

Range expansion of three invasive alien mammals in Bulgaria

Yordan S. Koshev*, Nedko P. Nedyalkov & Ivaylo A. Raykov

ABSTRACT. We report the changes in the distribution of three alien mammal species in Bulgaria, the coypu *Myocastor coypus*, the muskrat *Ondatra zibethicus*, and the raccoon dog *Nyctereutes procyonoides* after their entry into Bulgaria in the fifties and sixties of the last century. The data has been summarised from field surveys, reviews from scientific literature, analyses from official databases of national institutions and organizations, databases compiled from volunteers and hobbyists, etc. After its introduction in 1953, *M. coypus* rapidly spread in Bulgaria and there are more than 417 records of the species. Today it is the most widespread invasive mammal in the country. *O. zibethicus* was introduced in 1956, and is known from only 22 records. However, this species was able to cross the physico-geographic barrier of the Balkan Mountains in 2007, which is a strong evidence for its invasive capabilities in the territory. The first observations of *N. procyonoides* were reported in 1968. There are currently 75 records of the species coming from almost the entire territory of Bulgaria. The majority of the records (77.4%) are between sea level and 199 m a.s.l. and 56% of them are in national protected areas. The most frequently observed negative impacts are described and recommendations are made for further study and reducing the populations of the invasive mammals.

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Расширение ареала трёх видов инвазивных чужеродных млекопитающих в Болгарии

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РЕЗЮМЕ. Сообщается об изменениях в распределении трех чужеродных видов млекопитающих в Болгарии: нутрии *Myocastor coypus*, ондатры *Ondatra zibethicus* и енотовидной собаки *Nyctereutes procyonoides* после их проникновения в Болгарию в пятидесятых и шестидесятых годах прошлого века. Данные обобщены на основе полевых обследований, обзоров научной литературы, анализа официальных баз данных национальных учреждений и организаций, баз данных, составленных добровольцами и любителями, и т.д. После своего появления в 1953 году *M. coypus* быстро распространилась в Болгарии, и существует более 417 сообщений об этом виде. Сегодня это самое распространенное инвазивное млекопитающее в стране. *O. zibethicus* была завезена в 1956 году и известна всего по 22 наблюдениям. Однако этот вид смог пересечь физико-географический барьер Балканских гор в 2007 году, что является убедительным доказательством его инвазивных возможностей в регионе. О первых наблюдениях *N. procyonoides* было сообщено в 1968 году. В настоящее время насчитывается 75 сообщений об этом виде, поступающих почти со всей территории Болгарии. Большинство зарегистрированных точек (77,4%) расположены в интервале высот между уровнем моря и 199 м, и 56% из них находятся в национальных охраняемых районах. Описаны наиболее часто наблюдаемые негативные воздействия и даны рекомендации по дальнейшему изучению и сокращению популяций инвазивных млекопитающих.

КЛЮЧЕВЫЕ СЛОВА: *Myocastor coypus*, *Ondatra zibethicus*, *Nyctereutes procyonoides*, инвазивные виды, ареал, Балканский полуостров, Болгария.

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Introduction

Humans have spread species outside of their natural distribution, making them alien in new areas. From all of the human-facilitated invasions between 5% and 20% of alien species have negative impacts on the invaded ecosystems. Such species are termed invasive. They may have a strong negative influence on biological diversity and can be one of the primary reasons for the extinction of native species (Clavero & Garcia-Berthou, 2005; Scalera *et al.*, 2012).

Invasive alien species also impact the ecosystem services which humans depend on. They are in competition with native species and have the ability to negatively affect their populations, impact their habitats, carry foreign diseases, etc. Invasive mammals have been frequently introduced in Europe because of their valuable fur (15% of introductions), and for hunting purposes (21%), or were intentionally released or escaped as pets (10%) or from zoos (6%) (Vilà *et al.*, 2010; Genovesi *et al.*, 2009, 2015).

Three of the invasive alien mammals in Europe included in the list of 100 worst species in Europe are the *Ondatra zibethicus* (Linnaeus, 1766) (4th place), *Myocastor coypus* (Molina, 1782) (17th place) and *Nyctereutes procyonoides* (Gray, 1834) (66th place) (Nentwig *et al.*, 2018). They were introduced to Bulgaria after 1948 due to their valuable fur and in time developed wild breeding populations (Dragoev, 1978).

M. coypus was first introduced in Bulgaria in the autumn of 1948 in the Sherba game farm (east of Varna), where the animals were bred in cages (Dragoev, 1978). In 1953, two groups of coypus were released in Lake Mandernsko and the Arkutino Reserve (south of Burgas) (Peshev *et al.*, 2004).

