Biological Invasions
Research Article

ACTA ZOOLOGICA BULGARICA
Acta zool. bulg., 71 (3), 2019: 417-425

Occurrence of the American Mink *Neovison vison* (Schreber, 1777) (Carnivora: Mustelidae) in Bulgaria

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Abstract: The American mink farming was resumed in Bulgaria in 2013. Currently, there are four livestock farms with a total capacity of about 130,000 minks. In the period 01.08.2017–11.03.2019, the occurrence and potential damages of escaped minks in the area of the largest farm (with a capacity of about 128,500) near the village of Madzherito (Stara Zagora District) were studied. The study showed 54 records of a total of 108 escaped minks, of which 27 were found in the wild, including two records of mink tracks in the Natura 2000 Site BG0000425 "Sazliyka River". The greatest number (72%) was recorded in late winter and early spring, which coincides with the first reproduction period of minks. In the wild, minks were found at a distance of up to 6 km away from the farm and in settlements of up to 8 km far from the farm. Negative impacts of the escaped minks on the local population and economy were observed. An increase in the number and capacity of the mink farms will undoubtedly lead to an increase in the number of escaped minks and will increase the likelihood of establishment of a wildlife mink population in Bulgaria.

Key words: Invasive alien species, mink fur farming, escapees, negative impact, Natura 2000 Site

Introduction

The American mink *Neovison vison* (Schreber, 1777) is a medium-sized semi-aquatic generalist and opportunist predator, native to most of North America (Bonesi & Palazon 2007). It has valuable fur and is, therefore, artificially farmed or introduced (intentionally or accidentally) in many countries around the world, where it has subsequently established populations. Besides in Europe (Austria, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Poland, Portugal, Romania, Spain, Sweden and the United Kingdom), the American mink has established populations in Asia and South America (Skorupski 2015, 2016, Bouros et al. 2016, Cogălniceanu et al. 2017). Because of its strong negative impact on biodiversity and ecosystems in the countries, where it has been introduced in Europe, as well as on the European economy, the species is considered as invasive alien species and included in the list of the 100 most dangerous invasive alien species in Europe (http://www.europe-aliens.org/speciesTheWorst.do). It is also listed as a priority invasive alien species for South-Eastern Europe (project ESENIAS-TOOLS, www.esenias.org). It is proposed that is should be included in the List of invasive alien species affecting the EU in Regulation (EU) No 1143/2014 (EU 2014).

The farming of the American mink for fur production in Bulgaria has started in the beginning of the 1950s (Dragoev 1978) but there is no precise information on the number of farms and their capacity. There is information that in the period 1950–2013 six American mink fur farms existed in Bulgaria (Fig. 1). The farm in the village of Kurtovo (now Kurtovi (Vulchi) Livadi in the Rila Mountains) was closed in 1955. Seven animals from this farm

were released near the Eugulia-Vedeana River (near Samokov Town) but later were reported as 'disappeared' (Dragoev 1978, Gabrashanski et al. 1980). There was another mink farm near the town of Perushtitsa and the 'acclimatisation' of animals from this farm was reported as successful (Dragoev 1978). During this period, hunters observed escaped minks in the area that caused damages to the game. Musketarski (1982) reported about a farm with 4,000 animals in the village of Bohot (Pleven District), whose capacity was planned to grow three times (12,000 animals) by the end of 1982. There is information from questionnaires about a farm near the town of Kostinbrod and about escaped minks in the area of the Voluyak Reservoir (including findings of minks after the official closure of the farm). There are also reports about farms located in the south-east of the town of Yambol and about shot free-living animals close to the village of Zornitsa (Burgas District) in 1999–2000 (R. Mirchev – pers. comm.). The existence of a farm near Batak Reservoir in the Western Rhodope Mountains was also reported (Z. Shindarska – pers. comm.).

