

# NOBANIS – Invasive Alien Species Fact Sheet

## *Ondatra zibethicus*

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### Species description

**Scientific names:** *Ondatra zibethicus*, (L., 1766) Cricetidae (*Muridae*, *Arvicolinae*)

**Synonyms:** *Ondatra zibethica*, *Castor zibethicus*, *Fiber zibethicus*, *Myocastor zibethicus*, *Ondatra americana*, *Mus zibethicus*, *Mussascus*

**Common names:** Muskrat (Musquash) (GB), Swamp rabbit (GB), Marsh rabbit (GB), Marsh hare (GB), Bisam (DE), Bisamratte (DE), Moschusratte (DE), Zwergbiber (DE), Zibethratte (DE), Bisambiber (DE), Biberratte (DE), Sumpfskaninchen (DE), Sumpfhase (DE), Muschmaus (DE), Zibetmaus (DE), Wasserratte (DE), Bisamrotte (DK), Ondatra (EE), Piisamrott (EE), Piisami (FI), Moskusrotta (IS), Ondatra (LT), Ondatra / bizamžurka (LV), Piżmak (PL), Ондáтра (RU).



**Fig. 1.** *Ondatra zibethicus*, photo by Nanna Ramsgaard.



**Fig. 2 and 3.** Close-up of tail and hind feet of *Ondatra zibethicus*, photo by Nanna Ramsgaard

### **Species identification**

*O. zibethicus* can attain a head and body length of 40 cm, a tail length of up to 25 cm, and a maximum weight of 1.5 or 2 kg. The species is especially adapted to an aquatic mode of life: its tail is naked and laterally flattened, the nose and ears are closeable, and the edges of its hind feet carry swimming bristles (Burghause 1988). It has a “rat-like” appearance but is actually closely related to voles (*Microtus* spp.) and lemmings (*Lemmus* spp.) (Banfield 1974).

### **Native range**

*O. zibethicus* originates from North America.

### **Alien distribution**

The central European populations of *O. zibethicus* are recruited from at least two centers of dispersal. Two males and three females were released for hunting purposes at Dobrisch near Prague around 1905 (*cf.* Hoffman 1958). In 1908 it was introduced to the Czech Republic for fur farming. Some animals were said to have been kept at Krumau on the upper Moldavia River at about the same time (possibly since 1888), and another group of *O. zibethicus* was supposedly released at Tabor in 1905 (according to Hoffman 1958). Within a few years, these private stocks probably gave rise to a wild population in Bohemia, which gradually extended its range, invading Austria (Mühlviertel) in 1912, Bavaria in 1914, and Saxony and Silesia in 1917. From their Bohemian center, *O. zibethicus* spread across the Sudeten Mountains into the Oder Basin, across the Lausitz Mountains to the Spree River, over the Fichtelgebirge to the rivers Saale and Main, and over the Bohemian Forest to the Naab and Danube. They spread rapidly along the Elbe River, attaining its mouth in 1947 (the first specimens were found in Hamburg in 1933; *i.e.* after having covered a straight distance of 550 km in only 28 years; their colonization of the Elbe and Havel rivers is

described by Hoffmann 1958). *O. zibethicus* subsequently colonized eastern Germany, spreading westward across the Mecklenburg lake district (Kintzel 1985; cf. Kirchner 1954). Since 1967 they have inhabited the entire Emsland (western Germany) (Schröpfer & Engstfeld (1983).

In south-western Germany, *O. zibethicus* invaded the counties of Kehl, Offenburg and Lahr in 1932, and the counties of Lörrach, Freiburg, Emmendingen, Müllheim, and Säckingen in 1955. By 1980, it had colonized every county in the State of Baden-Württemberg. *O. zibethicus* is now naturalized throughout all of Germany (Heidecke & Seide 1986).

For financial reasons, Finland imported about 1, 100 *O. zibethicus* from Germany, Czechoslovakia and North America (Artimo 1960). The animals were released in a total of 293 localities all over Finland from 1919 and onwards. Within 35 years (1920-1955) *O. zibethicus* had established in almost all available habitats, with the exception of those in the northernmost parts of Finland. In northern Finland, the spread has been distinctly slower than in southern Finland. The spread has varied within limits of 4-120 km per year, but usually *O. zibethicus* has spread at a rate of 10-20 km per year.

From northern Finland *O. zibethicus* spread into Sweden, and in 1957 the species had fully occupied the lower region of the border river Torneälven (Artimo 1960). In Sweden, there have been and still are excellent possibilities of studying the dispersal rate of the *O. zibethicus* southwards in the country (Danell 1996).

