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The breeding population of Saker Falcon *(Falco cherrug)* in the Czech Republic between 1999–2010

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ABSTRACT—The Saker Falcon *(Falco cherrug)* is a rare but regular breeder in the Czech Republic. It has only bred in the Pannonian part of Moravia over the past few decades, except for an isolated breeding locality in Northern Moravia/Silesia, occupied in 1989–1999 and 2003–2007. Between 1999–2010, the breeding of the species was confirmed in 15 grid squares. In total, 92 breedings were confirmed (5–11 annually); with at least a further 24 occupied territories found. At least 39 probable breedings were detected. The total population size of the Saker in the Czech Republic was estimated at 15–20 pairs during this period. Out of 89 breedings, 13 occurred on high voltage pylons, 75 on trees and one nest was situated on a cliff. In 47 cases, nests of other bird species such as Common Buzzard *(Buteo buteo)*, White Stork *(Ciconia ciconia)*, Northern Goshawk *(Accipiter gentilis)* and other species were used. Artificial nesting platforms or nestboxes were used in 30 cases, tree hollows in 10 cases. The following trees were used for nesting: *Quercus* sp. – 29 cases, *Populus* sp. – 22, *Fraxinus* sp. – 10, *Robinia pseudacacia* – 6 and *Alnus* sp. – 4. Out of 92 breeding attempts, 72 (78%) were successful; at least 200 young were fledged. The average breeding productivity was 2.2 young per nest and 2.9 young per each successful breeding. Out of all breeding attempts 22% failed because the nest was abandoned due to disturbance or for unknown reasons (8 cases), presumably predated by Marten (*Martes* sp.) (4 cases), chicks were found dead in the nests (two cases) or, in one case, a clutch probably went cold due to the death of one or both parents. In three cases broken eggs were found in the nests, and in one case, the clutch was not fertilized. In another case, the breeding probably failed due to the sexual immaturity of the parent bird(s). Egg-laying most often took place between March 1 and April 10; in nearly 65%, it occurred between March 21 and 31 (n = 68). Five replacement clutches were found. In these cases, the egg-laying occurred between April 15 and 30 (4 cases) or even as late as between May 1 and 5 (1 case). In 1999–2010, 159 Sakers were ringed (9 adults and 150 juveniles). A juvenile from the Bruntál district (North Moravia/Silesia) was found in Italy (660 km) after 214 days. In several cases, Sakers bred surprisingly close to the occupied nests of other raptors or wading birds. The minimum distance between two occupied nests of Sakers was 1.3 km (both pairs were successful).

Key words: *Falco cherrug*, breeding biology, population, Czech Republic

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Introduction

The Saker Falcon *(Falco cherrug)* belongs to the most endangered regularly breeding bird species in the Czech Republic (CR). There is a long term human interest focussed on this species not only because of its rarity, but because of its attractiveness as a falconry bird as well. Historical data about the Saker population in the Czech Republic is very scarce. We

only know that they bred in Bohemia in the 19th century *(Komárek, 2007)*. Only very few breeding records were documented from the first half of 20th century *(Hudec & Šťastný, 2005)*, but in the second half of the century, the breeding population in South Moravia was established. Systematic research started in 1976 by *Petr Horák* and *Vladimír Gahura*. We present data from the year 1999 onwards, since data from previous years have already been published *(Horák, 2000a)*. The Czech Republic recently forms the western- and northern-most part of the Saker´s global breeding range.

A management plan for the Peregrine and Saker Falcons was developed in 1996 *(Hlaváč, 1995)*. Since then, most of the activities connected with the Saker Falcon have been coordinated by a group of experts—ornithologists, amateur and professional conservationists, falconers and scientists. The group was dissolved in 2006. Since then, the monitoring and ringing of the Saker Falcon have been coordinated by the Agency for Nature Conservation and Landscape Protection of the Czech Republic (ANCLP). Monitoring has been carried out every year in the whole of the known breeding range, but, some breeding pairs have certainly not been found. Other activities are not centrally coordinated. The development of the Czech Saker population has been well documented since 1976, thanks to the work of *Petr Horák*, and since 2005 of other ornithologists as well. Obviously its size depends mainly on the status of the whole European population, in smaller part has been influenced by the coordinated activities. The results of the monitoring in 2005–2007 were summarised by *Hora et al. (2010)*. The Saker Falcon is classified as a "critically endangered species" under the nature protection legislation in the CR.