Since 2013, a new wave of mink farming has been recorded in Bulgaria. Currently, there are mink farms with a total capacity of about 130,000 minks registered by the Bulgarian Food Safety Agency (BFSA 2019). According to the Fur Europe (2015), two farms have been operating in Bulgaria, with 100,000 mink furs produced per year worth 1,810,550 Euro (https://www.fureurope.eu) and the yield is expected to increase. At present, there are four mink farms in Bulgaria (Fig. 1): (1) at the village of Madzherito (Stara Zagora District, N 42.34913, E 25.653371), with a capacity of 128,576 and 118,685 farmed animals; (2) at the village of Luben Karavelovo (Varna District, N 43.341313, E 27.787268), with a capacity of 1,500 animals, which is not in operation temporarily and (3) one at the village of Chargan (Yambol District, N 42.478197, E 26.631627), with a capacity of 1,000 animals, officially farming 160 animals (BFSA 2019). There is also a fourth farm not present in the BFSA registers – a demonstration farm affiliated to the Faculty of Agriculture of Trakia University in Stara Zagora (N 42.402905, E 25.568596), with about 110 animals. The capacity of the biggest farm (near the village of Madzherito) is planned to increase its capacity up to 400,000 individuals (RIEW 2015) and a new mink farm is planned to be constructed near the village of Mogila, Stara Zagora Municipality (RIEW 2014).

Until now, there is no evidence of an established mink population in Bulgaria (Bonesi & Palazon 2007, Bouros et al. 2016, Cogălniceanu et al. 2017). However, after resuming mink-farming, the number of observed minks in the wild and the reported damages have increased, which makes it urgent to study the occurrence of the minks. Usually, in the first years of mink invasion in other countries in Europe, the hunters and conservationists do not have adequate knowledge about this species. Thus, the mink can remain undetected for substantial periods, especially if its density is low (Brzeziński et al. 2019).

The aim of this study was to investigate the occurrence of the American mink in Bulgaria and the potential damages caused by escaped individuals from the existing fur farms.

Materials and Methods

Study area

The study was conducted in the area of the American mink fur farm with the largest capacity located near the village of Madzherito (Stara Zagora District) and the surrounding villages (Fig. 3). The farm is located in south-eastern Bulgaria in the Thracian Lowland with a well-developed network of rivers, rice fields, fishponds, irrigation canals and small reservoirs. The study was conducted in the period from 01.08.2017 to 11.03.2019.

Collection of materials and data

The materials and data were collected using the following methods:

Biosecurity check. The author and a group of experts checked biosecurity of the mink farm on 25 March 2019. It was found that the farm was surrounded by only one single metal solid fence (Fig 2*a*), under which there were holes through which the minks can pass. Inside and outside the fence, fresh mink excrements (Fig 2*b*) were found. There were buffer zones only on the entry doors of the farm. There were mink traps for the escapees and the areas surrounding the farm buildings and installation of protective grids on paths, which might be used as an escape route. The records of escaped minks showed that these measures were not efficient.

Interviews of local people and media monitoring. With the help of volunteers, the local people were interviewed if they know the species, if they have observed it and taken pictures or videos of the escaped minks. Interviews and questionnaires are a commonly used method of collecting information in studies on proliferation of the American mink (Adamopoulou & Legakis 2016, Brzeziński et al. 2019). As a source of information, my study also used publicly available data: news from the Internet