In 1927, 10 *O. zibethicus* were introduced from Finland to Russia. Twenty individuals from Finland were released to the wild near the islands of Solovets. At the beginning of 1928, *O. zibethicus* was released in massive numbers in the territory of the Soviet Union. By 1955 large areas near different water bodies were occupied by about 160,000 *O. zibethicus* (Lavrov 1957).

In the early 1930s *O. zibethicus* was also introduced to the Kola Peninsula (Lund and Wikan 1995). In total, about 1,000 *O. zibethicus* were released on the Kola Peninsula during 1931-1936. Just before 1950 *O. zibethicus* occurred all over the peninsula (Semjonov-Tian-Sjanskij 1987).

*O. zibethicus* were imported into Russia in 1928 - 1932 from Finland, Canada and England. After that ten thousand animals caught in new settlements, were released into the nature. Natural dispersal occurred very quickly as well and by 1970 the muskrat has occupied almost all suitable territories. Their distribution in Russia is from the western border up to Kamchatka. It exceeds the natural area significantly.

Between 1980 and 1988 there are very few observations of *O. zibethicus* in Norway. Since 1988 there has been a rapid population increase in Sör-Varanger, and today *O. zibethicus* has spread to almost every part of the municipality (Danell 1996). Little is known about the distribution and abundance of *O. zibethicus* in other parts of Finnmark or the rest of Norway, but it seems likely that the species has a scattered distribution and low population numbers (Lund 1995). *O. zibethicus* has, however, been documented shot or caught in gillnets intended for fishing, in Hattfjelldal in Nordland county and in Lierne in North Trøndelag county in 2005. For both areas it appears that *O. zibethicus* has migrated into Norway along watersheds crossing the mountain range along the border. South of the mountainous areas the *O. zibethicus* probably will spread easier across the border and also spread north-south on rivers in southern Norway.

The incidental record of *O. zibethicus* in Denmark was from the island of Rømø in 1989 (Ramsgaard and Christensen 2006). Since 2000, *O. zibethicus* has been regularly reported from the

southern parts of Denmark close to the German borders, the size of the population has, however, not been determined yet (Ramsgaard 2005, Ramsgaard and Christensen 2006).

In France, *O. zibethicus* farms were founded in the southern Vosges Mountains after World War I. When the price of *O. zibethicus* furs plunged during the 1920s, a number of farms closed and released their animals (e.g. 500 animals in 1928 near Belfort). This population spread to Switzerland and Alsace by 1930, and the Meuse and Moselle rivers in 1935.

*O. zibethicus* was introduced twice to Estonia: in 1947, 190 animals and in 1952, 361 animals, raised from the original stock, were released to water bodies in southern and western parts of Estonia (N. Laanetu, pers.comm.).

The first record of *O. zibethicus* in Latvia is from 1961; it spread from Belarus and later also from Estonia and Lithuania, where it was introduced (Ozols 1997).

### **Pathways of introduction**

*O. zibethicus* was introduced for fur farming and breeding purposes.

### **Alien status in region**

*O. zibethicus* is present in most of the countries of the region (see table 1). In some parts of Estonia the American mink (*Mustela vison*) has displaced *O. zibethicus* by taking its habitat (Kukk 2001). However, in other parts of Estonia *O. zibethicus* is still present, but in very low numbers, e.g. in South-Estonia and near the Narva reservoir (in north-east of Estonia) (Kull *et al.* 2005).

*O. zibethicus* occurs throughout Poland. However, within the last 15 years, the numbers have dropped significantly (by 81% in NW Poland). This is partly due to the presence of *Mustela vison* (Brzeziński *et al.* 2010). However, the considerable decrease in *O. zibethicus* was recorded in all of Poland, even in locations without American mink presence.

In Norway *O. zibethicus* occur in areas with quite unfavourable habitats where population density is very low (Danell 1996).

The status of *O. zibethicus* in Latvia is not known; but in later years the number of *O. zibethicus* has decreased, because of its natural enemies, such as *Mustela vison* and *Arvicola terrestris* (Ozols 1997, J. Ozoliņš, pers. comm.).

In Russia *O. zibethicus* kept its new huge area, but its quantity has significantly decreased for the last 15 - 20 years. There are many reasons for the decline in the numbers of *O. zibethicus*, but in the north of the area there has been a reduction of edible plants and intensive growth of inedible plants (Павлов, и др.1973, Соколов, Лавров, 1993.)

