



The Eurasian Beaver *Castor fiber* Linnaeus, 1758 (Rodentia: Castoridae) Is Returning to Bulgaria

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Abstract: We report the presence of the Eurasian beaver *Castor fiber* Linnaeus, 1758 (Rodentia: Castoridae) in the north-eastern part of the Danubian Plain in Bulgaria (UTM code: MJ12), at about 25 km straight-line distance from the Danube River, 20 km from the Yantra River and about 85 km along the river bed of the Rusenski Lom River from its estuary. The territory is within the Natura 2000 Special Area of Conservation BG0000608 “Lomovete” under the Habitats Directive. The first information about traces of the life activity of the species is from mid-September 2020 and the photo registration of an individual is from April 2021. During this period, there were similar registrations of beavers in other neighbouring territories, which increases the chances of the species returning to Bulgaria in a semi-natural way. The newly established locality represents the southernmost point in the distribution of the species on the Balkan Peninsula and one of the southernmost for Europe. This is the first record of the Eurasian beaver in Bulgaria considered extinct in this country for more than 150 years.

Key words: beavers, recovery, Bulgarian mammals, Danube river system

Introduction

The Eurasian beaver *Castor fiber* Linnaeus, 1758 (Rodentia: Castoridae) was a widespread species throughout Europe and the Northern half of Asia throughout the period after the last glaciation until two or two and a half centuries ago. However, its mass killing for fur, castoreum (beaver castor glands) and meat, along with the destruction of its habitats, contributed to its rapid decrease in numbers and to the fragmentation of its range (OGNEV 1947, LAVROV 1981). At the end of the 19th and the beginning of the 20th century, the species was in a critical condition in its almost entire range and was preserved in separate

refugia on the territory of Europe – in France, Germany, Poland, Belarus, Ukraine, southern Norway and European Russia (OGNEV 1947, BATBOLD et al. 2021). With few exceptions, its status was similar in the Asian part of its range in Russia, Mongolia and China (OGNEV 1947, SKALON 1951). None of those autochthonous localities is in contact with Bulgaria or Bulgarian river system, and the probability of recovery of beaver population in the country without introduction is highly unlikely.

As a result of reintroductions and systematic recovery measures, from the 1200 individuals left at the beginning of the 20th century both in Europe and Asia (OGNEV 1947, HALLEY & ROSSELL 2002),

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to date the species has increased its numbers to 1,222,000 animals in Europe (WROBEL 2020), and to about 1,500,000 in Eurasia (HALLEY et al. 2020). There are programs for the restoration of the species in most European countries but it is still completely absent in the South of Europe (southern parts of the Iberian, Apennine and Balkan Peninsulas, including Bulgaria) as well as in Turkey and the Caucasus (HALLEY et al. 2020, WROBEL 2020). Such measures are strongly advisable given habitats degradation and global climate changes associated with warming, drought and xerophytization.

The recovery of the beaver in Europe is a result of its successful reintroduction in 25 countries, which have imported animals from the eight preserved populations. In a relatively short period from 20–50 to 80 years, their numbers grew very quickly (LAVROV 1981, DANILOV et al. 2007, WROBEL 2020). The Eurasian beavers have been reintroduced several times in neighbouring to Bulgaria countries, i.e. Romania (KISS et al. 2012, PAȘCA et al. 2018) and Serbia (ĆIROVIĆ et al. 2001, 2009). Three localities in Romania where these reintroductions took place are known: in the rivers of Olt (about 350 km from its mouth at the Danube), Muresh (over 500 km from the Danube) and Yalomitsa (about 65 km from the Danube). They represent the potential source places from where the species can disperse and colonise other suitable habitats along the Danube River and rivers from its catchment area. The location and size of the Danube and its river system determine the essential (general) role in genetic exchange, free distribution and functioning of beaver populations in all countries of this region (HALLEY et al. 2020).

The Eurasian beaver is a protected species in many countries where it has been restored after reintroduction (TRBOJEVIĆ & TRBOJEVIĆ 2016). In other regions of the world, it is still a hunting target (OGNEV 1947, HALLEY et al. 2020, BATBOLD et al. 2021). The species is included in the Berne Convention (Annex 3) and the Habitats Directive 92/43 (Annexes 2, 4 and 5). Its category in IUCN is LC (Least Concern).