O. zibethicus invaded Bulgaria via two pathways in two opposite regions of the country between 1956 and 1960. The species was introduced in 1956 when 19 muskrats were released in Lake Srebarna on the Danube (Markov & Petrov, 1966; Peshev *et al.*, 2004). Simultaneously, there are records of muskrat populations on the territory of the Republic of Serbia on the River Timok (at its inflow to the Danube where it borders the two countries) and River Nišava (originates in Bulgaria and flows to Serbia) during the period 1956–1960 (Savic, 1960). The species must have spread along these rivers to Bulgaria relatively quickly, as it was registered near the Serbian border around Vidin and Belogradchik in the 1960's (Markov, 1968).

N. procyonoides has invaded Bulgaria independently of human activity. After 1928 approximately 9100 individuals were released in more than 70 regions in the former Soviet Union. Eventually, the species expanded its range with a speed of 40 km per annum (up to 120 km per annum) (Kauhala & Kowalczyk, 2011). The first individual in Bulgaria was shot in Lake Shabla (North-East Bulgaria) in 1968 (Peshev & Yordanov, 1968).

The three invasive species targeted by this study were identified as posing a high risk and are currently in the list of invasive alien species of Union Concern. European Union member states are required to take appropriate

action if populations of these invasive mammal species are found on their territories (EU 2014).

Considering the importance of invasive alien mammals to the economy and biodiversity, the purpose of this research is to analyse the spread of *M. coypus*, *O. zibethicus* and *N. procyonoides* along with their altitude distribution and presence in protected areas. Finally, we make recommendations with regards to reducing their numbers and negative effects in Bulgaria.

Material and methods

Origin of distribution data

A total of 514 records were collated using the following sources of information: field surveys of the authors in period 2015–2019 (22 records, 8.75% of the total); Archives of the Executive Forest Agency of the Ministry of Agriculture and Foods of Bulgaria (AEFA 2019), Archive of the Bulgarian Hunters and Fishermen Union (ABHFU 2019) (39 records, 7.8% of total); the electronic database SmartBirds (Popgeorgiev *et al.*, 2015) in which volunteers collect data on mammal species in Bulgaria, often with photos and accurate descriptions (134 records, 26% of total); review of news in the media; information in specialized internet hunter and fishermen's forums; questionnaires in social media filled out by experts, hunters and fishermen disseminated in Facebook specialized groups (see Supplementary material) between 01.09.2019 to 30.04.2020 (191 records, 37.15% of total); and finally analyzing the available scientific literature from 1960 to today (Markov & Petrov, 1966; Markov, 1968; Peshev & Yordanov, 1968; Dragoev, 1978; Gerasimov, 1988; Genov, 1984, 2012, 2017; Milchev, 2007; Georgiev, 2010; Gruychev, 2012, 2017; Natchev, 2016; Tsekova & Georgiev, 2016; Boev, 2017; Mihaylov *et al.*, 2017; Popova & Zlatanova, 2017; Koshev *et al.*, 2020) (106 records, 20.6% of total).

After being critically analysed, the data were included in the database of East and South European Network for Invasive Alien Species (ESENIAS project) (Trichkova *et al.*, 2017).

Critical assessment of the data

Target species are not equally familiar to Bulgarian biologists, hunters or nature lovers. Oftentimes *M. coypus* and *O. zibethicus*' external characteristics can be mistaken for those of other native species, e.g. the European water vole (*Arvicola amphibius* Linnaeus, 1758) and river otter (*Lutra lutra* Linnaeus, 1758). *N. procyonoides* could be mistaken for the European badger (*Meles meles* Linnaeus, 1758). On the other hand, *M. coypus* is well known in Bulgaria, justifying the lack of reliable evidence for some observations because the observers usually do not feel the need to photograph animals or their tracks, which they consider common.

After critically analysing the reliability of the data gathered from the aforementioned sources, the materials included in the present study were divided in three groups following Ćirović & Milenkovic (1999): **a) Doc-**

umented — 432 (84% of total) records of the authors of this publication; data published in official sources e.g. scientific publications and reports, records with photographs, records from scientists and hobbyists (hunters, photographers, etc.) with high expert potential such as the SmartBirds database; **b) Observed** — 82 (16% of total) observations of individuals with accurate descriptions, logged on official databases (ABHFU 2019; AEFA 2019), media news, hunting forums; **c) Uncertain data** — information in the form of documents or observations of uncertain credibility due to their geographic isolation, atypicality of the habitats, atypical altitude, etc. Uncertain data were not included in neither the analysis nor maps.

