

NOBANIS - Invasive Alien Species Fact Sheet

Oncorhynchus mykiss

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Species description

Scientific names: *Oncorhynchus mykiss* (Walbaum, 1792), Salmonidae

Synonyms: *Fario gairdneri* Richardson, 1836, *Oncorhynchus kamloops* Jordan, 1892, *Parasalmo penshinensis* Pallas, 1814, *Salmo gairdneri* Richardson, 1836, *Salmo gilberti* Jordan, 1894, *Salmo irideus* Gibbons, 1855, *Salmo kamloops* Jordan, 1892, *Salmo masoni* Suckley, 1860, *Salmo mykiss* Walbaum, 1792, *Salmo nelsoni* Evermann, 1908, *Salmo penshinensis* Pallas, 1814, *Salmo purpuratus* Pallas, 1814, *Salmo rivularis* Ayres, 1855, *Salmo stellatus* Girard, 1856, *Salmo truncatus* Suckley, 1859.

Common names: Kirjolohi (FI), Pstrag teżowy (PL), Rainbow trout, Steelhead trout (GB), Radoozhnaya forel (RU), Regnbogasilungur (IS), Regenbogenforelle, Stahlkopfforelle (DE), Regnbueørred (DK), Regnbueaure, Regnbueørret (NO), Regnbåge, Regnbågelax (SE), Varavīksnes forele (LV), Vaivorykštīnus upetakis (LT).



Fig.1. 7.3 kg male *Oncorhynchus mykiss* in nuptial dress. The surface is shiny because the scales are embedded in the skin (as extra armour) during spawning, photo by Bror Jonsson.

Species identification

Oncorhynchus mykiss has a streamlined body with adipose fin. They are deep-bodied and sideways compressed. Average length of *Oncorhynchus mykiss* is 30-45 cm and the anadromous form steelhead 50-75 cm. Extremely large sea-run individuals can be more than 120 cm in length and above 25 kg in mass. The general body shape is typical for a trout, with a moderately large head and a mouth that extends back behind the eyes. The colours vary with habitat, size and sexual condition.

Oncorhynchus mykiss that live in lakes have a very silvery appearance, usually with a dark olive-green colour on the back. Occasionally the back is a deep steely blue, mostly in *O. mykiss* that live well offshore in deep lakes or in small fish that have not yet spawned. Cheeks and opercula are

pink, the body sides marked with a vague, pink blush to rose red band and a large number of rather small black spots, mostly restricted above the lateral line or scattered over the whole side. The belly and ventral surface of the head are whitish. Eyes have an olive to bronze colour. Sometimes a soft, metallic-pink colour is present along the sides of the body and the head (Scott and Crossman 1973).

When *Oncorhynchus mykiss* leave lakes to spawn in running waters, their colours become more intense. The pinkish stripe that is present on the sides of lake fish becomes a rich crimson colour, the fins attain a stronger red colour, and there is sometimes a red slash in the folds below the lower jaw. The belly and the lower sides turn a smoky grey and spots on the sides and upper fins become bolder and more clearly delineated. *Oncorhynchus mykiss* parr (juveniles) have an olive-green colour on the back and silvery olive high on the sides. There are 8-13 oval-shaped marks along the sides, which may also have smaller dark spots along them. Rosy-yellow markings occur along the lateral lines between the oval marks. As the parr grows, adult colouration is attained (Scott and Crossman 1973).

Native range

The native range is the Eastern Pacific Ocean and the freshwater, mainly west of the Rocky Mountains, from northwest Mexico (including extreme northern Baja, California), to the Kuskokwim River, Alaska. It is probably native in the drainages of the Peace and Athabasca rivers east of the Rocky Mountains (MacCrimmon 1971).

Alien distribution

History of introduction and geographical spread.

