Cerambycidae indet.	2	0.01%
		Cetonia aurata	1	0.00%
		Coccinellidae indet.	6	0.02%
		Coleoptera indet.	32	0.13%
		Elateridae indet.	2	0.01%
		Holochelus aequinoctialis	1	0.00%
		Hydrophilidae indet.	1	0.00%
		Lucanus cervus	3	0.01%
		Melolontha melolontha	14	0.06%
		Oryctes nasicornis	2	0.01%
		Scarabaeidae indet.	4	0.02%
		Zabrus tenebrionides	2	0.01%
	Hymenoptera		**1**	0.00%
		Hymenoptera indet.	1	0.00%

Class	Order	Species	Number	% N
	Mantodea		**2**	0.01%
		Mantis religiosa	2	0.01%
	na		**22**	0.09%
		Insecta indet.	22	0.09%
	Orthoptera		**16**	0.06%
		Acrididae indet.	1	0.00%
		Calliptamus italicus	2	0.01%
		Gryllotalpa gryllotalpa	12	0.05%
		Gryllus campestris	1	0.00%
Mammalia			**5900**	23.71%
	Artiodactyla		**8**	0.03%
		Capreolus capreolus	7	0.03%
		Sus scrofa	1	0.00%
	Carnivora		**18**	0.07%
		Felis catus	2	0.01%
		Mustela nivalis	12	0.05%
		Mustela sp. *(eversmanii/putorius)*	2	0.01%
		Vulpes vulpes	2	0.01%
	Chiroptera		**18**	0.07%
		Chiroptera indet.	2	0.01%
		Nyctalus noctula	16	0.06%
	Eulipotyphla		**29**	0.12%
		Crocidura leucodon	1	0.00%
		Erinaceus roumanicus	4	0.02%
		Sorex minutus	1	0.00%
		Talpa europaea	23	0.09%
	Lagomorpha		**963**	3.87%
		Lepus europaeus	962	3.87%
		Oryctolagus cuniculus	1	0.00%
	na		1	0.00%
		Mammalia indet.	1	0.00%
	Rodentia		**4863**	19.54%
		Apodemus agrarius	5	0.02%
		Apodemus sp.	10	0.04%
		Arvicola amphibius	36	0.14%
		Cricetus cricetus	745	2.99%
		Micromys minutus	4	0.02%
		Microtus arvalis	1307	5.25%

Class	Order	Species	Number	% *N*
		Microtus sp.	33	0.13%
		Microtus subterraneus	3	0.01%
		Mus musculus	4	0.02%
		Mus sp. *(musculus/spicilegus)*	3	0.01%
		Mus spicilegus	1	0.00%
		Ondatra zibethicus	2	0.01%
		Rattus norvegicus	12	0.05%
		Rattus sp.	1	0.00%
		Rodentia indet.	3	0.01%
		Spermophilus citellus	2694	10.83%
Pisces			**1**	0.00%
	Cypriniformes		**1**	0.00%
		Cyprinus carpio	1	0.00%
Reptilia			**17**	0.07%
	Squamata		**17**	0.07%
		Lacerta agilis	14	0.06%
		Lacerta sp.	2	0.01%
		Natrix natrix	1	0.00%
Total			**24 882**	100.00%