For the creation of the maps and the extraction of basic ecological characteristics, the program ArcGIS was used (ESRI, 2010).

Geography of Bulgaria

Bulgaria is situated in the centre of the Balkan Peninsula in Europe. Its territory is semi-mountainous with the highest mountains being in the southern part of the country. The territory of Bulgaria can be arbitrarily divided into North and South, separated by the Stara Planina (Balkan) Mountain Range (Koprarev *et al.*, 2002) which often acts as a barrier to the spread of mammal populations (Peshev *et al.*, 2004). The Northern and Southern parts of the country offer different conditions, e.g. annual mean temperatures, rainfall, snow cover, minimum winter temperatures, etc., where generally in Northern Bulgaria harsher continental climates are present, while in the South conditions are milder with more Mediterranean influence to the local climate (Koprarev *et al.*, 2002). The descriptions of the ranges further divide the country into western and eastern parts, segmenting the country into four parts for better accuracy.

The main invasion pathways of water-related mammals are through rivers and other water bodies. The Danube and its tributaries (the Iskar River and other rivers in Northern Bulgaria) are part of the Black Sea Basin. The Struma and Mesta Rivers are connected to the Aegean Sea basin. Two other large rivers that discharge into the Aegean Sea are the Maritsa and Tundzha Rivers, which flow through the Thrace Valley of South Bulgaria (Koprarev *et al.*, 2002).

The data on the distribution of the species over the years was not uniform. The average speed of expansion was calculated using the location and year of the first species record as their point of origin. The endpoint is the most distant and most recent datum for the species. The distances between the point of origin and endpoint were calculated for each species and averaged for a 10-year period.

Results

The coypu (*Myocastor coypus*)

Currently there are 417 records of the coypu in Bulgaria, of which 377 are documented and 40 observed. Of the reported records, 360 (86%) are new. In South Bulgaria the species composes a compact reproductive

population in the Thrace valley, and the Kazanlak and Tvardishka Basins. It was found in compact populations along River Maritsa (from Belovo town to the border with the Republic of Turkey), River Sazliyka, River Tundzha and the Lakes of Burgas (Fig. 1). In Northern Bulgaria the species was found in the Lakes of Varna, River Batova, Lake Durankulak and south of Dobrich town. There are data for existing populations in the Danube and the region of Lake Srebarna. The easternmost point of distribution in Northern Bulgaria is Pavlikeni town.

The coypu is distributed from sea level to the highest point of the Samokov Valley (862 m a.s.l.). It is found in the valley of River Iskar in the gorge of Stara Planina Mountain, as well as in the valley of River Struma and in South Bulgaria near Boboshevo town.

The muskrat (*Ondatra zibethicus*)

There are several records of the muskrat in North Bulgaria (Danubian Plain) in the region around Pleven town (Fig. 2). The first occurrence of the species in South Bulgaria was near Yambol town (River Tundzha) in the diet of a long-legged buzzard (*Buteo rufinus* Cretzschmar, 1829) (Milchev, 2007). Milchev (2007) suggested that an individual had escaped from a private collection. The data from ABHFU (2019) and AEFA (2019) provide evidence for the presence of a stable population of the species in the wild in the region of Burgas for several consecutive years after that record. It is very likely that the muskrat is confused with the coypu in some instances, but the accumulation of data shows that it has possibly expanded its range south. In Western Bulgaria there is uncertain data in the region of Rudartsi Village and Dolna Dikanya Dam (Pernik district) which have not been mapped in Figure 2.

The raccoon dog (*Nyctereutes procyonoides*)

A total of 36 documented and 39 observed records of the occurrence of the raccoon dog in Bulgaria have been collected, of which 66 (88%) are new and unpublished. These records have been divided into the two groups: Reliable evidence is available for Balgarovo town (Burgas district), Lake Shiroka Polyana in West Rhodope Mountains (Genov, 2012), Targovishte town, the Danube and others (Fig. 3). There are data for the regions of Eastern Rhodopes and Strandzha Mountain (close to the Greek and Turkish border, respectively).