The aims of the present paper are: (1) to give an overview of the development of the Czech Saker Falcon population in 1999–2010 and to compare it with the situation in 1976–1998, (2) to provide some important data on breeding biology and ecology, and (3) to provide a reliable estimate of the current population size of Saker Falcon in Czech Republic, as well as (4) to discuss the most important threatening factors.

Materials and methods

Monitoring and protection of the Saker Falcon was realised almost single-handedly by the late *Petr Horák* between 1976–2005. He collected data on breeding biology, searched for the nests, carried out the protection of breeding sites, installed artificial breeding platforms and nest boxes or safeguarded the nests that were at risk of breaking up. After his premature death in 2005, the monitoring and protection of Saker has been coordinated by ANCLP. Field activities have been carried out by a group of 6–7 ornithologists, predominantly from February to July. Intensive and systematic searches for raptors' nests and checks on artificial breeding sites in selected areas (historical and potential suitable breeding sites) took place from February to April. Moreover, all observations of Sakers during the breeding season were registered and evaluated, new nests were continuously searched for on the basis of these records. All occupied nests were regularly checked for data on breeding biology, breeding success and to prevent nest robberies or breeding failures caused by human activities. In several areas, data on distribution and behaviour were collected in the non-breeding period as well. Finally, all accidental observations from the whole country were collected.

An area of 1400–3300 km^2 was regularly checked by *Petr Horák* in 1999–2005. Since 2006, an area of 3000–4000 km^2 has been under control.

Grid squares of c.11x12 km (traditionally used in CR) were used to present the results. Breeding cases were divided into two categories: confirmed breeding (documented occupied nest or observation of fledged juveniles up to first half of July, or observation of juveniles together with adults) and probable breeding (repeated observations of an adult or a pair without direct evidence of breeding). The probable breeding category can also include unsuccessful breeding attempts that were terminated before the nest was found.

Several pairs have bred in border regions with Austria or Slovakia. The hunting areas of these pairs are usually stable over the years, but the breeding sites frequently move from one side of the border to the other. These pairs were included into the results if the nest was found less than 1 km from the border or in the case of probable breeding.

Results

The breeding of the Saker Falcon in the Czech Republic has been repeatedly confirmed only in south Moravia – in floodplain forests along the Morava and Dyje rivers in its southernmost part and in "agricultural steppes" (agrocenoses) south of Brno and east of Znojmo. An isolated pair bred near the Polish border in Silesia. In central Moravia (south of Olomouc), the breeding of Sakers has been probable in some years.

The edges as well as the interiors of the forests were used by Sakers for breeding in floodplain areas. Groves, windbreaks or riparian forests were preferred in agricultural steppes, but if no suitable trees were available, breeding on high-voltage pylons in natural nests or on nest platforms occurred. Although an isolated pair breeding near the Polish border was 150 km away from the core population, the breeding habitat was the same as in south Moravia. The altitude of nest sites ranged from 150 to 250m, rarely up to 400 m. At least one breeding was confirmed in 16 grid squares (5672, 5772, 6966, 6967, 7064, 7065, 7161, 7163, 7164, 7165, 7263, 7264, 7265, 7267, 7268, 7367) in 1999–2010. Two squares were occupied every year and five squares only once during this twelve-year period.

Compared to the period 1976–1998, breeding in five previously occupied squares was not confirmed but on the other hand, seven new squares were used. All of them bordered on to other squares, which had previously been occupied, except for the 7161. The situation is shown on Table 1.

The probable breeding was recorded in 18 squares, but in nine of them, confirmed breeding was recorded as well. So in nine squares only probable breeding was known (6569, 6954, 7063, 7069, 7166, 7167, 7169, 7262, 7266).

