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THE MEDITERRANEAN WATER SHREW (*NEOMYS ANOMALUS*) IN NORTHERN BELARUS: NEW RECORDS AND IDENTIFICATION CRITERIA

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Mediterranean water shrew (*Neomys anomalus*) in northern Belarus: new records and identification criteria. — A. Savarin, V. Savarina. — The article analyses the new record of *Neomys anomalus* in the lakes Dolzhin (geographic coordinates of the place of capture 55°06′33,8″N, 28°36′03.1″E) and Vechelye (55°07′55.3″N, 28°36′38.6″E and 55°07′55.4″N, 28°36′37.2″E) of Ushachsky district, Vitebsk region, Belarus. The material was collected in July 2019. Captured individuals (n = 3) differed by individual external characteristics (a grey-white spot around the eye but not behind it; non-contrasting transition of colouration between the back and belly) from individuals captured in 2018 (n = 4) on Lake Borkovshchina and its ducts. The revealed morphological differences between individuals trapped in different years confirm the known data on phenetic variability of *N. anomalus*. The body weight (7.14–8.03 g) and the main parameters (for example, the ratio of tail length to body length was 0.65–0.68) did not differ significantly. Also individuals of *N. anomalus* did not differ significantly by craniometrical characters (height of coronoid process was 4.04–4.17 mm). In 2018–2019, individuals of the Mediterranean water shrew were trapped in three interconnected lakes, the total length of which with the channels is about 8 km. The shallow and densely overgrown with trees and shrubs channels between the lakes contribute to the dispersal of individuals. According to the results of the 2018 survey, the relative abundance of *N. anomalus* on Lake Borkovshchina and its channels was 4 individuals / 100 trap-days, and according to 2019 data on Lake Dolzhina and Lake Vechelye — 5.0 and 4.4, respectively. The findings give a reason to suggest the stability of the local population. One of the factors contributing to this phenomenon is the reduction in flood water. To maintain the abundance of the species, it is necessary, first of all, to preserve the shoreline, riparian and aquatic vegetation in lakes. It is advisable to include lakes into the system of protected areas with the status of reserves.

Key words: *Neomys anomalus*, habitat, lakes, Vitebsk region, Belarus.

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Introduction

There are two species of water shrews (*Neomys* Kaup, 1829) in the territory of Belarus: the Eurasian *N. fodiens* (Pennant, 1771) and Mediterranean water shrew *N. anomalus* Cabrera, 1907. The Eurasian water shrew is a eurybiontic abundant species inhabiting a variety of natural and artificial reservoirs (including reclamation canals, city ponds, ditches at solid waste landfills, etc.). The Mediterranean water shrew remains one of the least studied representative of the mammal fauna of Belarus. Since 2004, it has been included into the IUCN Red List Appendix as a data deficient species (DD).

In the XX century, this water shrew was caught a few times in the territory of the Belarusian Polesie (Kamenets and Rechitsa regions), as well as in the Berezinsky Biosphere Reserve in a floodplain oak forest and near a forest stream in a spruce forest (Kashtalian, 2005). Unfortunately, individuals caught in the 20th century were exported from the country and nowadays they are part of the collection of the Zoological Museum of Moscow State University (MSU). In 2015, one individual was caught at the silt sites of the wastewater treatment plant in Bereza city, Brest region (Savarin, Molosh, 2017). In 2018, 4 animals were caught on Lake Borkovshchina and its channels in the Ushachsky District, Vitebsk Region. It should be noted that the Ushach group of lakes unites more than 60 reservoirs with a total area of 75 km^2 connected by numerous and shallow channels and rivers. Based on this, a wider distribution of the Mediterranean water shrew, primarily in the north of the country, was hypothesised (Savarin, 2019).