In Austria it is present today in all federal provinces along rivers in the lowlands (Englisch 2005).

| Country                 | Not found | Not established | Rare | Local | Common | Very common | Not known |
|-------------------------|-----------|-----------------|------|-------|--------|-------------|-----------|
| Austria                 |           |                 |      |       | X      |             |           |
| Belarus                 |           |                 |      |       | X      |             |           |
| Belgium                 |           |                 |      |       |        | X           |           |
| Czech Republic          |           |                 |      | X     |        |             |           |
| Denmark                 |           |                 |      | X     |        |             |           |
| Estonia                 |           |                 | X    |       |        |             |           |
| European part of Russia |           |                 |      |       | X      |             |           |
| Finland                 |           |                 |      |       | X      |             |           |
| Faroe Islands           | X         |                 |      |       |        |             |           |
| Germany                 |           |                 |      |       | X      |             |           |
| Greenland               | X         |                 |      |       |        |             |           |
| Iceland                 | X         |                 |      |       |        |             |           |
| Ireland                 | X         |                 |      |       |        |             |           |
| Latvia                  |           |                 |      | X     |        |             |           |
| Lithuania               |           |                 |      | X     |        |             |           |
| Netherlands             |           |                 |      |       | X      |             |           |
| Norway                  |           |                 | X    |       |        |             |           |
| Poland                  |           |                 |      |       | X      |             |           |
| Sweden                  |           |                 |      | X     |        |             |           |

**Table 1.** The frequency and establishment of *Ondatra zibethicus*, please refer also to the information provided for this species at [www.nobanis.org/search.asp](http://www.nobanis.org/search.asp). Legend for this table: **Not found** –The species is not found in the country; **Not established** - The species has not formed self-reproducing populations (but is found as a casual or incidental species); **Rare** - Few sites where it is found in the country; **Local** - Locally abundant, many individuals in some areas of the country; **Common** - Many sites in the country; **Very common** - Many sites and many individuals; **Not known** – No information was available.

## Ecology

### Habitat description

The animals live semi-aquatically. They are crepuscular, spending the day in burrows or floating reed lodges up to 1.5 m in height (mostly during winter – depending on habitat and climate) (Heidecke & Seide 1986, Ramsgaard 2005).

### Reproduction and life cycle

Females usually throw 3 or 4 times per year from late April on, producing 2 to 12 offspring (4 to 7 on average) annually. In colder climates females may throw only twice a year (Ramsgaard 2005). The young grow a nest coat after 18 days, an adolescent coat after about 4 weeks, and the adult coat at about 4 months (Burghause 1988). The rate of reproduction depends on food supply, population density, and water temperature. The mortality of the offspring increases at low water temperatures and high population densities (*cf.* Meinert & Diemer 1977). Females may attain sexual maturity at the age of five months, and the males after seven months (Heidecke & Seide 1986).

### Dispersal and spread

The principal migration period of *O. zibethicus* is during spring (peaking in March) and fall (peaking in October). The migration period may extend from fall to spring during very mild

winters. The rate of dispersal varies from year to year, depending mostly on the survival rate of the litter in spring, as well as on the amount of precipitation during the summer, as low water levels strongly impede the dispersal of the species (Burghause 1996). Dispersal rates of 6-8 km/year have been reported from several countries in Europe including Denmark (Ramsgaard and Christensen 2006 and references therein). High water levels may provide stochastic dispersal opportunities (Ramsgaard 2005). For example *O. zibethicus* can migrate long distances (up to 160 km/day) by rafting, being carried long distances by river currents (Böhmer *et al* 2001)

## Impact

### Affected habitats and indigenous organisms

*O. zibethicus* feeds mainly on the plants of reed belt communities (Pietsch 1982; Krauss 1990; Diemer 1996), particularly on common reed (*Phragmites communis*). According to Burghause (1988), one animal is capable of cropping 1.5 m<sup>2</sup> per night. *O. zibethicus* also likes to dig for roots, and it is particularly attracted to the tubers of Jerusalem artichoke (*Helianthus tuberosus*), a common neophyte in river plains (Burghause 1988, 1996). Although *O. zibethicus* is considered a generalist species in terms of its diet, it predominantly eats only a few species, which for example could be the plant species mentioned above (Ramsgaard 2005). Small well-vegetated lakes with relatively stable water levels are especially favored by *O. zibethicus* in Finnish waters, but heavy impacts have also been reported in waters with poor stands of helophytes (Rintanen 1976). *O. zibethicus* grazing affects the structure of littoral vegetation (Danell 1977, 1979). This change in vegetation affects communities of aquatic invertebrates (Nummi *et al.* 2005).