An apparently geographically isolated breeding pair from Silesia was in fact strongly connected with the South-Moravian population. This was confirmed by a male born in this area in 1996, which bred in south Moravia (180 km S) four years later. This connectivity was also proven by the restoration of the breeding pair after its break-up. It bred continuously from 1989 to 1999. For the next three years, only the male was observed and no breeding was confirmed. The pair bred again from 2003 up to 2007. Since then, only the male has been observed. Despite the fact, that the breeding site is situated near the Polish border, breeding in Poland was confirmed only once *(Sielicki et al., 2009).*

Square No.	Number of breeding pairs											
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
5672	1	–	–	–	1	2	–	–	–	–	–	–
5772	–	–	–	–	–	–	1	1	1	1	–	–
6966	1	1	1	–	1	2	1	1	1	1	1	–
6967	–	–	–	–	–	–	1	–	–	–	–	–
7064	–	–	–	–	–	–	–	–	–	–	–	1
7065	–	–	–	–	–	–	–	–	–	1	1	–
7161	–	–	–	–	–	–	–	–	–	1	–	–
7163	–	1	1	1	1	1	1	–	–	–	1	–
7164*	1	1	2	1	1	1	1	1	1	1	1	1
7165	–	–	1	–	–	–	–	–	–	–	–	–
7263	–	–	–	–	–	–	–	–	–	1	1	2
7264	–	–	–	–	–	–	1	2	2	1	1	1
7265	–	–	–	–	1	–	–	–	–	–	–	–
7267*	1	1	1	1	1	1	1	1	1	1	1	1
7268	–	1		–	–	1	–	–	–	–	–	–
7367	1	1	2	3	2	3	3	1	1	2	–	1
Total	5	6	8	6	8	11	10	7	7	10	7	7

Table 1. The number of confirmed breedings of the Saker Falcon *(Falco cherrug)* in the individual grid squares in 1999–2010. Grid squares where at least one breeding was confirmed in 1976–1998 were marked by '*'.

Horák (2000a) estimated the size of the Czech Saker population at 15 breeding pairs with a maximum of 11 confirmed breedings in 1991 and 2004. Since then, no dramatic changes have been observed wih only a slowly increasing population trend. The recent estimate for the Czech Republic is 15–20 pairs.

Out of 89 occupied nests found between 1999–2005, 13 were placed on high-voltage electric pylons (3 on natural nests, 10 on artificial breeding platforms), 21 were on trees on artificial breeding platforms or in nest-boxes, 44 breeding attempts were found on trees in the nests of other birds (Common Buzzard, *Buteo buteo* – 23, White Stork, *Ciconia ciconia* – 10, Northern Goshawk, *Accipiter gentilis* – 4, Grey Heron, *Ardea cinerea* – 2, Honey Buzzard, *Pernis apivorus* – 2 and Red Kite, *Milvus milvus,* White-tailed Eagle, *Haliaeetus albicilla* and Imperial Eagle, *Aquila heliaca* – 1 case, each), in 10 cases the breeding was performed in a natural tree cavity and once on a rock.

The tree species with the nest or artificial nest platform was known in 71 cases: Oak tree (*Quercus* sp.) – 29, Poplar (*Populus* sp.) – 22, Ash (*Fraxinus* sp.) – 10, Robinia (*Robinia pseudoacacia*) – 6 and Alder (*Alnus* sp.) – 4 cases. The elevation of the nests ranged from 6 to 30 metres.

One pair bred ten times (nine confirmed and one probable case) in a tree cavity *(Horák, 2000b; Horal et al., 2006; Horal, 2008)*. The female was presumably the same in all cases, but for two seasons she bred with a new male. Altogether three different cavities were used (in eight cases the same cavity up to its destruction), always in a solitary English oak *(Quercus robur).* This female reared at least 28 chicks (probably at least 31). After the

Year	Nests	Successful nests	Fledged young	Juv./nest	Juv./successful nest
1999	5	2	7	1.4	3.5
2000	6	5	17	2.8	3.4
2001	8	7	17	2.1	2.4
2002	6	5	16	2.7	3.2
2003	8	7	17	2.1	2.4
2004	11	8	18	1.6	2.3
2005	10	10	28	2.8	2.8
2006	7	7	19	2.7	2.7
2007	7	5	16	2.3	3.2
2008	10	5	14	1.6	2.8
2009	7	5	13	1.9	2.6
2010	7	6	18	2.6	3.0
Total	92	72	200	2.2	2.9

Table 2. Annual breeding success data of the Saker Falcon *(Falco cherrug)* in the Czech Republic in 1999–2010

disappearance of the former female in 2008, a new pair was established in 2009, but the pair started to breed on White Stork nests.