Discussion

Myocastor coypus is an invasive alien mammal with the densest and most widespread populations in Bulgaria (North, South and Central Western) in comparison to the other two target species. Initially, the species was only bred in farms. However, private farmers in the 1980's begin breeding coypus with the aid of the Central Cooperative Union — Bulgaria. After 1989 and the socio-economic changes in Bulgaria caused the decline of the cooperative activities and the raising of these animals became unprofitable. The furs were difficult to sell and farmers, either consciously or not, began releasing their animals in the wild (Hristo Nikolov, pers. com.). That is how there

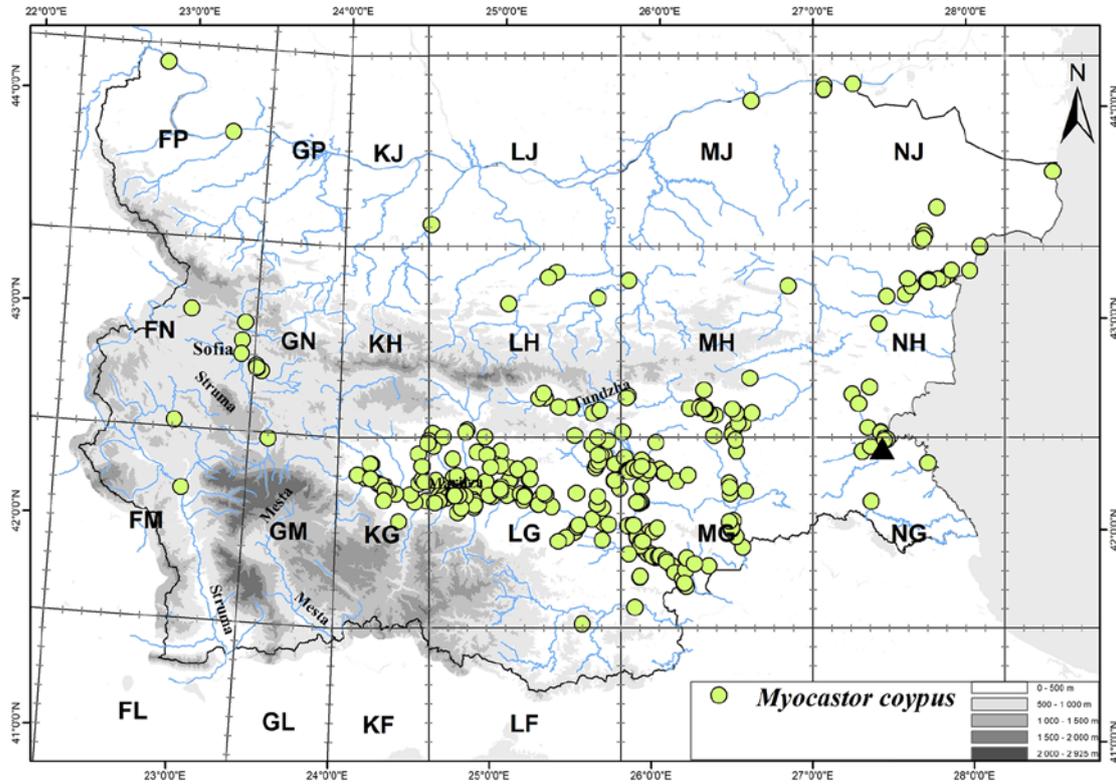


Fig. 1. Distribution of the coypu *Myocastor coypus* in Bulgaria (1953–2020). The triangle indicates the site of the species’ first appearance in the wild.