In Bulgaria, the beaver is considered extinct long ago (BOEV 1958, 1975, 2013, BOEV & SPASSOV 2019) but there are recent, almost overlapping, reports about its resettlement in Northern Bulgaria. Some results from the present study were reported in April 2021 (KODZHABASHEV et al. 2021) and then followed by a short communication concerning an adjacent locality (NATCHEV et al. 2021). The problem of its modern status in the country remains unresolved and legally controversial, since the beaver

does not appear in both nature conservation documents and Red Data Book of Bulgaria as well as in the hunting legislation. However, it is a part of the Regulation 2/2009 about Conditions for Fur and Game Breeding Species (https://www.bfsa.bg/uploads/File/Dokumenti_naredbi/Naredba_2.pdf), which actually excludes the possibility of protecting the species in a case of its possible new appearance and its possible reintroduction.

As reliable information on the most recent occurrence of beavers in Bulgaria, skeletal remains from archaeological excavations in the area of Nikopolis ad Istrum from 1750–1850 are considered (BOEV & SPASSOV 2019). This ancient Roman settlement has been located on the banks of the Rositsa River, a left tributary of the Yantra River, 20 km north of the town of Veliko Tarnovo. In more recent times, one dead beaver (hit by a car) was noticed in June 2011 on the road in the Varbitsa Pass, near the river of Luda Kamchiya, but it has never been reported (T. TEOFILOVA, unpublished). That animal was not photographed; its body was in very bad condition but it certainly was larger than a coypu and had the typical beaver tail.

Proving the presence of the beaver in riparian habitats is easy and sure by the availability of nibbled trunks or gnawed through and felled trees. These traces are permanent, and may be used to identify an old presence of the species or to assess the individually occupied territory along the riparian habitat (OGNEV 1947, OSCHMARIN & PIKUNOV 1990, FORMOZOV 2006).

After finding gnawed and felled trees, most likely by the animals reported in this article, a targeted study was planned and carried out in the Eastern Danubian Plain in order to prove the existence of a functioning beaver population in Bulgaria. It included collecting of biological information about their presence, accidental observations of animals, their tracks and other signs of their activities, photo recording, and an attempt for estimation of the possible number of animals.

Materials and Methods

We found the first traces of beaver's presence in mid-September 2020, so we started this targeted study and our observations are continuing in the time and after the submission of the present article. In November 2020 and January 2021, by workers in State Forest Enterprise Byala and fishermen, we received other signals and photos of gnawed trees and a swimming animal (most likely a beaver). Our first purposed photo documenting was undertaken in



Fig. 1. Habitat of the newly established beaver settlement in NE Bulgaria, 19–26 March 2021.

the spring of 2021, from 12 March to 13 April, immediately after the spring waters allowed it.

The region where the beaver's presence was registered is located in the Eastern Danubian Plain, in the river system of the Rusenski Lom River and its tributaries (UTM code: MJ12), about 25 km away along a direct line from the Danube River, 20 km from the Yantra River, along the Rusenski Lom River bed, about 85 km from its estuary. We prefer not to share of the exact location due to precautionary measures in order to prevent abuse by poachers and villains. The territory falls within Natura 2000 Special Area of Conservation BG0000608 "Lomovete" under the Habitats Directive.

The locality is on the branches of two relatively small rivers about 3–5 m wide and 1–1.5 m deep (Fig. 1). The shores are heavily overgrown with blackberries (*Rubus caesius* L.) and other hygrophytic and mesophytic vegetation. The main tree species are willows (*Salix* spp.) and poplars (*Populus* spp.), and the accompanying species are elm (*Ulmus* spp.), ash (*Fraxinus* spp.) and others. On the slopes of one of the rivers, there are single trees of black locust (*Robinia pseudoacacia* L.). The hygrophytic vegetation is concentrated in a relatively narrow strip, from 15–20 to 30–40 m in width. The animals adhere strictly to this strip and do not leave it, and their movements are either in the water or on parallel paths in close proximity to the river.