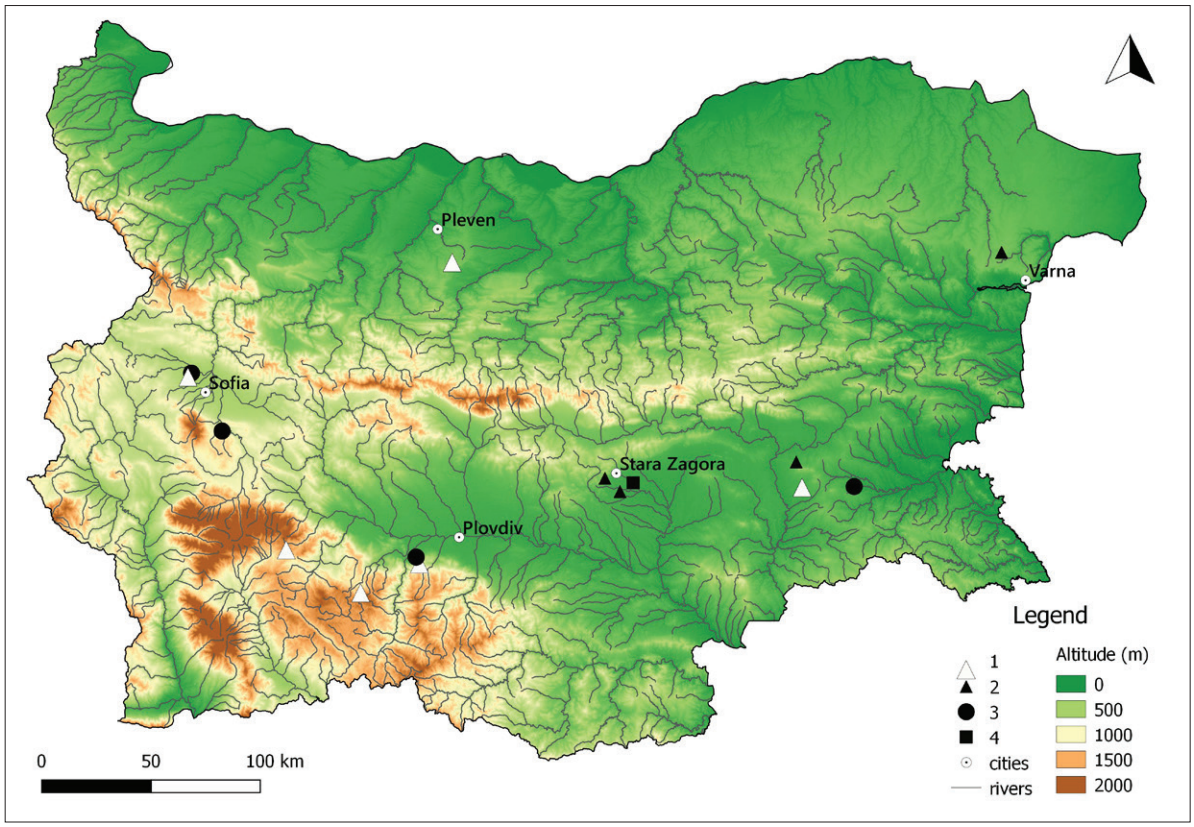

Fig. 1. Mink farms in Bulgaria according to the data available for the period 1950–2019 and data about dead or escaped individuals by 2013. Legend: 1 – mink farms before 2013; 2 – mink farms after 2013; 3 –minks escaped or shot by hunters before 2013; 4 – mink farm planned to be constructed.

with pictures or videos of the American mink published in regional and national media. I established contacts with the authors who were further questioned regarding the date and place of the observations and the type of damages registered.

American mink capturing. For additional verification of the presence of the American minks, two standard traps for capturing martens and polecats (23 x 60 x 23 cm with a hole and a lid and a hook on which a meat lure was attached; Fig 2*c*) were provided to local people who had reported the presence of minks in their properties. When a mink was observed in the properties, the traps were placed and remained there for several days until the mink was caught.

Searching for tracks of minks in the wild. In April 2018 and March 2019, I explored the rivers and ponds around the villages of Madzherito, Zagore, Kolarovo and BG0000425 'Sazliyka River' Site of Community Importance (SCI) designated according to the Directive 92/43/EEC (Habitats Directive). The transect method was used to search for scats and tracks of the American minks at 15 monitoring points. The caught, photographed or dead minks as well as their tracks were determined according by the guidance of Aulagnier et al. (2009) and Olsen (2013).