*O. zibethicus* may sometime feed on crayfish, zebra mussels, crustaceans, and insects (*cf.* Ulbrich 1928, Hoffmann 1958), bivalves - including threatened taxa such as *Anodonta*, *Unio*, and the freshwater pearl mussel *Margaritifera margaritifera* (*cf.* Brander 1955; Baumann & Everding 1986; Hochwald 1990; Zimmermann *et al.* 2000). This indirectly affects rare fish species that deposit their eggs in bivalves, such as the bitterling (*Rhodeus amarus*).

The effects of spreading of *O. zibethicus* are often linked with those of anthropogenic pollution, as in the case of the decline of reed belts in many lakes (Kintzel 1985; Barthelmes 1991). According to Barthelmes (1991), long-term observations at a lake in Berlin (Grosser Müggelsee) have shown that the decline in reed cover may have been due mainly to the feeding pressure exerted by *O.*

*zibethicus*. In Kintzel (1985), Stüber reports that at the Lake of Döbberlin "the plant cover was usually destroyed completely after one or two years, after which *O. zibethicus* moved on".

Bernhardt and Schröpfer (1992) have shown that in the Ems region *O. zibethicus* removes bulrushes (*Typha latifolia*), promoting the development of club-rushes (*Schoenoplectus lacustris*).

All in all, the general opinion on the impact of *O. zibethicus* on their habitat is mixed, especially in northern Europe. On one hand, the animal is regarded as a positive factor because it creates openings in dense vegetation stands and it prevents lakes from being overgrown by vegetation. On the other, it has been blamed for destroying valuable vegetation and creating mud-flats. Depending on human interest in the development of the particular wetland, *O. zibethicus* may be regarded as a valuable element or as a "pest" species (Danell 1996).

The American mink (*Mustela vison*), which is now spreading throughout Germany, is an important predator of *O. zibethicus* (Burghause 1988; Stubbe 1993). Other natural enemies are martens, European polecats, weasels, foxes, lynxes and various birds of prey and large owls; however, the populations of these predators have been anthropogenically decimated, so that their predation pressure on *O. zibethicus* is low. *O. zibethicus* is difficult to catch for most of the predators since it

spends most of its time in the water. The *O. zibethicus* taken by the mentioned predators are often sick or young animals which spend more time on land (Ramsgaard 2005).

### **Genetic effects**

No known genetic effects.

### **Human health effects**

According to Hoffmann (1958), *O. zibethicus* is host to a great number of parasites (41 species of trematodes, 22 species of cestodes, 27 species of nematodes, and others), notably various species capable of infesting humans, such as the dog tapeworm (*Taenia hydatigena*), the cat tapeworm (*Taenia taeniaformis*), and the dwarf tapeworm (*Echinococcus multilocularis*; cf. Diemer 1996). *O. zibethicus* only occasionally affect humans directly. This occurs in situations when the animals are cornered. They defend themselves vigorously and may even attack humans (Danell 1996).

### **Economic and societal effects (positive/negative)**

*O. zibethicus* may dig far into the banks of water bodies. Their extended burrowing activity can cause serious economic damage (undermining of banks, dams, road and railway embankments) causing their collapse during floods. Also damage to flood protection structures (destabilization of flood dikes), and to fish farms (chewing through nets and fish traps) have been observed (Burghause 1996). The system of passages of one *O. zibethicus* family may extend up to 25 m along the bank and 15 m inland. In Germany the costs of economical impacts caused by *O. zibethicus* are regarded to be 12,400,000 euros (Reinhardt *et al* 2003).

*O. zibethicus* may also reduce the ecological value of wetlands of interest to nature conservation by destroying the reed belts, feed on endangered plant species and prey upon rare freshwater bivalves. The animal moves four times its own weight in gnawed off plants. About a quarter of this is eaten by the animal, creating quite a lot of dung which usually goes into the water.

In Sweden *O. zibethicus* is called a “keystone” species because it creates better living areas for water fowls and insects as it creates openings in dense vegetation stands and thus prevents lakes from being overgrown by vegetation (Danell 1996).

## **Management approaches**

### **Prevention methods**

Indications that the spreading of *O. zibethicus* would result in serious damages already existed at the beginning of the 20th century. The first police regulations in Germany on *O. zibethicus* control were enacted in Saxony and Bavaria in 1917, and provided the basis for the organization of the first control institutions after World War I (Hoffmann 1958, Burghause 1996). The increasing problems caused by *O. zibethicus* in Germany led to the creation of a State Control Service (*Reichsbekämpfungsdienst*) in 1933. The State Regulation on *O. zibethicus* Control (*Reichsverordnung zur Bekämpfung der Bisamratte*) came into effect on July 1<sup>st</sup> 1938, based on the Act for the Protection of Cultivated Plants (*Gesetz zum Schutze der Kulturpflanzen*) of 5 May 1937.

