The story of the creation and monitoring of the Russian Desman (Desmana moschata L.) population reintroduced of in the Kerzhenets river floodplain in the Nizhny Novgorod region

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Abstract. The article summarizes the results of creating the reintroduced population of the Russian desman (Desmana moschata L.) in the Nizhny Novgorod region in the floodplain of the Kerzhenets river (the left tributary of the Volga) and monitoring of its status in 2005-2017. In 2001-2002, a total of 51 individuals were released in the Kerzhenskiy State Nature Reserve. In subsequent years, the desman iinhabited the floodplain of the Kerzhenets river 20 km upstream and 60 km downstream of the river. The number of reintroduced population was 35-40 individuals in 2012, 17 individuals – in 2013. Probably from 30 to 50% of the reintroduced population of desmans inhabit the territory of the Kerzhenskiy State Nature Reserve. Population numbers of desmans in the Reserve varied from 25 individuals in 2005 to 3 in 2015. The positive population trend was recored in 2016-17. Also the paper discusses the limiting factors, the relationship between desmans and muskrats. Now the number of reintroduced population is at a critically low level. However, it is essential for conservation of this endangered species. Recommendations for continued monitoring of the desman status in the valley of the Kerzhenets river are presented.

1. Introduction

The Russian desman is a relic of the tertiary period and endemic to Eastern Europe. The species is listed in The IUCN Red List of Threatened Species (Category Endangered) [1], in the Red Data Book of Russia (category 2 – species decreasing in numbers), in the Red Data Book of the Nizhny Novgorod region (category B – endangered species with rapidly declining numbers). A great reduction in the species number in different parts of the home range in the early of 21st century was noted by many specialists [2-6]. In the XIX century in the Nizhny Novgorod region, as well as throughout European Russia, the desman number was great; it was a common game species. At the turn of the millennia in the region, the species has remained mainly in the floodplain of the Oka river, where its numbers have decreased rapidly. In the floodplain of the Kerzhenets river (left tributary of the Volga), the species has extinct by the early 1990s [7]. The State Nature Reserve "Kerzhensky" was established in the Nizhny Novgorod region in 1993, the Russian desman has become one of the model species,which was selected in the Kerzhenskiy State Nature Reserve for the implementation of the programme of recovery of extinct species and study the problems associated with this process. This article summarizes the results of reintroducing the desman population in the floodplain Kerzhenets and monitoring of its status in 2005-2017.

According to the "Chronicles of nature" of the Kerzhenskiy State Nature Reserve we present the information about the catching and release of animals in wild to reintroduce the desman population [8]. Monitoring of its number and distribution in the Kerzhenets flood plain was carried out from 2005 to

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2017.Census of desman was conducted in autumn according to the standard technique [9, 10]. Terms and the volume of surveys are presented in Table 1.

Table 1. Terms and the volume of surveys.

Year	Surveyed waterbodies		Length of routes, km	
	in the Kerzhenets Reserve	In adjacent territories	in the Kerzhenets Reserve	In adjacent territories
2005	14	-	22.82	-
2006	41	-	52.58	-
2012	32	35	51.52	51.31
2013	59	59	66.54	105.87
2015	57	-	66.85	-
2016	19	-	34.46	-
2017	20	-	36.84	-

The first assessment of success rates of the desman recovery we carried out on the territory of the KerzhenskiyReservein 2005-2006. The Kerzhenets river floodland within the boundaries of the reserve was recognised as a model territory where the surveys were conducted regularly. According to the results of these surveys, we estimate the desman population trend. In 2012-13, we surveyed the whole valley of the lower reaches of the Kerzhenetsriverto determine the borders of the reintroducing population of desman.

2. Results and Discussion

2.1. Reintroduction of the Russian Desman

Activities aimed at the re-acclimatization of the Russian desman were carried out in the Kerzhenskiy State Nature Reserve in 2001-02. A total of 51 animals was released in nine floodplain lakes of the Reserve (Table 2). Animals were caught in the floodplain of the Oka river in Vacha, Vyksa and Pavlovo districts of the Nizhny Novgorod region. Locations of catching and release of animals have shown in Figure 1.