Database and analysis of data reliability. The collected data records were organized in database. One record contained locality, coordinates (latitude, longitude), date, reliability, source of information (name of the person if available, address, internet site, etc.), number of observed minks, establishing method (questionnaire, video and photo-recording, capturing animals , live or dead animals, tracks).

For example, there was a record with one locality, one set of coordinates, one date, one source of information, video recording establishing method but with two minks on a video clip; in the database, this observation was entered as one record with two individuals. In this way, the number of records and the number of individuals (minks) differed. When there were observed tracks, in database were included one record with one individual was entered in the database. When there were reported minks with litter, one record and one mink were included in the database.

The distribution maps of the observed minks were based on the analysis of the sources of information, with the data divided as follows: (a) reliable data (animals that were either caught live, see Fig.

2*c*) or found dead, photographed and video-recorded (Fig. 2*d*), mink tracks on the shoreline, interviews with persons with experience with the species (they had either photographed or hunted the animal before), such as hunters, fishermen and biologists; (b) unreliable data – interviews with people for whom there was no information whether they knew the species well; (c) mink farms – available information on farms in the literature or personal communications.

Results

In the period 01.08.2017 – 11.03.2019, 54 records of mink observations were reported, describing a minimum of 108 individuals (observed mink tracks, captured minks, photographed and described by the locals, see Fig. 3). Forty-nine of the records were reliable (Table 1) and five were unreliable (Table 2). There were also reliable reports (from a hunter knowing this species well) of a young mink and litters in the wild. In 16 of the records, the local people reported more than one observed mink at one location, so the number of records was smaller than the number of minks.

Three females were captured by traps in the nearest village of Madzherito on 15.09.2018, 11.11.2018 and 19.11.2018 (Fig. 2*c*). The first captured mink was in a very poor general condition and died afterwards. The autopsy performed by a qualified vet at the 'Blue Cross' Veterinary Clinic, Sofia, showed that the mink suffered many impairments and poor health. The liver was three times its normal size, yellow in colour, the heart was enlarged and there were multiple foot lesions. The other two minks were successfully rehabilitated and sent to the Zoo in Sofia.

The greatest number of observed minks was recorded in late winter and early spring: in February and March there were 77 animals (72%); in April, July and August there were 11 animals (10%), while in autumn (November and December) there were 20 animals (18%).

The observations showed that the American minks caused damages to the human economic activities. There were killed or injured domestic animals in the villages of Madzherito and Zagore: 47 hens, cocks or chicks, about ten rabbits, a few in-

Table 1. Established reliable records and numbers of American minks in the wild.

Locality (at the settlements and around them)	Number of records	Number of minks per record	Number of minks				
			Communicated by local people who know the species	Captured by property owners or in this study	Killed by property owners, found dead on the road	Photo or video recordings	Mink's tracks
Elenino	1	1	1	-	-	-	-
Zagore	3	4	3	1	-	-	-
Kaloyanovets	1	1	1	-	-	-	-
Kolarovo	1	2	2	-	-	-	-
Madzherito	39	91	23	23	32	8	5
Pamukchii	1	1	1	-	-	-	-
Stara Zagora	2	2	1	-	-	1	-
Hristyanovo	1	1	1	-	-	-	-
Total	**49**	**103**	**33**	**24**	**32**	**9**	**5**

Table 2. Established unreliable records and number of American minks in the wild.

Locality (at the settlements and around them)	Number of records	Number of minks per record	Numbers of minks	
			Communicated by local people	Killed by property owners, found dead on the road
Arnautito	1	1	1	-
Badeshte	1	1	1	-
Karanovo	1	1	1	-
Lyaskovo	1	1	1	-
Radnevo	1	1	-	1
Total	**5**	**5**	4	1