Oncorhynchus mykiss has been introduced worldwide; to all the temperate and sub-Arctic parts of the world, except Antarctica, it is restricted to localities above 1200 m in tropical areas. Few considerations seem to limit its distribution. The species is flexible and adaptable to new habitats, including hatcheries, lakes, rivers, ponds, and artificial impoundments. However, successful spawning in rivers in Europe is uncommon. The first attempt to introduce *Oncorhynchus mykiss* into the British Isles was made in 1884 when eyed eggs were shipped from United States (MacCrimmon 1971). In 1887 a good breeding stock was established. *Oncorhynchus mykiss* were sent to Germany from Michigan in 1882 and dispersed to various hatcheries. From Germany it was spread to Sweden in 1892, Denmark in 1894 and to Finland in 1898. The first introductions of *O. mykiss* into Poland were probably between 1882 and 1889 through the effort of a German scientist. The species was imported to Norway and Iceland from Denmark in 1902 and 1951, respectively.

Pathways of introduction

Oncorhynchus mykiss is introduced via aquaculture, and the populations are sustained by continuous releases and escapes from hatcheries and farms. Successful reproduction in nature is rare (Rask *et al.* 2000)

Alien status in region

The species is common all over Europe, and occurs both in rivers, fjords and coastal waters (see table 1). In Norway 11 self-reproducing populations are known (Hindar *et al.* 1996), In Denmark and Sweden, a few self-reproducing populations exist (Larsen 1983 1984). In Germany, on the other hand, no self-reproducing population is known (Nehring 2006). However, individuals of the species are still common in many countries due to continuous releases, in table 1 the frequencies thus relate to the total abundance of the species, not to the few self-reproducing populations.

Country	Not found	Not established	Rare	local	Common	Very common	Not known
Denmark						X	
Estonia					X		
European part of Russia			X				
Finland					X		
Faroe Islands					X		
Germany					X		
Greenland		X					
Iceland			X				
Latvia					X		
Lithuania					X		
Norway					X		
Poland					X		
Sweden					X		

Table 1. The frequency and establishment of *Oncorhynchus mykiss*, please refer also to the information provided for this species at 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

Oncorhynchus mykiss are primarily freshwater fish, although sea-run populations, often known as steelhead, exist in some areas. Any population of *O. mykiss* is, however, capable of migrating to or surviving in the sea.

The species prefers well-oxygenated, clean fresh water. Optimal temperature for growth is 17 °C, preferred temperature for spawning is around 12°C, and it tolerates temperature in the range of 0 °C to 25 °C. *O. mykiss* tend to thrive better in lakes than in streams or rivers, although large fish are often present in remote headwaters (McDowall 1990).

Reproduction and life cycle

The reproduction of *Oncorhynchus mykiss* is sexual. Fertilisation is external, with the female trout excavating a hollow in streambed gravel for the eggs to be laid in winter, spring or early summer. Between 700 and 4000 orange-red eggs are laid per spawning event. The male then fertilises the eggs and they are covered with a layer of gravel. This 'nest' is known as a redd. The fecundity is approximately 2000 eggs per 1 kg somatic mass of females. Egg diameter is ca. 5 mm (Scott and Crossman 1973).

Lake fish usually spawn in lake tributaries, where the young trout feed and grow before migrating downstream after about a year. Growing to maturity in the lake takes around 2 to 4 years, at which time they migrate back to the tributaries to spawn. Most fish will return to the tributary in which they hatched. Some lake populations may spawn in lake-shore gravels rather than travel into tributaries. Maximum recorded age is 11 years. In Norway, there appears to be no specific homing

behaviour of released hatchery fish, contrasting observations in its original area (Jonsson *et al.* 1993a).

Dispersal and spread

O. mykiss is mainly spread by man to hatcheries as egg or eyed eggs. The fish are released in lakes and rivers to improve the native fish fauna for anglers and to invade new locations. Some areas have regular restocking programs. There are also unintentional escapes from fish farms and hatcheries (Jonsson *et al.* 1993b; Hindar *et al.* 1996).