Table 2. The number and structure of the group of desmans, which was released in the Kerzhenets river valley

Year of release	Number of released individuals			
	total	♂	♀	juv
2001	11	3	3	5
2002	40	16	12	12
Total:	**51**	**19**	**15**	**17**

In 2001, 11 animals were released into the Krasnyy Yar lake. Some of them successfully overwintered. Desmans were recorded in spring and summer 2002, both at the site of release and in the neighbouring lakes, located 1-2 km upstream and downstream of the Kerzhenets river. Furthermore, desmans were noted in the lake, located 12 km upstream of the Kerzhenets river from the place of release.

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downstream of the river Kerzhenets from the place of issue.

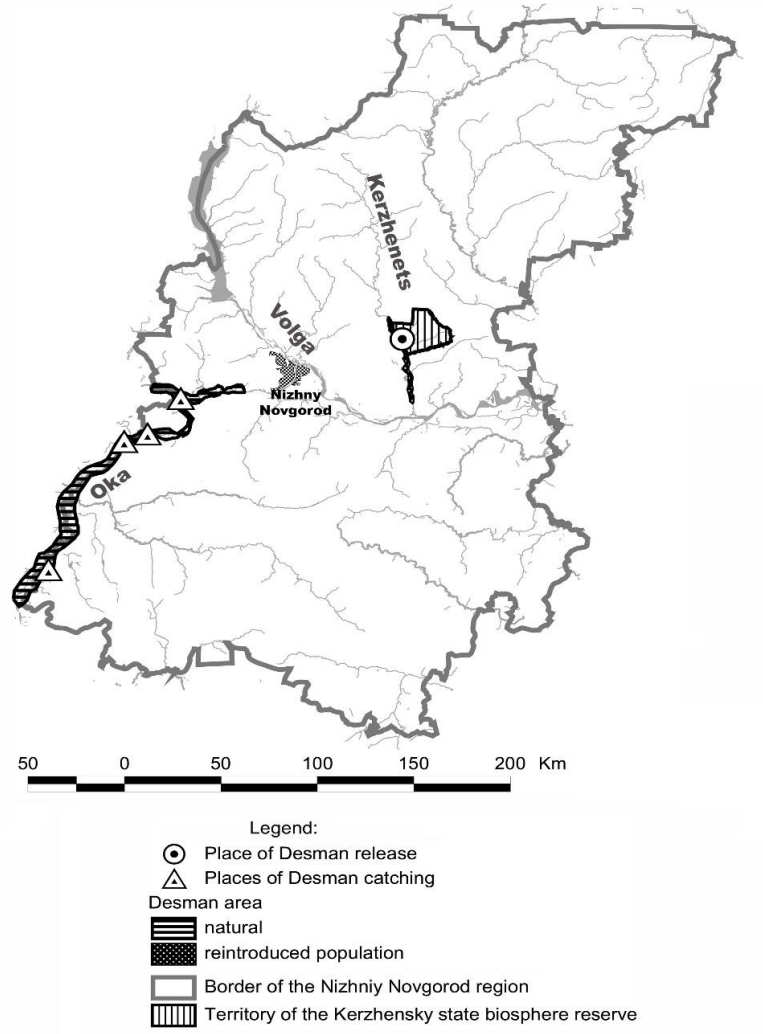

Figure 1. Locations of catching and release of desmans in the Nizhny Novgorod region