The collection of biological information about the life activities of beavers was carried out by several methods. These were:

(1) Regular patrolling of the river beds, where traces of the animals are been detected – nibbled, gnawed and felled trees, fresh footprints and trails

on the wet soil and silt, active paths, remnants of woody food resources, feeding and resting grounds, presence of dens. In addition to the rivers, we also observed the terrains around the relatively narrow terraces of the rivers, and along the steep banks.

(2) During each visit, we noted the state of the nibbled, gnawed and felled trees found in the previous visits, and registered the new ones.

(3) Determination and taking into account the species composition, size, way of pruning, shredding and felling of the trees, their location, and the direction of falling of the preferred trees.

(4) Measuring the size of the tracks for possible identification of the number and size of the animals.

(5) Photo documenting and proving the presence of beavers with Bresser Game Camera 5MP with motion sensor for day and night shots. Two cameras were installed, one looking at a freshly gnawed tree and the other directed to the entrance of the den. The cameras were checked once a week. Specific behavioural reactions were observed: demonstrations of an occupied territory, diurnal and nocturnal activity and attitude towards other animals inhabiting the area.

(6) Interviewing local residents who have information about the animals as well as forest stations officials who regularly monitor the condition of riparian forests and plantations.

Results

The initial registration of the beaver was accidental, in September 2020, by forest station officials who encountered "illegal logging" of coastal trees, which turned out to be gnawed in a very specific "beaverly" way. Detailed patrolling of the river banks soon result-



Fig. 2. The “illegal logging” of coastal trees: nibbled, gnawed and felled by the beavers trees on the banks of the rivers from the Rusenski Lom catchment area, 19–26 March 2021.

ed in finding of recently nibbled or older wounds on many trees, all located near the riverbank (Fig. 2). The gnawed through trees were mainly willows and poplars. We also found nibbled bark of elm and other impossible to identify saplings. Most of the fallen trees were on the very shore of the rivers, with the gnawing being from the land, which is why the fall was more often directed to the water. In most cases, the life activities of beavers were localised only in close proximity around the shore, and even with a distance of 50 meters from the water body, all traces disappeared.

As for the size of the preferred trees, three size classes were established:

- trees with a diameter of 50–70 cm and a height of up to 18–20 m;
- trees with a diameter of 30–40 cm and a height of up to 10–12 m;
- relatively thin trees with a diameter of 15–30 cm and a height of about 5–6 m.

The total number of the trees felled was 80–100, of which the taller predominated. A larger number of tall trees, about 30–40, were felled during the

winter period when snow cover was present. After the trunks were cut down, the branches were also gnawed through and carried away, probably in the water, because there were no signs of their storage on land.

The examination of tracks and trails was carried out on a soft substrate, where they are more distinct and could be measured. Unfortunately, on that substrate, they were usually smeared by the massive and fleshy tail, which impeded the measurements. For the habitability of the beaver paths, we judged by the fresh mud tracks, which width was between 30 and 50 cm. Usually, the paths started from the river bank, where the animals set up a ground for rest and observation (Fig. 3).

The registered signs of beavers' life activities were mainly gnawed and felled trees as well as tracks and paths on the moist coastal substrate and walking. Based on these traces, we express the probability of the presence of more than one individual, most likely five animals (two larger and three smaller). We also found attempts of beavers to dam the river by felling large trees transversely on the riverbed as well as the presence of a beaver's den. The latter observation allows us to claim a settled lifestyle. So far, we have no evidence of breeding and we cannot specify the exact number of animals; on this topic, we may only conjecture.

The den found by us was underground excavation into the banks of the river, which was hidden among dense blackberries. Its entrance was above the river level, although at full water it remained be-

low the water, which suggests the likely setting of the inner chamber at a bigger height.

We found no animal faeces when patrolling the territory, which was probably due to frequent increases in water levels and flooding of narrow river terraces or their excretion in difficult to pass places.

The result of the setting on the cameras was the night documentation of the animals (Fig. 4). We could not successfully capture an animal entering or leaving the den, which was probably due to the specifics of the species, i.e. probably from the den the animal directly dives into the water, which is why the close-mounted camera captures only an empty frame. The opposite bank of the river in the section of the den was very steep, and the installation of the camera did not allow the needed changes in distance and vision angle.