Impact

Affected habitats and indigenous organisms

Impacts include hybridisation, disease transmission, predation and competition with native species. Furthermore the massive use of the species in aquaculture may in some areas (eg. in Denmark) lead to pollution with surplus food as well as to problems with the free passage of native species in the affected rivers (Jensen and Rasmussen 1988).

Whirling disease is a condition caused by a protozoan (*Myxobolus cerebralis*) that causes dysfunction in the nervous system of salmonids, and may result in curvature of the vertebral column. This results in fish losing the ability to maintain a proper orientation, causing them to swim in a spiral motion (McDowall 1990). The stocking of hatchery-reared *Oncorhynchus mykiss* into the wild has caused outbreaks of this disease in the United States, threatening wild fish populations (Gilbert and Granath 2003). This disease may be also one of the reasons why *O. mykiss* have difficulty establish self-sustained populations in Europe, although it is believed that other causes may also cause the problem. In Poland, the species is not self-reproducing although whirling disease has not been observed during the last 50 years.

Oncorhynchus mykiss feed on zoobenthos, zooplankton and fish, and in many countries introduced *O. mykiss* have been reported to have negative effects on native fish, amphibians and invertebrates. In New Zealand it is suspected that *Oncorhynchus mykiss* affect native fish species through direct predation and competition for feeding areas (McDowall 1990), while in the United States there is evidence that the same is happening to fish such as the humpback chub (see *Gila cypha* in IUCN Red List of Threatened Species), suckers, and squawfish. Little is known about negative effects on the native European fauna.

Oncorhynchus mykiss often spawn in the spawning areas of brown trout (*Salmo trutta*) and Atlantic salmon (*Salmo salar*) in spring when their spawn (eggs or alevins) are in the gravel nests (Jonsson *et al.* 1993a). When *Oncorhynchus mykiss* spawn they may destroy the eggs of the native trout and salmon.

Genetic effects

In the United States, the introduction of *O. mykiss* into areas outside of their native range has caused problems due to their ability to hybridise with native salmonid species, affecting their genetic integrity. Some species, such as the Alvord cutthroat (*Oncorhynchus clarki*) have become virtually extinct because of this. Species also known to be affected by hybridization include the Lahontan cutthroat trout (*O. clarki henshawi*); golden trout (*O. aquabonita*); Gila trout (see *O. gilae* in IUCN Red List of Threatened Species) and Arizona trout (see *O. apache* in IUCN Red List of Threatened Species).

There seems to be little genetic effect (other than through ecological competition) on European salmonids because of a general difference in spawning time. There are fall spawning strains in fish farms in Europe which give viable triploid crosses with brook trout.

Human health effects

None

Economic and societal effects (positive/negative)

This species is highly valued as a sport fish, with regular stocking occurring in many locations where wild populations cannot support the angling pressure.

Management approaches

Prevention methods

Since successful spawning is very rare outside its original range, there is usually no need for a special management of the species. However, the building of inland hatcheries and fish ponds and the production and release of *Oncorhynchus mykiss* is restricted, not the least because of the disease threat to wild fish caused by infected *Oncorhynchus mykiss* escaping from such facilities. It can carry parasites such as sea lice (*Lepeophtheirus salmonis*) as well as *Gyrodactylus salaris*, which are lethal to Atlantic salmon.

Eradication, control and monitoring efforts

Systematic fishing for *Oncorhynchus mykiss* occurs after major escapes from fish farms, e.g. to reduce the spread of sea lice.

Information and awareness

None

Knowledge and research

Ecological research has been carried out in Denmark (Larsen 1983, 1984) and Norway (Hindar *et al.* 1996, Jonsson *et al.* 1993a,b).

Recommendations or comments from experts and local communities

None

References and other resources

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Links

www.fishbase.org,
www.aquatic-aliens.de

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