To track individuals released in 2002 we used transmitters SOM 2190 (weight about 6 g, a radius of transmitting about 1 km, the battery duration on average 270 days) and receivers TRX-48 with three-element feeder antenna. Transmitters were fit to the base of the tail. A total of 10 individuals was tagged and released in 6 lakes. Movements of tagged animals were recorded daily. It was found that 5 individuals left the release site in the early days. They moved at the long distances up to 3.9 km from the release site, reaching other floodplain lake or channel of the river Kerzhenets. Of the 10 tagged animals, 5 were died and 4 individuals with transmitters during the first weeks left the zone the reception and in spite of searches, were not found. One individual until December 2002 had been reliable alive. After the waterbodies were covered with thick ice the signal of its transmitter had been lost. In addition to the death of 5 tagged animals, 4 desmans moved outside the Reserve and died in fishing nets in 2002. Thus, in 2001-2002, at least 9 individuals were reliably died (17.6% of the total number of released animals).

2.2. Monitoring of the desman reintroduced population

Monitoring, which had been conducted for 15 years after releasing, has showed the succes of reintroduction activities. Desmans stable inhabit the Kerzhenets river valley. They survive on the site of the floodplain in the border of the Kerzhenskiy State Nature Reserve and have settled along the river valley at the length of at least 50 km (about 90 km along the river). Points of animal registrations in 2012-13 are located 20 km upstream and 60 km downstream of the river Kerzhenets from the place of release. The desman population trend surveyed by us in the floodplain in the Kerzhenskiy State Nature Reserve is presented in Table 3.

Table 3. The desman population trend in the Kerzhenskiy State Nature Reserve in 2005-2017.

Year of surveys	Density, ind./km	Population number (ind.) in the Kerzhenskiy State Nature Reserve
2002	No data	No more than 20
2005	0.74	25
2006	0.47	16
2012	0.14	11
2013	0.05	9
2015	0.04	3
2016	0.19	5-8
2017	0.22	6-10

Considering the number of individuals, which died before the breeding season, the reintroduced population has become to develop from 40 animals. Because in the first months after releasing the desmans actively settled throughout the area, probably no more than half of the survived individuals has remained in the Reserve. In 2005, the population was estimated at no less than 25 individuals. This indicates successful reproduction. The number of animals has probably increeased in the sites of release. The next decade, there was a steady decline in density and numbers. For the last two years the population trend has been towards stabilization and slow growth of the species. Assessing the poplation status in general, it is necessary to consider not only the model area in the release site within the Reserve, but changes in the home range and the total number. This survey encompassed all over the valley of the lower reaches of the Kerzhenets river in 2012-13. In 2012, signes of 18 animals were found in the surveyed waterbodies. The total population number is estimated at 35-40 individuals (including 11 in the Reserve). According the survey results we projected favorable future for stability of the reintroduced population of the species.

However the results of surveys in 2013 had shown that the forecast was unduly optimistic. Despite the extensive surveys, taking into account the extrapolation the total number of desman in the Kerzhenets river valley, was 17 individuals (including 9 species in the Reserve). Probably from 30 to 50% of the reintroduced desman population inhabit the territory of the Reserve.

Decreasing the population number in twice cannot be the result of errors of counts. The desman had disappeared in several waterbodies, where was registered in 2012. Decrease in the species number was recorded in the Reserve territory in lesser degree than neighboring areas. The desman population numbers decreased in the surveyed area apparently due to the impact of limiting factors. Considering the fact that the Kerzhenets river mouth and the Volga floodplain have been flooded with waters of the Cheboksary reservoir the impact of spreading and redistribution of animals seem to be not significant,. Large reservoirs are not a habitat for the desman.

Surveys conducted in the Reserve in 2015 showed a continued negative population trend. However, in 2015-16, there was some increase in density and desman population number in the Reserve. During summer 2017 (before surveys), according to reports of local people, 5 individuals died in the illegal fishing nets in the vicinity of the site of release. However, the species number have remained extremely low. The threat of death of the reintroduced population have existed.