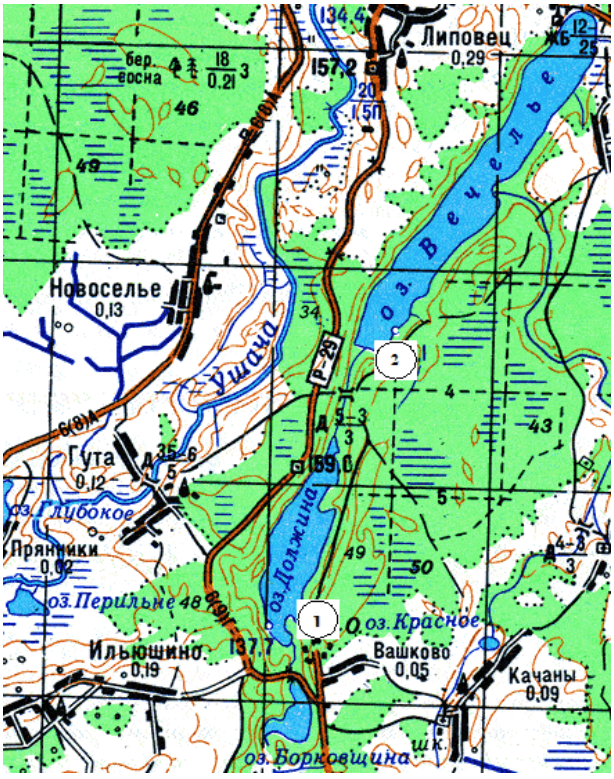


Fig. 1. Map of the study site (symbols are in the text).

Рис. 1. Карта місця досліджень (позначення в тексті).

The purpose of the work is to describe the new places of capture of *N. anomalus* and express a point of view on the distribution and conservation of this species in the region.

Material and methods

The studies were carried out in July 2019 near Vashkovo village of the Ushachsky district, Vitebsk region, near the complex of interconnected lakes Borkovschina — Dolzhina — Vechelye (Fig. 1), belonging to the basin of the Zapadnaya Dvina river. Lakes are of glacial origin (Komarovsky, 2008).

The general metric parameters of the lakes are large maximum (17.9–35.9 m) and average (5.8–18.5 m) depths, the absence of islands, and elongation of basins in the northeast direction. Summarized information presented in Table 1. The lakes belong to the Ushach group, they are interconnected by narrow (on average 3-4 m) and shallow (on average 0.4–0.5 m) channels, the shores of which are densely overgrown with woody-shrubby and grassy vegetation (Fig. 2).

According to the complex of morphometric, hydrochemical and hydrobiological indicators, the lakes belong to mesotrophic reservoirs. Total mineralization varies within the range of 217.5–232.1 mg/L, water transparency is 3.3–4.0 m.

After rains, the water in the ducts quickly becomes turbid, the water level in them rises by 5-10 cm, the width of the duct increases by several meters. The speed of the flow of water also increases, which leads to the washing off of broken branches from the shores and their flooding and waterlogging.

Soil traps were used to catch shrews — PET bottles with a volume of 5–6 litres cut from above (diameter up to 16 cm), filled up to 4/5 with water. In rainy weather, water was poured to half the volume of the trap or less. Preservative agents were not poured into containers to prevent chemical contamination and foreign odours. No grooves between traps were made. Containers were dug to a distance of 5 m from each other, not further than 0.5–1.0 m from the shoreline, with maximum conservation of existing vegetation. Two traps were exposed in the southern part of Lake Dolzhina (for 20 trap-days), and five in the southern part of Lake Vechelye (45 trap-days) (Fig. 1, *1* and *2*, respectively). Traps were checked once a day, in the morning.

