

## Assessment of invasive muskrat *Ondatra zibethicus* distribution and impacts on ecosystems in Lithuania

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### Abstract

After acclimatization muskrats spread over almost all Lithuania and increased to about 40 000 individuals in the 1980s. But since then the number of muskrats has decreased to about 2000 individuals. We used BINPAS (Bioinvasion Impact/Biopollution Assessment System) for terrestrial ecosystems, which is usually using for water ecosystems, to assess the impact of *Ondatra zibethicus* on native species and communities, on habitats, on ecosystems and the biopollution level (BPL). The impact of muskrats varied between different regions of Lithuania. Widespread and high numbers of muskrats, and strong biopollution of ecosystem functioning were identified in four regions of Lithuania – Nevėžis and Nemunas Rivers, Šalčia River, Varėnė river, Vištytis Regional Park.

Keywords: BINPAS, bioinvasion impact, *Ondatra zibethicus*, muskrat, distribution

### Introduction

The muskrat *Ondatra zibethicus* was introduced to Lithuania from Archangelsk in 1954 and from Kazakhstan in 1956 (Lavrov, 1957). After acclimatization, they have spread over almost all of Lithuania. The aim of this paper is to describe the distribution, abundance and the impact of muskrats on native species and communities, habitats and ecosystems in Lithuania.

### Materials and methods

Muskrat distributions were analysed in 11 forest enterprises: Alytus, Valkininkai, Kaunas, Šiauliai, Anykščiai, Varėna, Šalčininkai, Zarasai, Nemenčinė, Utena and Ignalina. The abundance of muskrats was assessed by the numbers of individuals, lodges and burrows. To evaluate the biopollution level (BPL) of muskrats we used the method of Bioinvasion Impact/Biopollution Assessment System (BINPAS) proposed by Olenin et al. (2007) and available at <http://www.corpi.ku.lt/databases/binpas>. Invasive species impacts were scored at five levels ranging from: no impact (0), weak impact (1), moderate impact (2), strong impact (3) and massive impact (4). We similarly assessed muskrat abundance impacts on native communities (C0-C4), habitats (H0-H4), ecosystem functioning (E0-E4), and biopollution level in the period 1986-2011 over 16 biotopes in Lithuania.

### Results

Muskrat distribution and abundance during the last 10 years has been highly variable. For example, in 2002 muskrats were most abundant in forest enterprises of Zarasai district (400 individuals), Valkininkai (333 individuals), Nemenčinė (293) and Utena (278). In 2005, however, they were most abundant in Valkininkai (220) and Ignalina (124), respectively.

The highest abundance (E) from the overall assessment occurred in five different Lithuania regions. But in many cases, muskrats occurred in low numbers in several localities (A). The impacts on native species or communities ranged from none (C0) to moderate (C2) and no sites with strong or massive impacts were detected.

A strong impact level on ecosystem functioning (E3) was evident only on the Šalčia river, upstream of Žygmantiškės village, Šalčininkai district. In other cases, the impact levels were weak or nonexistent. The impact was on habitats was also low (H0-H2), but a strong biopollution level (BPL=3) was noted in 5 regions.

## Discussion

In this study we examined the distribution and bioinvasion situation in Lithuania of the invasive species *O. zibethicus*. Numbers of muskrats during the investigation period in Lithuania were quite variable. During 1991-2000 five rivers (Varėnė, Šalčia, Merkys, Šventoji, Virinta) were surveyed along their banks to establish muskrat distribution and abundance. In the Šalčia, Merkys after eight years muskrat became practically extinct. In Varėnė the relative abundance was similar in all 9 years, as were the Šventoji and Virinta (Ulevičius and Balčiauskas, 2002). Compared to the period 1967-1975 when muskrats were abundant in Lithuania and the numbers were estimated at about 40.000, currently their numbers have fallen to 2.000-2.500 individuals (Žiemienė and Paulauskas, 2005).

The impact of muskrats on native species and communities (C0-C2) were negative for amphibians, fish and mollusks. Negative impacts also occurred on herbal and woody plants, and new growth was reduced in areas densely populated with muskrats. Muskrat impacts on waterfowl macrophytes (reeds, rushes etc.) degraded the protective properties of vegetation in coastal waters. Muskrats also impacted on the semi-aquatic rodent guild species composition, particularly the indigenous semi aquatic rodent *Arvicola terrestris* (Danilov, 2009). They caused moderate impacts on riparian vegetation structure by feeding on it, and also burrowing in the banks of water bodies (Sokolov and Lavrov, 1993). They also affected species composition, population size and age structure of freshwater unionid mussel communities (Owen et al., 2011). Muskrats impacts extended beyond habitat damage to effects on ecosystems (Danell, 1996; Nentwig et al., 2009). In Nevėžis and Nemunas Rivers, Šalčia River, Varėnė river, and Vištytis Regional Park muskrats were assessed as having a strong impact (E3) on ecosystem functioning and energy flow by consuming riparian vegetation, and releasing of the subsurface ground by burrowing and thus influencing chemistry and physical properties of water (Sokolov and Lavrov, 1993).

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