Low success of the desman population recovery may be caused by several reasons. An important limiting factor is the fish poaching with nets. The animal deaths for this reason in the Kerzhenets river valley was validly registered. Indirect evidence of this is the fact that the desman inhabits the lakes of the Reserve at the site of release constantly, but appears and disappears in some waterbodies in adjacent areas in different years. At the same time, despite on the species protection in the Reserve, its number in the protected area of the Kerzhenets river valley, remains extremely low. In the mid-twentieth century it was here that the density of the species reached extremely high values. In 1940, in separate lakes, there were 10-20 burrows per 100 m of the river bank [11]. Apparently, one of the reasons that the density of reintroduced desmans in the lakes of the Kerzhenets river floodplain is unable to reach former values is due to changes to its habitat, particularly the reduction of biomass and productivity of zoobenthos. According to our observations, even over the last 15 years the signs of aging waterbodies have been noted: a reduction in their width and depth. A number of shallow lakes, which were with open water in 2005, have overgrown with sedges and willows, and young black alders have appeared in some places. In 2005, a significant number of gastropods (Lymnaea stagnalis L., Planorbarius corneus L., Viviparus viviparus) was noted in the majority of waterbodies. Near almost all the desman burrows visited by us their empty shells were registered. In 2015-17, on particular water bodies both living and eaten gastropods were recorded only a few times. Perhaps reintroduced desmans in the first years of their life in the new place had reduced the prey species numbers. The question of capacity of the desman habitats, and the rate of aging waterbodies in the Kerzhenets valley needs further study.

The muskrat and beaver had been absent in the Kerzhenets river valley until 1940. Reacclimatized desmans have lived together with these semi-aquatic rodents. According to our observations, the desman in the site of release and in the remained habitats in the Oka floodplain, actively uses the burrows of beavers and muskrats. In separate waterbodies the desman practically not digs its own burrows, but uses ones of other semi-aquatic rodents, where makes holes at a distance from the entrance from 10 cm to several meters. The ratio between surveyed burrows that were digged by desmans themselves and made by beaver and muskrats and occupied by desmans in the Kerzhenets floodplain has shown in Table 4.

Table 4. The desman records and its burrows encountered in the Kerzhenets floodplain in 2005-17.

Year	Encountered burrows				Encountered animals
	by desmans	by muskrats	by beavers	total	
2005	10	0	19	29	4
2006	11	8	9	28	4
2012	18	2	9	29	2
2013	11	2	9	22	0
2015	4	0	0	4	0
2016	6	0	5	11	1
2017	4	0	5	9	0

In dry years cohabitation with beavers has a significant positive value to desman. Beavers make waterbodies deeper, building dams, paving the channels to a depth of 0.5-1.0 m across shallow water to the burrows and foraging places, creating conditions for the desman survival.

It is widely believed [12] that muskrats displace desmans from suitable habitats. According to our long-term observations (since 1987) in the Oka river floodplain the muskrat could not be recognized as a competitor or enemy for the desman. These species have been living together in a single waterbody in shared burrows for decades.

The presence of burrows by beaver and muskrat conceals the desman existence and significantly complicates its census. At high abundance of gastropods the burrows of these rodents occupied by desmans are easily identified by the presence of empty shells at the entrance. Under conditions of the almost complete absence of gastropods the desmans living in burrows by beaver and muskrat may be significantly underestimated.

3. Conclusion

Thus, a reintroduced population of desmans have been created and have existed in the Kerzhenets river valley for 15 years. The population is at a critically low level. Recovery of the species density to values that occurred in the mid-twentieth century is the apparently impossible as a result of habitat changes and limited prey numbers. However, even the limited additional population is of great importance to conserve this endangered species.

It is necessary to continue annual monitoring of the desman population in the model area within the Kerzhenskiy State Nature Reserve. It is advisable to carry out surveys aimed at the study of the species distribution and numbers along all the Kerzhenets river valley in 2018-19, covering the sampling of waterbodies in the lower and upper reaches of the river. It is also necessary to study the limiting factors and to calculate the habitat capacity for the species in the Kerzhenets river floodplain, to assess the feasibility of additional release of animals caught in the Oka floodplain.

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