Table 1. Morphometric parameters of lakes (Vlasov et al., 2004)

Таблиця 1. Морфометричні параметри озер (Власов та ін., 2004)

Lake name	Area, km ^{2}	Maximum depth, м	Average depth, m	Length, km	Maximum width, km	Shoreline, km
Borkovschina	0.16	21.8	5.8	0.76	0.3	2.33
Dolzhina	0.65	17.9	7.1	2.01	0.5	5.23
Vechelye	1.36	35.9	18.5	3.68	0.48	8.25

Fig. 2. Reservoirs: *a* — Lake Borkovschina, *b* — duct of Lake Dolzhina, c— Lake Dolzhina, *d* — duct of Lake Vechelye, *e, f* — shoreline of Lake Vechelye.

Рис. 2. Водойми місця дослідження: *a* — оз. Борковщина, *b* — протока в оз. Довжині, *c* — оз. Довжині, *d* — протока в оз. Вечелля, *e, f* — берегова лінія оз. Вечелля.

Results and discussion

As a result of research, 3 juvenile individuals of *N. anomalus* were caught*:* 1 (male) on Lake Dolzhina (geographical coordinates of the place of capture are 55°06′33.8″N, 28°36′03.1″E) and 2 (male and female) on Lake Vechelye (55°07′55.3″N, 28°36′38.6″E and 55°07′55.4″N, 28°36′37.2″E, distance between traps was 25 m). The shallow part of the littoral of the catch sites on both lakes was intensely overgrown with almost one species of aquatic vegetation — common reed (*Phragmites communis*) (Fig. 2, *c, e*). Moreover, suspended organic matter of ash-yellow colour (up to 2 m wide) with a strong odour of hydrogen sulphide (H_2S) accumulated on Lake Vechelye in the shoreline zone (Fig. 2, *f*). Two individuals of *N. anomalus* were caught in this area.

We give a comparative description of the caught individuals' external characters.

The belly is grey-smoky, the colour between the legs is grey with a sandy tint, neck is white-grey (fig. 3, *a*). There is a dark spot around the anus which is characteristic for individuals of *N. anomalus* and occurs in populations with different frequencies (Michalak, 1983).

Colouration of the back is brown-black, smoothly turning into a light colour on the belly (Fig. 3, *b*). There is a grey-white spot around the eye, and not behind it (Fig. 3, *c*).

Of interest is the fact that we have caught individuals earlier in 2018 on Lake Borkovschina (55°06′18.5″N, 28°36′04.7″E) and its ducts (55°06′20.9″N, 28°36′01.5″E) with two bright spots (under the eye and beyond), as well as with a sharper transition in colour of the belly and back, pronounced sandy colouration of the throat and middle part of the belly. The indicated morphological differences between individuals caught in 2019 and 2018 confirm the well-known data on phenetic variability of *Neomys anomalus* (Michalak, 1983).

In two individuals captured in 2019, the keel was noticeable only in the last third of the tail; in one individual, it was not visually diagnosed.

Natatory setae on paws were sparse and short (Fig. 3, *d*).

The body weight and basic measurements of the individual did not differ significantly (Table 2). The indicated metric data correspond to the data on the variability of external features of *Neomys anomalus* individuals, including those caught in Ukraine (Abelentsev, 1967; Merzlikin, 1999).

In connection with the habitat in the lakes Borkovschina, Dolzhina and Vechelye of two species of the shrew (*Neomys anomalus* and *N. fodiens*), we indicate some measurements of the skull (Table 2), which are of great importance in the diagnosis of these sibling species (Kryštufek at al., 2001; Zidarova, 2015; Balčiauskas at al., 2016).

Fig. 3. External features of *Neomys anomalus* (explanations in the text).

Рис. 3. Екстер'єрні особливості *Neomys anomalus* (пояснення в тексті).