Breeding on cliffs is very rare in the Czech Republic. One recent case from Podyjí/Thayatal National Park is described by *Valášek (in press)* and is a part of the present paper. 51 nests (54%) were situated in agrocenoses, usually in groves, windbreaks or riparian forests. Other nests were situated in floodplain forests and one in the canyon of the Dyje river. Altogether 92 confirmed breeding attempts, at least 24 occupied territories and 38 probable breeding attempts were found in the period 1999–2010. 72 breeding attempts (78%) were successful and at least 200 juveniles were fledged. The average production per all nests is 2.2 individuals/nest and average production per productive nest is 2.9 individuals/nest (for more detailed information see Table 2).

Juveniles from captivity were occasionally added into the nests of Sakers up to 2005, usually only in cases when chicks from the nest died or when there was only one chick on the nest. Altogether 15 juveniles were added to the nests. At least 250 Sakers were released by other methods. Up to now, not a single case of successful breeding of these released Sakers has been confirmed.

Twenty breeding attempts (22% of all known breedings) were unsuccessful. This is a considerable decrease in nest-failures compared to the period 1976–1998, when 42 (41.6%) of breeding attempts failed. The nest was abandoned eight times because of human disturbance or for other unknown reasons, four times it was predated by Marten (*Martes* sp.) (always with chicks in the nest), twice juveniles died and once the clutch went cold because of the probable death of a parent (parents), three times broken and once unfertilized eggs were found and once the parent bird(s) were probably immature and therefore infertile.

Period	Nr. of cases
1–10 March	8
11–20 March	9
21–31 March	44
1–10 April	7

Table 3. Egg-laying dates of the breeding of the Saker Falcon *(Falco cherrug)* in the Czech Republic in 1999–2010

Without the effective protection of the nests and without improving the breeding opportunities, the losses would be at least twofold. For example, six nests that were at risk of falling or fell down were fixed in the period 2000–2002. One attempt to rob a nest was recorded as well. Many nest sites were protected against human disturbance such as forestry works, etc.

Sakers only breed once a year. If the clutch is lost at the beginning of the incubation, often, a replacement clutch is laid. We found replacement clutches in five cases (the first clutch was found as well). In another two cases it was not clear whether it was replacement clutch, or a late first clutch (7.7% of all clutches if two doubtful cases are included). In four cases, the replacement clutch was started between 15–30 April, in one case between 1–5 May. In three of these cases, we know the timing of the first clutch as well (four times the first clutches started between 20–30 March, the replacement clutches between 25–30 April, respectively 1–5 May, once the first clutch started in the first half of March, the replacement clutch in the second half of April).

Because of the high sensitivity of Sakers to disturbance in the early stage of breeding, no systematic data about clutch size was collected. Most of the egg-laying terms were counted backwards or were based on direct observations of incubation start, in 68 cases with accuracy to a decade (see Table 3). In 75 cases, the clutch was laid in the period between 1 March and 10 April, only six replacement clutches were started later. It is not possible to exclude that some of the clutches started in April were not the replacement ones.

Two males and five females were breeding as immatures. In one case it was an immature male with an adult female, once it was an immature couple and four times an immature female with an adult male.

Up to now, Sakers have mainly bred in the nests of other raptors. Artificial breeding opportunities (platforms and nest boxes) were mainly installed in 1990s. Some of them were used by Sakers, but many of them are now in poor condition. We started with the installation of aluminium nest boxes on selected high voltage pylons in 2010, but we plan to install nest boxes only in some well chosen localities where the lack of other breeding opportunities is obvious.

159 Sakers (150 chicks on nests) were ringed in the period 1999–2010 (captive bred birds are not included). 24 recoveries and several tens of ring-colour readings were collected. Up to 2009, only coloured, not observing rings with a code were used. Identifying the colour of a coloured ring (without reading the entire code) is not a proper recovery, because several birds were ringed with the same colour. But thanks to coloured rings, we were able to recognise individuals in pairs and get information about pair bonds, exchange

of partners or pair productivity. Red observing rings with silver codes have been used since 2009.