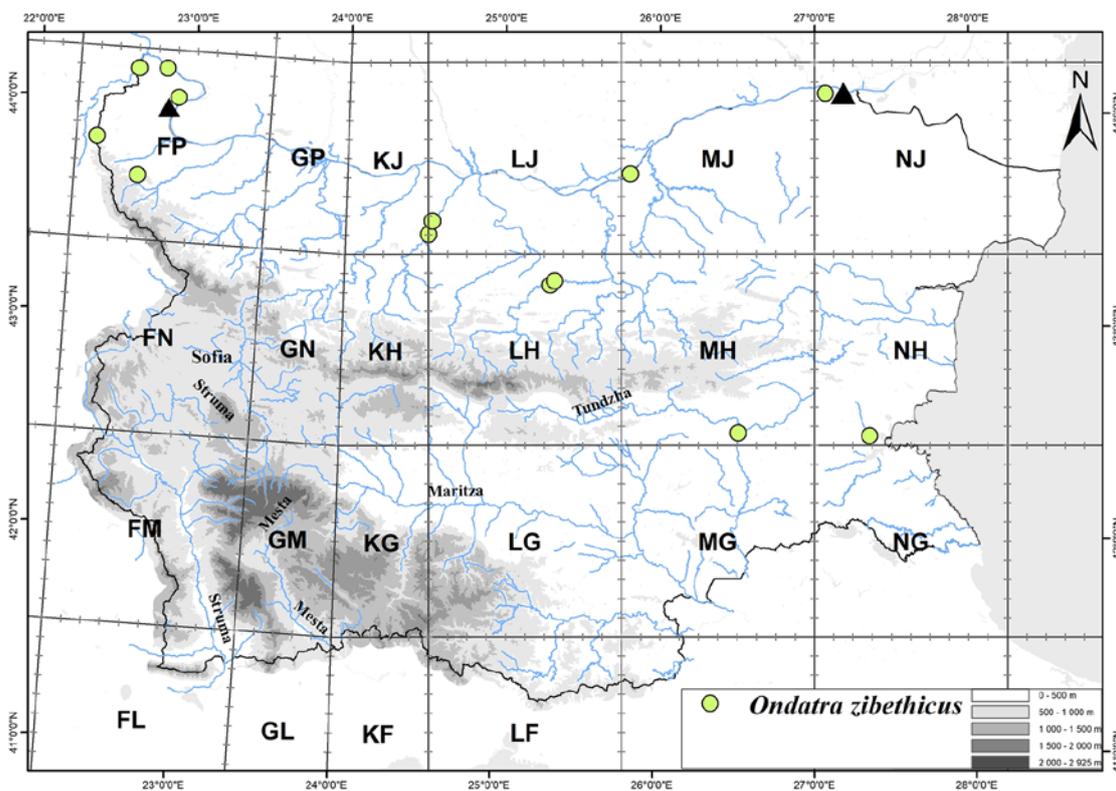


Fig. 2. Distribution of the muskrat *Ondatra zibethicus* in Bulgaria (1956–2020). The triangle indicate the sites of the species’ first appearance in the wild.

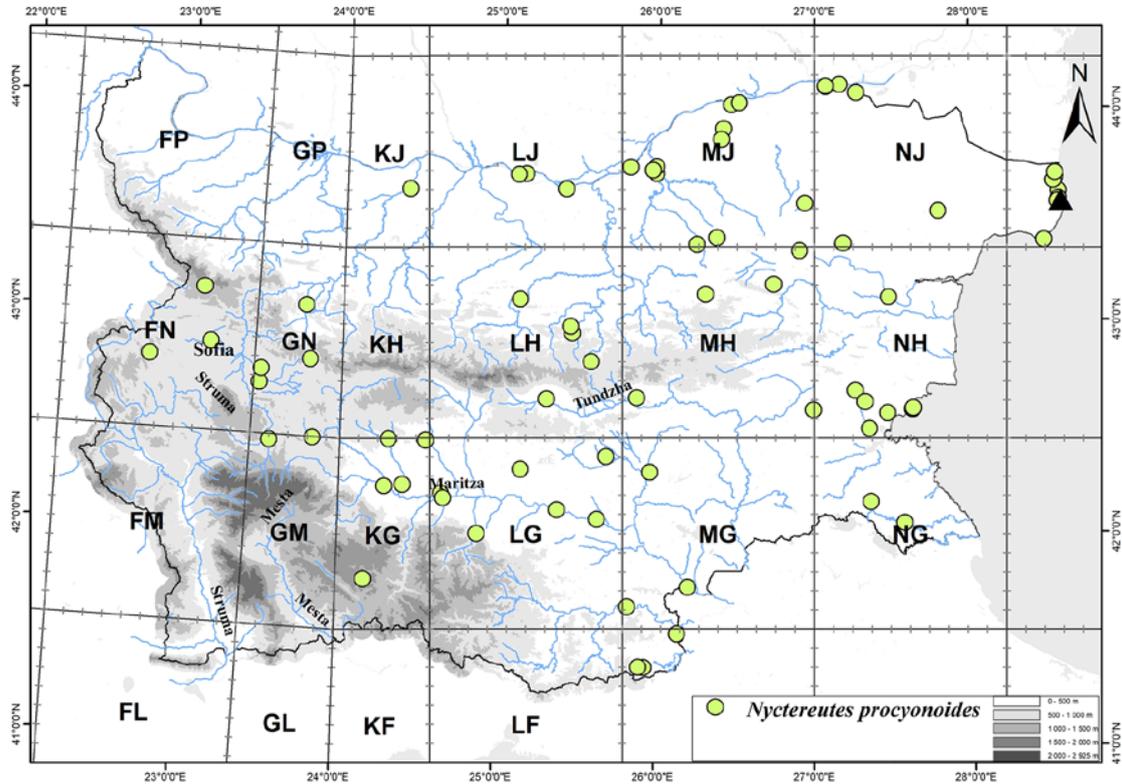


Fig. 3. Distribution of the raccoon dog *Nyctereutes procyonoides* in Bulgaria (1968–2020). The triangle indicates the site of the species' first appearance in the wild.