In addition to beavers, the cameras detected beech marten *Martes foina* (Erxleben, 1777) (Fig. 4), ring-necked pheasant *Phasianus colchicus torquatus* Gmelin, 1789, common blackbird *Turdus merula* Linnaeus, 1758 and magpies *Pica pica* (L., 1758). On the soft coastal substrate, we regularly found traces of ducks, a large rodent the size of muskrat *Ondatra zibethicus* (L., 1766) and other birds of the size of a blackbird and crow/rook. Near the area of registration of beavers, there was an active cattle farm, which showed no sign of negative influence on beavers.

During one of the day visits, we surprised one animal and it jumped and splashed into the river demonstrably flapping with its tail as a sign of occu-



Fig. 3. Beavers' footprints and paths on the river banks, 19–22 March 2021.

pied territory and frightening the “intruders”. This showed that in some circumstances beavers are also active during the day. This fact was supported by a surveyed fisherman who repeatedly observed two animals in the same section of the rivers explored. According to his information, the animals have been in the area for more than a year, and probably even more, according to some old and rotten nibbled stumps we found. Data on similar observations were shared by forestry officials from a neighbouring area, where two animals were repeatedly observed resting on the banks of the Danube River and a nearby island.

Discussion

The Eurasian beaver is a protected species in most European countries where it has been a subject of planned reintroduction (DANILOV et al. 2007, TRBOJEVIĆ & TRBOJEVIĆ 2016, HALLEY et al. 2020). The success of its restoration is exclusively resulting from its effective protection (BATBOLD et al. 2021). The finding of Eurasian beavers in the catchment of the Rusenski Lom River, more than 150 years since the extinction of this species from Bulgaria (BOEV 1958, BOEV & SPASOV 2019), is likely a result of the successful reintroduction of the species in the neighbouring Romania.

When tracking the development of populations and spreading of beavers along the Danube in Romania (PAȘCA et al. 2018), a progressive displacement of the species along rivers Olt and Vedyá, along the canal between the Vedyá River and Giurgiu and along the Danube has been registered; it is accompanied with populations rapidly increasing in numbers. Data on the distribution of the species along the Olt River, where 91 beavers have been released in 1998–2003, indicate the presence of animals at the mouth of the river, and in 2014–2017 this population already numbered 1565 individuals (IONESCU et al. 2010, PAȘCA et al. 2018). Other localities of the beaver in the Danube catchment area, close to the occupied habitat found by us, are known from the area between the towns of Giurgiu and Alexandria and the Vedyá River. There, introduced and self-spread individuals have rapidly increased their numbers and density and are in process of expansive colonisation on this sector of the Danube River, reaching the Prut River in Moldova in less than 20 years (BATBOLD et al. 2021, BOUROȘ et al. 2021). In 2011, Kiss et al. (2012) have discovered that the beaver had passed more than 250 km reaching the Danube Delta. Of c. 180 beavers imported and settled in Romania in 1998–2003

(IONESCU et al. 2010), beavers have increased to c. 2200 (2145–2250) and spread in many new places, mainly around the Danube and rivers from its catchment area (PAȘCA et al. 2018). A similar, albeit on a smaller scale, is the trend in Serbia, also in the catchment area of the Danube (SMERALDO et al. 2017) but the probability of animals from this reintroduced population entering Bulgaria is lower given the huge distances.

Strong colonisation, as an effect of the reintroduction of the Eurasian beaver in many places of the Danubian basin is reported in the summary article (HALLEY et al. 2020) on the modern distribution of beavers.

According to Bulgarian sources (BOEV 1958, BOEV & SPASOV 2019), some of the last established subrecent localities are several areas from the Danube catchment area that have traditionally been inhabited by the Eurasian beaver in the past. One of these places is the eastern part of the Danubian Plain, along the river system of Rusenski Lom. Inquiries conducted during the survey proved the presence of individuals by observations of gnawed trees and pairs of beavers in other adjacent areas within a radius of 30–40 km. It is highly likely that other individuals or pairs are present in the lower and middle currents of the rivers of the Danube catchment area and on the Danube islands in this sector of the river, and they are in the process of colonisation and permanent establishment.