One male born in Silesia was breeding in south Moravia (180 km southwards) at the age of five and six years. One male and one female born in south Moravia were later breeding less than 40 km from their birthplace. Four Sakers ringed as adults were later breeding 0–7.5 km apart. The fidelity of breeding pairs to the breeding site and faithfulness of the breeding couple was documented by colour rings.

Two Sakers ringed as juveniles in Slovakia and one in Hungary were found dead or wounded in the Czech Republic. All of them were juveniles during their post-breeding dispersal (September, October and November). Another six Sakers (two males and four females) fitted with satellite transmitters in Hungary (two males and two females out of 39 tracked Sakers) and Slovakia (2 females out of six) passed over the Czech Republic between 2007 and 2010 (*http://www.sakerlife.mme.hu; M. Prommer,* in litt.).

Two ringed Sakers fledged in the Czech Republic were found dead in Hungary, one in Austria and one in Italy (after 214 days at a distance of 660 km). In all four cases, dead juveniles were reported *(Cepák et al., 2008).*

Sakers may tolerate the proximity of other raptor (and other large bird) species breeding close to their nests even though males actively defend their nesting territories. Young Sakers very often attack other raptors, storks or herons after fledging. Some of the shortest distances documented between the nests of Sakers and other species during the study period are listed as follows:

– White-tailed Eagle (Soutok, 2008) – 500 m
– Imperial Eagle (Soutok, 2007 and 2008, the same breeding place) – 140 (!) and 745 m
– Red Kite (Soutok, e.g. 2007 and 2008, the same breeding place) – 125 and 290 m; (Soutok 2010) – two occupied nests of Red Kite (400 m from each other), both at a distance of 240 m from a Saker nest
– Black Kite *(Milvus migrans)* (Soutok 2008) – 285 m
– Honey Buzzard (Soutok, 2008) – 300 m; (Soutok, 2005 and 2008) – 475 and 655 m
– Common Buzzard (Soutok, 2005 and 2006) – 220 and 410 m; (Znojmo region, 2008) – 50 m, but breeding of Sakers was not successful
– Kestrel *(Falco tinnunculus)* (Soutok, 2006) – 195 m
– Black Stork *(Ciconia nigra)* (Soutok, 2010) – 490 m; (Soutok, 1998 and 1999–2001) – 250–300 m and 700–800 m
– White Stork (Soutok, 2009) – 30 m.

Sakers have been found breeding in a colony of Grey Herons several times: in Břeclav district in 2002 and 2004, and in Znojmo district in 2005 and 2006. Two occupied nests of Grey Heron were at a distance of 1.5 m from a successful Saker nest in 2005. In 2006, three heron nests were occupied within c. 2 m around a Saker nest.

Interactions with breeding Goshawks are difficult to evaluate. It seems these two species strongly avoid each other in agricultural areas with closest distances of occupied nests 3.3 or 4.6 km in 2007, 4.3 or 5.5 km in 2009 and 2.1 or 5.3 km in 2010. The situation may differ in floodplain forests.

Sakers commonly breed in White Stork nests in south Moravia. Strong fights between these two species may occur sometimes. Four from six breeding attempts of Sakers in

White Stork nests were unsuccessful due to Storks' attacks in the period 1976–1998. No failed breeding because of White Storks (ten cases of breeding in Stork nests) was found in the period of 1999–2010. To keep the nest undisturbed when the female is incubating is probably the most important factor for avoiding the breeding failure caused by Storks. The location of the nesting tree is crucial. The probability of destruction is much lower on solitary trees than in the forest edge, because the Saker male has much better view here and can defend the nest against Storks more easily.

The nearest distance of two successful Saker nests was only 1.3 km (Břeclav district, 2005) or 2.2 km (Znojmo district, 2010). The nearest distance of two occupied Saker nests was 1 km (Silesia, 1997) but one of the nests was occupied only by a solitary male.