Fig. 2. Observations of the American minks and their habitats near the mink fur farm in the village of Madzherito: a. Single metal solid fence of the farm with mink faeces outside (11.03.2019, photo Y. Koshev); b. New fresh mink scats at the site (25.03.2019, photo Y. Koshev); c. A mink caught in the village of Madzherito (15.09.2018, photo K. Georgieva); d. a mink photographed in the fishponds near the village of Madzherito (11.03.2019, photo M. Kachamakova); e. typical habitat of the American minks – a fishpond and a river in the vicinity (photo Y. Koshev); f. habitat of the American minks at the SCI BG0000425 Protected Site "Sazliyka River" (photo Y. Koshev).

jured lambs (the exact number was not reported), one bitten new-born horse, one killed cat with its kittens, a bitten small dog and killed pigeons. In addition, the minks settled near fishponds where they caught fish or tore the nets (Fig. 2 *d, e*) that caused a mass escape of the fish.

For 12 minks, there was information about their colour: five white, five brown / beige and two greyish individuals.

Reports for observations of minks came pre-

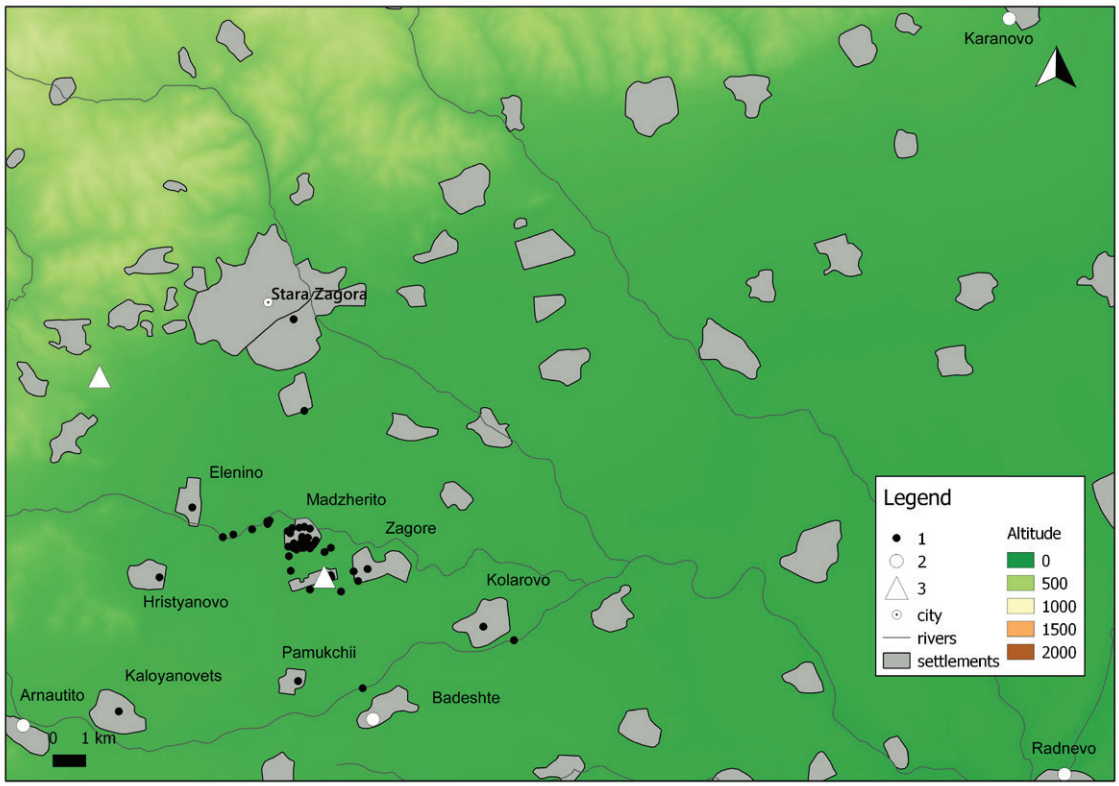

Fig. 3. Records of observed American minks near the mink farm of the village of Madzherito (Stara Zagora District). Legend: 1 – reliable record; 2 – unreliable record; 3 – mink farm.

dominantly from the settlements. There were 59 reports of minks in the village nearest to the farm – Madzherito (Fig. 3).