Parallel to the Danube River in neighbouring Romania, there is a canal connecting the Vedyá River with the town of Giurgiu. It is likely that beavers use these available water routes for migration and subsequent spreading. This channel is situated in a territory with a registered beaver population increasing in numbers and density in the recent years; animals that have reached the Danube River use it as a corridor for spreading in all directions (HALLEY et al. 2020, BATBOLD et al. 2021). The newly established locality of beavers in Bulgaria is the southernmost point in the distribution of the species on the Balkan Peninsula and one of the southernmost for Europe (in view of the reintroduction spread of the species in Spain, which is the only point further south). We suppose that the case with the occupied habitat found by us might be similar with the findings of BATBOLD et al. (2021). They report for successfully reintroduced and rapidly breeding beaver populations, which have colonised new territories through the Romanian river network, in the area between Giurgiu and Alexandria along the Vedja River, as well as along the Danube and its islands. Furthermore, it is also possible that the beavers from



Fig. 4. Nocturnal activity of the beaver (and a beech marten) documented by one of the cameras, 9–11 April 2021.

the Yalomitsa River are spreading through the convenient ecological corridors on the left bank of the Danube (branched and dense network of water bodies, i.e. rivers, lakes, marshes, dams and canals) and reaching their current locations, including this at the Rusenski Lom River in Bulgaria.

The distribution of the beavers along the Danube River system is a natural process and all areas along the Romanian Danube bank, where beavers have been registered, are potential places for its registration on the opposite Bulgarian shore. Of particular interest are the sections near mouths of rivers with islands that beavers can use as an intermediate station and temporary refuge for beavers when swimming across the large, fast and full-water river. Similar preferences have been registered in other places where beavers spread in the systems of large rivers (OGNEV 1947, SKALON 1951, LAVROV 1981, DANILOV et al. 2007).

Due to the complete extermination of beavers in Bulgaria in the distant past and the lack of cranio-logical and genetic samples for modern research, the subspecies affiliation of the extinct Bulgarian populations cannot be identified. Very likely, the newly identified individuals are carrying the genes of rein-

troduced animals in Romania, which were imported from Bavaria (PAȘCA et al. 2018).

The first signal for the beginning of colonisation by beavers is the presence of gnawed hygrophytic trees on the shores and their subsequent pruning. This process has the highest intensity in the autumn-winter period when beavers have no alternative food and mainly feed on bark and young twigs (OGNEV 1947, DANILOV et al. 2007). Regardless of the season, the remains of the felled trees and the scars on the nibbled bark are easily noticeable and are characteristic marks of the presence of beavers (OSCHMARIN & PIKUNOV 1990, FORMOZOV 2006). Similar to our observations, it was found that beavers store pruned branches of felled trees in the water in other parts of its range (OGNEV 1947, LAVROV 1981, DANILOV et al. 2007).

The felling of large trees in rivers and their blocking by a barrage from the trunks is a repeatedly described element of the biology of the beavers when establishing a couple or family group (OGNEV 1947, DANILOV et al. 2007). With this construction, the pooling of the river is caused, resulting in lifting its level and increasing the area of its flood terrace and the water surface, which is characteristic

of colonies of individuals who have long occupied suitable habitats, away from constant stress and civilization. In the southern parts of the range, the biology of the beavers differs and animals do not make surface shelters and lairs but dig underground dens (BOEV 1958, OGNEV 1947). Although we found beaver attempts to dam the river by felling large trees, in these areas, large barrages are not characteristic, and the fallen, river-enclosing trees simply reduce the strength of the current and increase the water surface (OGNEV 1947, LAVROV 1981). The branches of the felled tree that have fallen into the water are used by the animal to attach and stack gnawed and dragged twigs for the winter, which the beaver stores in the icy water and consumes during cold winter days (OGNEV 1947). The habitat with the den we established is exactly of this type. The felling of a larger number of tall trees during the winter, observed in our case, seems normal since, with the onset of the warming, the intensity of gnawing drastically decreases (OGNEV 1947, LAVROV 1981, DANILOV et al. 2007).