was a registered increase in coypus in the wild after the year 2000 (nearly 406 records 97% of the records). Today, there is no data regarding coypu farms in the Bulgarian Food Safety Agency (ABFSA 2020). In 2016 the farming of the species was prohibited in the European Union (EU 2014). Despite this, some hobbyists in Bulgaria secretly breed, trade, translocate and oftentimes release coypus in the wild. The release of coypus is often done with the purpose of cleaning reeds and other dense aquatic vegetation which otherwise obscure fishing or hunting activities in lakes, ponds, etc. (Y. Koshev, N. Nedyalkov, St. Lazarov, unpubl. data). That is how records of coypus appear outside of their regular range and in unusual altitudes (near Samokov town, at the foot of Rila Mountain; State Hunting Farm “Mazalat” at south slopes of Stara Planina). Therefore, we believe that there is still a clear anthropogenic drive of the spread of the coypu.

In Romania, *M. coypus* is established along the Danube in many areas (Murariu, 1996; Murariu & Chisamera, 2004; Miu *et al.*, 2018). The species inhabits the shared area of the Danube between Bulgaria and Romania in small stable populations (Murariu, 2005). That is why the accounts of coypus in Lake Srebarna and Silistra town (downstream the Danube) seem logical. In the Republic of Northern Macedonia the closest records are approximately 35 and 60 km from Bulgaria (Purger & Kryštufek, 1991; Ćirović, 2006).

In Greece there is a stable population in the Lake Kerkini (Adamopoulou & Legakis, 2016) which is only

8 km from the Bulgarian border (Fig. 1). The Kerkini Lake is situated on River Struma, which is the main river artery in South-western Bulgaria. We conducted a study in this region, but no signs of coypus were found. However, it is very likely that there are coypus present or that they can enter Bulgarian territory, especially because there are records upstream River Struma (near town of Boboshevo, Kustendil District, Southwestern Bulgaria). In Eastern Greece and the European parts of Turkey the species is found along River Maritsa and River Tundzha (Tanka Reka) near Edirne city (Özkan, 1999; Adamopoulou & Legakis, 2016).

Downstream River Maritsa from Belovo town to its estuary in the Aegean Sea and along River Tundzha there is a stable coypu population. Through this population, which spans the largest area of the three neighbouring countries, South-eastern Bulgaria acts a source of the spread of this invasive species (Fig. 1). In the future, one of the additional negative impacts in this region could be the development of a wild population of the highly invasive American mink (*Neovison vison* Schreber, 1777) along River Tundzha, where minks have been observed (Koshev, 2019).

Myocastor coypus has varying environmental effects which can either benefit or impact human activity. It has a positive effect on water bodies by clearing excess aquatic vegetation (Mihaylov *et al.*, 2017; Y. Koshev, unpubl. record). On the other hand, it negatively impacts wheat and barley fields near dams by digging up

dikes and destroying the crops (Mihaylov *et al.*, 2017; N. Nedyalkov, unpubl. record).

At very low temperatures in winter, some animals get frostbite in peripheral parts of their bodies, most often in the tail. Cases of leucism/albinism are not uncommon among coypus, which is an indicator of inbreeding due to the reduced numbers caused by harsh winters (Mihaylov *et al.*, 2017).

Coypu remains have been found in the diet of an eastern imperial eagle (*Aquila heliaca* Savigny, 1809) (Boev, 2017; N. Nedyalkov, unpubl. record) and a skull was found in front of a red fox (*Vulpes vulpes* Linnaeus, 1758) den (Gruychev, 2012). However, there is no information on whether these cases were of predation or scavenging. The coypu is a carrier of some illnesses (leptospirosis, salmonellosis, toxoplasmosis, etc.) dangerous to animals and humans (Peshev *et al.*, 2004).

Our calculations show that the species has spread with an average speed of 50 km per decade. The territory of Bulgaria has a low probability of occurrence of coypu under current climate and recent occurrences (Schertler *et al.*, 2020). In fact, the dense population of the species in southern Bulgaria shows that it occupies a large area and the probability of finding it in surrounding regions increases. Additionally, our study showed that this species is actively spread by humans and modeling its current and future distribution will be difficult.