Discussion

The breeding range of Saker has shown no significant changes since the 1990s (*Horák, 2000a*). Several squares have been occupied recently, but all of them are neighbouring previously occupied ones. The shift can be caused only by the movement of a breeding pair from one square to the neighbouring one. There is no obvious evidence for the spread of Sakers to new areas, an areal shift is not forecasted due to climatic changes, either *(Huntley et al., 2007).*

Although no expansion has been confirmed, a positive trend in the breeding success, which started in 1990s has continued. Breeding success has increased significantly compared to the period 1986–1998. The number of confirmed breeding attempts increased from 81 to 92 (by 13.5%), but the number of successful breeding attempts increased from 49 to 72 cases (by 47%). The number of fledged juveniles increased from 140 to 200 (by 42%). When compared to similar data of the period of 1976–1986 an even more significant increase can be seen.

The breeding success increased significantly during the period 1999–2010. Only 20 (22%) breeding attempts failed. The reasons for nest-failure are similar to those in the previous period (*Horák, 2000a)* (mainly human disturbance caused by forestry or field works, predation, falling down of the nest, human persecution and unknown reasons). The increase in breeding success was influenced by intensive monitoring and minimisation of risk factors after the nest was found. The stabilisation of nests and installation of artificial breeding platforms help to reduce the losses caused by break down of the nests. Nest robbing was only confirmed in one case (near Drnholec, 1999). Direct persecution (shooting on the nest) was confirmed in 2010 (Dyjákovice). Nest robbing and persecution may be controlled more effectively by increased monitoring efforts as well. Raising public awareness by ornithologists by discourageing local hunters or falconers from persecution or nest robbing has an increasing relevance. Some of the nest sites are well known, but many of them are still kept secret.

A significant proportion of the known breeding population shifted from natural breeding sites to nest boxes situated on pylons in several European countries (e.g. Slovakia and Hungary). No large-scale installation of nest boxes has taken place up to now in the Czech Republic. Therefore, most of the breeding pairs breed in natural nests. It is more difficult to

find them and threatening factors can be more significant, but the necessity to carefully evaluate the effect of the shift of the population from trees to pylons is preventing a large scale action. Up to now, the effect of the nest-boxes on pylons on breeding seems to be positive (but still has not yet been fully evaluated as far as we now). The risks of the nest falling down, losses caused by extreme weather, as well as nest predation are reduced in nest boxes. It is much easier to confirm nesting in a nest box, than in a natural nest. This is an obvious advantage for monitoring of the population, but can be dangerous from the nest robbing or persecution point of view. The fixation of the whole population on the pylons owned by one (or a few) companies could be problematic. Nest boxes need maintenance and if this is absent, problems can occur. We focus our conservation activities not only on nest boxes but also preferably on general raptor conservation including protection of their natural nest sites and the whole habitat.

The Saker population has been relatively stable in recent years in the Czech Republic. When considering its small size (15–20 pairs) and the fact that it is situated on the north-west edge of the distribution range, the dependence on population trends in surrounding countries is obvious.

The most important current and potential threatening factors for Saker Falcons in the Czech Republic are human disturbance (forest and field works, photographers, etc.), collisions with power-lines and useless and irresponsible reintroduction experiments. The contamination of food chains by toxic chemicals is another possible risk (two cases of broken eggs on a nest in 2007 and 2008, another case with probably intoxicated eggs in 2009). Another potential threatening factor is the plans for construction of wind-turbine farms in south Moravia. The general persecution of raptors in the surroundings of pheasantries and in field hunting grounds with other small game species as Brown Hare *(Lepus europaeus)* is a long-term problem. One case of shooting at an occupied nest of Saker Falcon was documented in 2010. All four chicks and both adults survived the attack without injury. The local chief of the hunting association was informed. Several dead Common Buzzards were found on the nests during the regular monitoring. It was possible to prove that the bird was shot only in one case. Intensive monitoring and field activities are the best practice for effective protection. Effective protective measures can only be implemented once the nest has already been located.

The addition of captive-bred juveniles into the "wild" nests of Saker Falcons was halted in 2005. The releasing of Saker Falcons by other methods has not been supported by ANCLP since 2005. It is considered useless and ineffective *(V. Hlaváč, in verb.)*. As far as we know, at least 250 Sakers were released into the wild in the Czech Republic and not a single case of breeding of a bird released from the captivity has been confirmed. This type of conservation activity is, however, still continued by some organisations (Forests of the Czech Republic, State Enterprise, some town councils, etc.) using gaps in Czech legislation.

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