In the wild, 27 minks were identified at a distance of up to 6 km from the farm. They were in the area of the fishponds and small rivers (Fig. 2*e*). Two of the records (N 42.33104, E 25.72622; N 42.316998, E 25.669569) were in the SCI Protected site BG0000425 "Sazliyka River", 5 km distant from each other along the course of the river (Fig. 2*f*). In the settlements, they were found at a maximum distance of 8 km from the farm in the district centre – the town of Stara Zagora (Fig. 3).

Discussion

With the renewal of the American mink farming in Bulgaria after 2013 and the increase in the capacity of the farms, the number of escaped minks observed in the wild has increased (Tables 1 and 2; Fig. 3). There is also an increasing possibility of the minks forming a stable wild population with all possible negative effects. The reported number of observed minks in this study should be considered minimal because local people say they refrain from reporting minks and damages caused by them for fear of conflicts with both farm owners and local authorities. At the same time, when they report to the mayors of settlements or to the farm owners, they are given chickens as a compensation for damages.

Rarely, American mink attacks larger animals. In its food, European roe deer *Capreolus capreolus* has been found, supposed eaten as carrion (Novákov & Koubek 2006) but without information about the cause of the death or the age of the animal. Sometimes American mink eats bigger animals such as beavers (2%), although they weigh 18-23 kg (Ibarra 2007). Minks are controlled by farmers because of their perceived impact on livestock, especially poultry and, sometimes, lambs (MacDonald et al. 2000, CABI 2019). On this background, the observations about bitten and injured lambs and new-born horse are not unusual, especially as they are not directly killed by the mink but died from their wounds. Minks are exceptional predators, capable of killing animals larger than them, and attacks may be a typical manifestation of surplus killing of confined animals (MacDonald et al. 2000, CABI 2019). The minks are initially not afraid of humans, likely because they have been raised in captivity. They are fed with the offal from the poultry farm production, which explains why most of the damages in the villages are done on poultry (from which the minks eat mainly the heads and the intestines).

The American mink has a negative impact on many species by reducing significantly their overall density (Bonesi & Palazon 2007). This species enters into strong competitive relationships (for food and habitat) with the European mink (*Museta lutreola*), the European polecat (*Mustela putorius*) and the River otter (*Lutra lutra*). One of the possible reasons for the reduction of the density of the European mink and its shrinking habitat is the competition with the American mink (Bonesi & Palazon 2007). The European mink is considered extinct in Bulgaria, with recent reports of individuals coming from the Danube River at Svishtov, Tutrakan, Ruse and Silistra (Spassov 2015). The European mink still coexists with the American mink in the Danube Delta (Cuzic et al. 2002, Spassov 2015). The formation of an American mink population on the territory of Bulgaria may prevent the return of this species to the Bulgarian fauna. In Bulgaria, there is a relatively well-developed population of the river otter both in terms of habitat and density (including in the outskirts of Stara Zagora Town), one of the populations with the highest density being in south-eastern Bulgaria (Georgiev & Koshev 2006, Georgiev 2007*a, b*, Petrov & Popov 2013, Spassov & Spiridonov 2015). It cannot be predicted how the two species would interact on the territory of Bulgaria. Furthermore, the American mink is a predator with a negative impact on many native species that build their nests on the ground, such as geese, ducks, even woodpeckers, rodents, aquatic and semi-aquatic organisms such as fish, amphibians and crayfish (Bonesi & Palazon 2007, Skorupski 2016, Cogălniceanu et al. 2017, Koshev & Nedyalkov, in press).