Table 2. Body and skull measurements of *Neomys anomalus* (lakes Dolzhina and Vechelye, 2019)
Таблиця 2. Проміри тіла та черепа у особин *Neomys anomalus* (оз. Довжина і Вечелля, 2019)

Measurements		No. 1	No. 2	No. 3	Mean
External	Body mass, g	7.14	8.03	7.95	7.71
	Body length, mm	61.0	66.0	68.0	65.00
	Tail length, mm	41.0	45.0	44.0	43.33
	Tail length/ body length ratio	0.67	0.68	0.65	0.67
	Foot length, mm	14.0	14.5	15.0	14.25
Cranial	Condylobasal length	18.70	19.51	19.28	19.16
	Cranial width	9.52	10.05	10.01	9.86
	Interorbital breadth	3.97	4.10	4.04	4.04
	Height of coronoid process	4.04	4.14	4.17	4.12

It should be noted that juvenile individuals of *Neomys anomalus* do not differ significantly from adult individuals by measurements of the body and skull (Spitzenberger, 1980).

Analysis of the presented external and craniometrical features of the three shrews caught in the Lakes Dolzhina and Vechelye allows stating that they belong to the same species — *Neomys anomalus* Cabrera, 1907.

For all Mediterranean water shrews caught in 2018–2019 in the lakes Borkovshchina, Dolzhina and Vechelye (n = 7) only one variant of 4 single-vertex (intermediate) teeth sizes ratio was revealed — all teeth are relatively evenly reduced: 1 > 2 > 3 > 4 (Fig. 4). European water shrews caught in the same reservoirs (n = 5) had two variants of tooth morphometry: 1 > 2 > 3 > 4 (uniform decrease) and 1 > 2 > 3 >> 4 (the 3rd tooth significantly larger than the 4th).

In addition, individuals of *N. anomalus* differed in the morphology of the upper Pm4 tooth: its lateral edges were rounded without a pronounced (as in *N. fodiens*) pointed protrusion (Fig. 5).

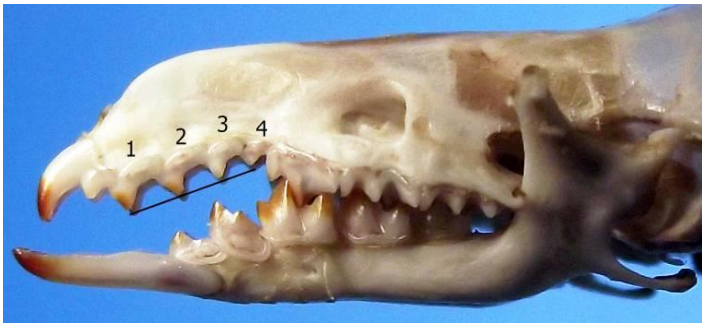
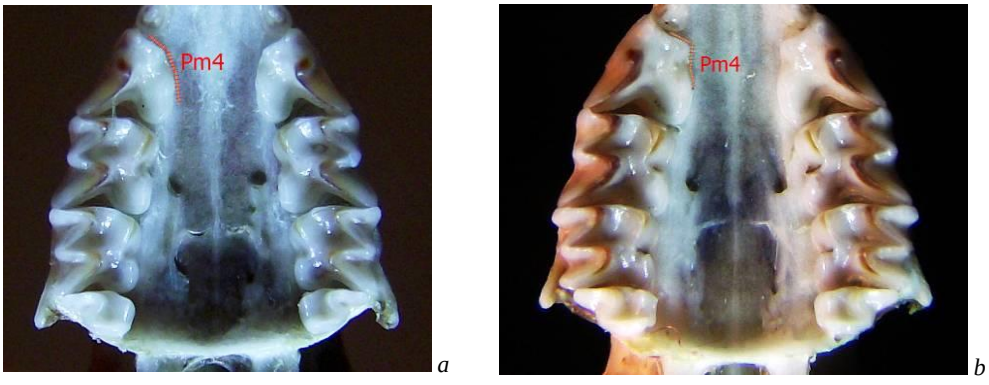


Fig. 4. The ratio of the size of intermediate teeth of *Neomys anomalus*.
Рис. 4. Співвідношення розмірів проміжних зубів у *Neomys anomalus*.



a *b*

Fig. 5. Morphology of the upper Pm4 of *Neomys anomalus* (*a*) and *Neomys fodiens* (*b*)
Рис. 5. Морфологія Pm4 верхньої щелепи у *Neomys anomalus* (*a*) и *Neomys fodiens* (*b*)

Fig. 6. External features of *Neomys fodiens* (explanations in the text).