Our data demonstrates that in Bulgaria *O. zibethicus* is found in Northern Bulgaria along the Danube and its adjacent water bodies. In 2007 the species was established in South-Eastern Bulgaria in the vicinity of Yambol town along the River Tundzha (Milchev, 2007). It is unclear how the muskrat appears in Southern Bulgaria, but this finding is supported by observations of the species in the region (Lakes of Burgas) (ABHFU, 2019; AEFA, 2019). After the first release of 19 muskrats in Lake Srebarna in 1956 (Genov, 1984), only 5 years later their numbers had grown to 10 000 individuals (Dragoev, 1978). However, after this initial increase in population size, a rapid decline was observed, likely caused by the outbreak of tularaemia, after which it was transmitted to humans (Markov & Petrov, 1966). A similar population decline has been observed in other areas where the muskrat was introduced (Skyrienė & Paulauskas, 2012). There is no data on whether *O. zibethicus* is being raised in Bulgaria. Our calculations demonstrate that the species has spread with an average speed of 30 km every decade.

Our data shows that *N. procyonoides* is found in the lower altitudes of nearly the entire country but with

very sparse distribution. There are new records of the species occurring in Western and Eastern Rhodopes and in Strandzha Mountain — very near the Turkish border. Naderi *et al.* (2020) reported the first instance of the species in Eastern Turkey, but it is highly likely that it is present in European Turkey via emigration from Bulgaria (Strandzha Mountain). There is no information on whether its spread has influenced human activity. However, there has been documentation of its negative impacts on the endangered Dalmatian pelican (*Pelecanus crispus* Bruch, 1832) in Lake of Srebarna Nature Reserve (Koshev *et al.*, 2020). In Bulgaria and Turkey it has been captured by camera traps at altitudes of 1548 m a.s.l. (Genov, 2012) and 2340 m a.s.l. (Naderi *et al.*, 2020), respectively.

Regarding the altitude of occurrence of *M. coypus*, they are found from sea level to up to 862 m a.s.l. (median = 141 m a.s.l., $n = 417$), *O. zibethicus* are found from sea level to up to 406 m a.s.l. (median = 138 m a.s.l., from 22 records) and *N. procyonoides* are found from sea level to up to 1548 m a.s.l. (median = 141 m a.s.l., from 75 records).

The most records for the three species are in the range of 0–199 m a.s.l. out of a total of 398 records 77.4% (Tab. 1). The three target species are game animals and their shooting is permitted annually (Hunting and Game Protection Law 2000), but they are rarely hunted because of lack of interest, lack of financial incentive, their fur is not easily sold, they do not have trophy qualities, nor is their meat used for food or other reasons.

The three species are certainly established in Bulgaria — syntopically in the region of Srebarna (Koshev *et al.*, 2020), the Lakes of Burgas and Lake Shabla (Fig. 4). In the protected areas in European ecological network “Natura 2000” there are 230 (or 55%) out of 417 records of *M. coypus*, 15 out of 22 records (or 68%) of *O. zibethicus* and 42 out of 77 (or 55%) records of *N. procyonoides*. The overall presence of the three target species in Natura 2000 sites is 308 records out of 287 or 56% of the invasive species are established in protected areas.

Conclusions

We can make the following conclusions and recommended measures to reduce harmful effects of the species:

The first mapping of the three invasive species *M. coypus*, *O. zibethicus* and *N. procyonoides* in Bulgaria

Table 1. Distribution of reliable records of *Myocastor coypus*, *Ondatra zibethicus* and *Nyctereutes procyonoides* according to altitude class (m a.s.l.) in Bulgaria.

Species	0–199	200–399	400–599	600–799	800–999	1000 <	Total
<i>Myocastor coypus</i>	334	72	8	2	1	–	417
<i>Ondatra zibethicus</i>	20	1	1	–	–	–	22
<i>Nyctereutes procyonoides</i>	44	19	6	1	3	2	75
Total	398	92	15	3	4	2	514

demonstrates that these three species are expanding their ranges.

Myocastor coypus inhabit nearly the entire Thrace Valley, producing a dense population which acts as a source of spread to neighbouring countries such as Greece and Turkey. The spread of the species is still facilitated by humans with an average speed of 50 km per decade. Their primary negative impacts are related to the digging of dikes and subsequently ruining agricultural plantations near water bodies.

Ondatra zibethicus has expanded its range by passing from North to South Bulgaria but with very low density and an average speed of 30 km every decade.