As a big amphibiotic mammal with a clumsy and slow-moving body on the terrestrial substrate, the Eurasian beaver is mainly active at night. During the day, the animals are in their den (which has a system of underwater moves or is close to shore) or lay under the sun on any of their riverside resting grounds (OGNEV 1947, DANILOV et al. 2007). The slightest stress makes animals to seek salvation in the water, jumping noisily and flapping demonstratively with their tail (OGNEV 1947), which can be used as a sure sign of the presence of a beaver without the need for its visual recognition. During the day, beavers are hidden in their refuge or ready to jump and dive in the water. Therefore, direct registration during the day is very difficult and requires a lengthy study (OGNEV 1947, SKALON 1951, LAVROV 1981). Our observations also confirm this data.

A single animal was repeatedly filmed. However, due to the night photos, it is difficult to identify whether it is the same specimen. It is highly likely that the animals are two or more but when feeding they are in different places and by this reason the camera catches only one of them. The demonstration of occupied territory and its protection is characteristic of couples, which was also confirmed by a first-hand account. The proportions of one of the filmed specimens are of a young animal (VALENTIN POCHKANSKI, pers. comm.), which allows the hypothesis of the presence of a couple with young, last year's cubs. Another shot, where the animal was photographed frontally, shows one of the characteristic morphological signs (OGNEV 1947) of the Eur-

sian beaver, i.e. the triangular shape of the nostrils (Fig. 4).

Near the area of registration of the beavers, there was an active cattle farm, which showed no sign of negative influence on beavers. The tolerability of beaver with other animals, as well as the documentation of their feeding in the same place, indicated their possible coexistence and tolerant behaviour.

The lack of legislation regulating the status of animals extinct due to extermination in the past is a serious problem in establishing their recovery. The need for rapid and effective protection of the newly established beavers and their habitats requires Bulgaria, as a member of the European Union, to fulfil the requirements of the Habitats Directive and the European Natura 2000 Network and to declare this species and its habitats officially protected within the meaning of the Biodiversity Act.

Conclusions

Finding of typically gnawed trees near the riverbank is a certain evidence of the presence of beavers and, combined with examination of tracks and photos from phototraps, it allows to prove the presence of the Eurasian beaver in Bulgaria. Attempts to dam the river by felling large trees transversely on the riverbed and setting up an underground den are a sure sign of settlement. The demonstration of the noisily jumping into the water animal and the subsequent flapping with its tail also proves the permanent establishment of beavers in the newly found locality in the southern part of the Eastern Danubian Plain. The discovery of the den increases the expectations of successful reproduction at this new locality.

The nibbled trunks and trees were mostly willows and poplars near the bank. The lack of gnawed and felled trees, footprints and paths out of the narrow flooded bank terrace shows that beavers move only along the river and do not leave riparian habitats where they feel safe. Since the beavers avoid moving away from the aquatic environment and the shores, river systems and riparian habitats remain their only way of spreading. Despite the relatively long distance (over 85 km), it is highly likely that the colonisation studied here took place along the river body of Rusenski Lom, starting from the Danube.

Information about observed beavers or traces of their life activities collected by non-specialists (fishermen, forest officials, shepherds, etc.) must be used rationally and, after analytical refinement, checked in the field. The establishment of the Eurasian beaver in the Bulgarian river system of the Danube,

after such a long period of extinction, is the result of natural self-displacement or preserved autochthonous refugium, which should be proved with modern genetic and biochemical methods. The presence of permanent beavers' settlement (regardless of the origin of the individuals) needs reasonable nature conservation measures to restore species, which had been almost completely doomed. We must consider that the resurrection of the beaver in Bulgaria is the beginning of its real and natural recovery, which is quite possible when it is included under legal protection and an appropriate conservation strategy.

As a locally extinct species, the Eurasian beaver is currently excluded from the nature conservation documents in Bulgaria. This requires its re-examination in the light of a species that has passed from extinct to extant status and due to its low numbers and high vulnerability should be proposed for protection, including protection of its habitats.

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