Рис. 6. Екстер'єрні особливості *Neomys fodiens* (пояснення в тексті).

Fig. 7. Typical edging around the anus of *Neomys fodiens*.

Рис. 7. Типова окантовка анального отвору у *Neomys fodiens*.

The following fact on the external variation of the water shrews requires a separate discussion.

On 12.07.2019 a female *Neomys fodiens* previously given birth was caught in Lake Dolzhina (body mass — 12.82 g; body length — 73 mm; tail length — 61 mm; foot length — 17.5 mm; the keel was all along the tail; condylobasal length — 21.5 mm; cranial width — 10.9 mm; interorbital breadth — 4.64 mm; height of coronoid process — 4.98 mm). This individual (Fig. 6) was similar in appearance to *N. anomalus* caught in 2019 (Fig. 3): grey-white high-raised colouration of the abdomen with a smooth transition to the back; dark solid spot around the anus (not in the form of an edging characteristic for *N. fodiens*, Fig. 7). The analysed case confirms that two species of the water shrew living in the same body of water can have almost identical colouration. It should be clarified that all individuals of *N. anomalus* caught in 2018–2019 did not have a pronounced red-brown coloration of the neck, often observed in individuals of *N. fodiens* from different regions of Belarus.

We consider important to create a photographic catalogue of variation of external and craniological characters of the two water shrew species caught in Belarus.

In connection with the proven habitat of *Neomys anomalus* and *N. fodiens* in one lake, zoological collections created on the basis of field studies in the Vitebsk and Minsk regions in recent years should be reviewed. In our opinion, an analysis of pellets of nocturnal birds of prey inhabiting wetlands in the floodplains would be highly informative (Gryz at al., 2012). For trapping of water shrews, it is advisable to use large diameter soil traps.

We assume that the capture of individuals of *Neomys anomalus* in recent years in various regions of Belarus (Brest and Vitebsk regions) and in territories where economic activity is carried out indicates the adaptive abilities of the species (including no fear of noise pollution, the ability to move significantly). The common view on habitats of *Neomys anomalus* in Belarus, mainly in specially protected natural areas, requires revision. Apparently, the Mediterranean water shrew is more widespread in Belarus than it is supposed.

Conclusions

Thus, in 2018–2019 individuals of the Mediterranean water shrew were caught in three interconnected lakes Borkovschina — Dolzhina — Vechelye, the total length of which with the channels is about 8 km. According to the results of the 2018 survey, the relative abundance of *Neomys anomalus* on Lake Borkovshchina and its channels was 4 individuals / 100 trap-days, and according to 2019 data on Lake Dolzhina and Lake Vechelye — 5.0 and 4.4 respectively. The findings allow to suggest the stability of the local population. This is determined not only by the movement of individuals from one reservoir to another, but also by the overgrowing of riparian vegetation. One of the factors contributing to this phenomenon is the reduction in flood water. Based on this, we believe that *N. anomalus* may also inhabit other lakes of the Ushach group.

In our opinion, in order to maintain the species abundance, it is necessary, first of all, to preserve the shoreline, riparian and aquatic vegetation in all lakes. It is advisable to include lakes into the system of protected areas with the status of reserves.

The most important characters in the differentiation of the two water shrew species inhabiting the same lakes were the following: body mass and main measurements, the length of the keel, the presence of natatory seta on the legs, as well as the commonly used measurements of the skull (condylobasal length, height of coronoid process and other). Morphology of the upper Pm4 of *Neomys anomalus* and *N. fodiens* should be clarified in further studies.

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