Nyctereutes procyonoides occupies nearly the entire territory of the country, with observations of the species in altitudes of up to 1548 m a.s.l. in Western Rhodopes with low density. Depredation has been observed on endangered nesting birds in Lake Srebarna nature reserve.

The three target species are found primarily between 0 and 199 m a.s.l. out of a total of 398 records and approximately 56% of their populations are located in protected areas and territories (European ecological network “Natura 2000” sites).

The recommended measures for the reduction of these invasive species’ populations and restricting their negative effects are as follows: regular monitoring of their distribution and numbers, evaluating their negative impacts and developing eradication activities in the protected areas.

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Appendix 1.**1. List of URL addresses of the internet forums and Facebook specialized groups****Hunter and fishermen's forums:**

Internet forum "Na lov" — www.nalov.com/forum;

Internet forum "Fishing mania" — www.forum.fishing-mania.com;

Internet forum "BG lov" — www.bglov.com/forum;

Internet forum "Na Riba" — www.nariba.com/forum;

Facebook specialized groups:

Mammals in Bulgaria — <https://www.facebook.com/groups/688742967895829/>

Fishes in Bulgaria — <https://www.facebook.com/groups/1402703820043236/>

Amphibians and Reptiles in Bulgaria — <https://www.facebook.com/groups/372508086208155/>

Bulgarian Wildlife Photographers — <https://www.facebook.com/groups/BWPhotographers/>

BirdsInBulgaria.org — <https://www.facebook.com/groups/birdsinbulgaria/>

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Contributor	Number of records
Ajsel Mehmed	2
Aleksandar Dutsov	1
Aleksandar Petrov	1
Andrey Ralev	1
Anelija Filipis	1
Ani Shumkova	1
Antonija Pancheva	1
Apostolos Apostolov	1
Atanas Delchev	6
Aydin Hatibov	1
Bojan Bojanov	1
Boris Zahariev	1
Borislav Borisov	6
Dejan Dimitrov	1
Desislava Stefanova, Pavel Pavlov	1
Didi Petrova	1
Dilian Georgiev	2
Dimitar Demerdzhiev	2
Dimitar Dimitrov	4
Dimitar Petkov	1
Dimitar Plachiyski	1
Dobromir Dobrev	8
Dobromir Dobrev, Dimitar Demerdzhiev	1
Emil Yordanov	3
Galia Veleva-Algaivel	1
Georgi Gerdzhikov	12

Contributor	Number of records
Georgi Ivanov	1
Georgi Kamov	1
Georgi Manolev	2
Georgi Popgeorgiev	7
Hristijan Hristov	1
Hristo Dimitrov	1
Irina Mateeva	1
Ivailo Nikolov	1
Ivan Kostadinov	2
Ivaylo Dimchev	4
Ivaylo Zafirov	2
Jordan Marinov Hans	1
Kamelija MahakJan	1
Katerina Lazarova	1
Kostadin Kostadinov	1
Krasimir Kirov	6
Kristian Yakimov	1
Lazar Milchev	2
Luchezar Pehlivanov	2
Lyubomir Profirov	1
Martin Kurtev	1
Martin Popov	2
Martin Stoimenov	1
Matev	3
Mihail Iliev	5
Milen Genov	1
Mladen Angelov	1

End of Appendix 1

Contributor	Number of records
Nikolai Kolev	37
Nikolay Dolapchiev	1
Nikolay Gemedzhiev	3
Nikolay Kolev	1
Nikolay Simov	1
Pavel Stoyanov	1
Pavlin Grigorov	1
Pencho Pandakov	2
Petar Manolev	3
Petar Shurulinkov	4
Petar Stankov	1
Petar Vasilev	1
Petko Tsvetkov	1
Petya Altimirska	1
Plamen Sirakov	3
Polina Hristova	2
Radoslav Moldovanski	9
Radostina Pravcheva	1
Roksana Kantrandzhieva, Petar Manolev	1
Rosen Mirchev	1

Contributor	Number of records
Rosen Tsonev	2
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Simeon Gigov	1
Stanimir Navushtanov	1
Stoyan Goranov	1
Stoyan Yordanov	3
Stoycho Stoychev	2
Svetoslav Spasov	1
Tihomir Dimitrov	8
Todor Rogachev	1
Vasil Atanasov	1
Vasil Genchev	12
Vladimir Dobrev	4
Vladimir Mladenov	7
Vladimir Todorov	1
Vladimir Trifonov	3
Volen Arkumarev	2
Yordan Kutsarov	4
Yordan Vasilev	14
Zahari Petkov	11