The results of the present study show evidence of minks escaping from the farm and there were also reports of young individuals and litters. This information, as well as the high number of records of minks in the wild, implies the establishment of a population, especially in view of the planned fourfold increase in the farm capacity near the village of Madzherito (RIEW 2015) and the planned new mink farm near the village of Mogila (Figs. 1 and 3; RIEW 2014). If a wild population is established, the cost of future eradication of the species will be very high (Zuberogoitia et al. 2010, Roy 2017). In northern Spain, the cost of removing the American mink from wildlife ranges from 652 to 2,970 Euro per mink (Zuberogoitia et al. 2010). Under a LIFE+ Programme project aimed at improving the condition of the European mink (http://lifelutreolaspain.com), plans are made to catch and remove the American minks from 775 km of rivers in Spain, with the total project cost amounting to 2,536,461 Euro. In Poland it is considered impossible to eliminate completely the species from the wild (Skorupski 2016). So far, successful eradications have been carried out on islands, with a total ban on mink farms (Bonesi & Palazon 2007).

The American mink can colonise large areas within a very short period. For example, in Poland, 20 years after the mass introduction of mink farms, the minks colonised 50% of the country by the end of the 1990s, with the expansion showing a direct correlation with the proliferation and development of the fur farms (Fasola et al. 2011, Iordan et al. 2017, Brzeziński et al. 2019). At present, 75% of the territory of Poland has an established mink population (Skorupski 2016, Brzeziński et al. 2019).

Most observations of the American minks in Bulgaria occur in late winter and early spring, which coincides with the first and the strongest breeding period when the animals are most active. This fact is in contradiction with the production cycle in the farms there, since the capacity is the highest in autumn before harvesting minks. In Spain, for example, copulations occur during March–April and cubs are born in April–May (García 2010). In Poland, the highest rates of mink captures are in spring (Brzeziński et al. 2019).

The establishment of this species in a river, which is part of a Natura 2000 Protected Site puts at risk the species subject to conservation in this protected area: *Lutra lutra*, *Bombina bombina, Elaphe quatuorlineata, Emys orbicularis, Triturus karelinii, Barbus plebejus, Rhodeus sericeus amarus* and *Unio crassus* (SDF BG0000425). In the area of the Stara Zagora, there is a highly developed network of rivers, irrigation canals, rice fields, small reservoirs and other sites which makes it particularly vulnerable to the establishment of this species and its proliferation due to the river network connectivity affecting the rate of range expansion (Brzeziński et al. 2019).

Conclusions

In the period 01.08.2017–11.03.2019, in the vicinity of the largest farm near the village of Madzherito (Stara Zagora Region), there were 54 records for 108 escaped minks, with 49 records (out of 54) being reliable. Twenty-seven minks were observed in the wild, including two records in a Natura 2000 Protected Site that puts at risk the species subject to conservation in this protected area.

Most records occur in late winter and early spring – 77 records (72%), which coincides with the first period of breeding of the species.

In the wild, the American minks were observed at a distance of up to 6 km from the farm. In settlements, minks were observed at a maximum distance of 8 km from the farm in the town of Stara Zagora.

The minks showed a strong negative impact on the local human population and the economy, with the most affected species being hens/chickens, farmed fish in fishponds and rabbits, sheep and pets.

Increase in the number and capacity of the mink farms, despite the measures aimed at reducing escapes, will undoubtedly increase the number of escaped minks, which will increase the chances of establishment of population in the wild. The area of Stara Zagora District has a highly developed network of rivers, irrigation canals, rice fields, small reservoirs and other sites which makes it particularly suitable for the establishment of this species and its proliferation.

Acknowledgements: The author is very grateful to the volunteers K. Georgieva, G. Chelebiev, I. Angelova, P. Veselinova, D. Marinova, L. Krivoshieva, E. Kenanov, T. Mishineva, S. Dimitrov, P. Atanasov, V. Anastasov and B. Borisova for their help in conducting interviews and mink trapping. The author is very grateful to M. Kachamakova, T. Trichkova and N. Nedyalkov for invaluable additional help. The initial data collection was funded by the Financial Mechanism of the European Economic Area 2009–2014, Programme BG03 Biodiversity and Ecosystem Services, ESENIAS-TOOLS Project, D-33-51/30.06.2015.

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Received: 05.03.2019
Accepted: 17.07.2019