The Bern Convention on the Preservation of European Wild Plants and Animals and their Natural Habitats lists *O. zibethicus* in Recommendation No. 77 among those species which demonstrably pose a threat to biological diversity, and therefore recommends its extermination. However, Burghause (pers. comm.) asserts that it has been obvious for decades that an extermination of *O. zibethicus* is no longer possible, not even at considerable effort.

According to Estonian List of Invasive Alien Species (Ordinance of the Minister of Environment, no 126 of 7th Oct. 2004) it is forbidden to bring *O. zibethicus* in the country for artificial breeding or keeping. In the Nature Conservation Law in §49 and §57 cases are described where particular prevention actions should take place (considering the problems of (invasive) species and their massive distribution).

### **Eradication, control and monitoring efforts**

The choice of the control method depends on the specific features of the problem and the characteristics of the impacted area.

In some countries the control of *O. zibethicus* is no longer focused on the extermination of the species, which is judged impossible. Instead, it is targeted at slowing down the rate of spreading and at controlling the population size in critical situations. By these measures, Rhineland-Palatinate has succeeded in preventing serious *O. zibethicus* damage, according to Burghause (1996). However, statewide control in Germany of *O. zibethicus* was only regarded as a reasonable task as long as there was hope of keeping certain areas pest-free (Burghause, pers. comm.).

Direct control of *O. zibethicus* in Germany, for example, has been conducted with traps (*cf.* Bothe 1993), poisoned bait (chlorphacinon), ferrets, poison gas, and firearms (Burghause 1996).

In the Netherlands, *O. zibethicus* are caught in underwater traps constructed to make entry easy but exit difficult. In the Netherlands, during the last decade of last century the number of catches was about 30,000 animals and in 2002, 363,042 *O. zibethicus* were caught (Landelijk Jaarverslag 2002). In Sweden, trapping of *O. zibethicus* has been insignificant due to the low price of *O. zibethicus* furs and the banning of leghold traps. Furthermore, the species has not been regarded as a “pest” animal in Sweden and therefore there have been no campaigns to reduce their numbers (Danell 1996).

In Estonia *O. zibethicus* is a hunting object, which can be also considered as a controlling method. According to the Hunting Law in Poland, *O. zibethicus* occurring in fish ponds can be shot throughout the year. Outside fish ponds, the species can be hunted between 11.04 and 15.04. In Latvia, according to Hunting Law, *O. zibethicus* can be shot from October 1<sup>st</sup> – March 31<sup>st</sup> and in unlimited numbers. In the open season of year 2004/2005, 69 *O. zibethicus* were caught in Latvia.

According to Burghause (1996), the "most successful, but also the most expensive" form of *O. zibethicus* indirect control is fortification of the embankments. The banks of water bodies are protected against *O. zibethicus* essentially by inserting a layer of plastic foil. These sections are additionally reinforced with a strong layer of large stones.

### **Information and awareness**

In Estonia two booklets introducing invasive species of local importance have been published (Kukk et al 2001, Kull *et al.* 2005.). The purpose of those booklets is to raise public awareness of the problems that go hand-in-hand with the spread of invasive species. The booklet contains species descriptions and photos as well as provides simple tips on how the spread of a species could be controlled.

### **Knowledge and research**

In Denmark, registration of the *O. zibethicus* distribution has taken place with the use of *O. zibethicus* rafts (Ramsgaard 2005, Ramsgaard and Christensen 2006). In Norway, there are no recent mappings of the *O. zibethicus* distribution and no analyses of the dispersal rate have been reported (Danell 1996).

## **Recommendations or comments from experts and local communities**

A monitoring program for *O. zibethicus* is recommended. It should focus on the maximum population density attained in the absence of control measures, and on the efficacy of predation by mink (*Mustela vison*). Lauenstein (pers. comm.) expects that some government agencies may reassess their position in the next few years, because the widespread lack of control activities could result in a serious aggravation of the *O. zibethicus* problem. Furthermore a better co-operation between the implicated countries is needed to collect better knowledge of the species (Nanna R. Ramsgaard, pers. comm.).

## **References and other resources**

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## Links

[The Lutreola foundation webpage in Estonia: A webpage dedicated to conservation of European mink \(\*Mustela lutreola\*\)](#). Available in both Estonian and English.

[Ondatra zibethicus on Invasive Species in Belgium](#)

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