

NOBANIS – Invasive Alien Species Fact Sheet

Neogobius melanostomus

Author of this species fact sheet: Mariusz R. Sapota, Department of Marine Biology and Ecology, Institute of Oceanography, University of Gdańsk, Al. M. Piłsudskiego 46, 81-378 Gdynia, Poland, tel.: +48 58 5236601, E-mail: ocems@univ.gda.pl

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Species description

Scientific names: *Neogobius melanostomus* Pallas 1811, Gobiidae

Synonyms: *Gobius melanostomus* Pallas 1811, *Gobius (Apollonia) melanostomus* Pallas 1811.

Common names: Round Goby (GB), Kruglyak–Grundel (DE), Schwarzmund-Grundel (DE), Sortmundet kutling (DK), Ümarmudil (EE), Mustakitatokko (FI), Babka bycza (PL), Bychok - kruglyak (RU), Svartmunnad smörbult (SE).

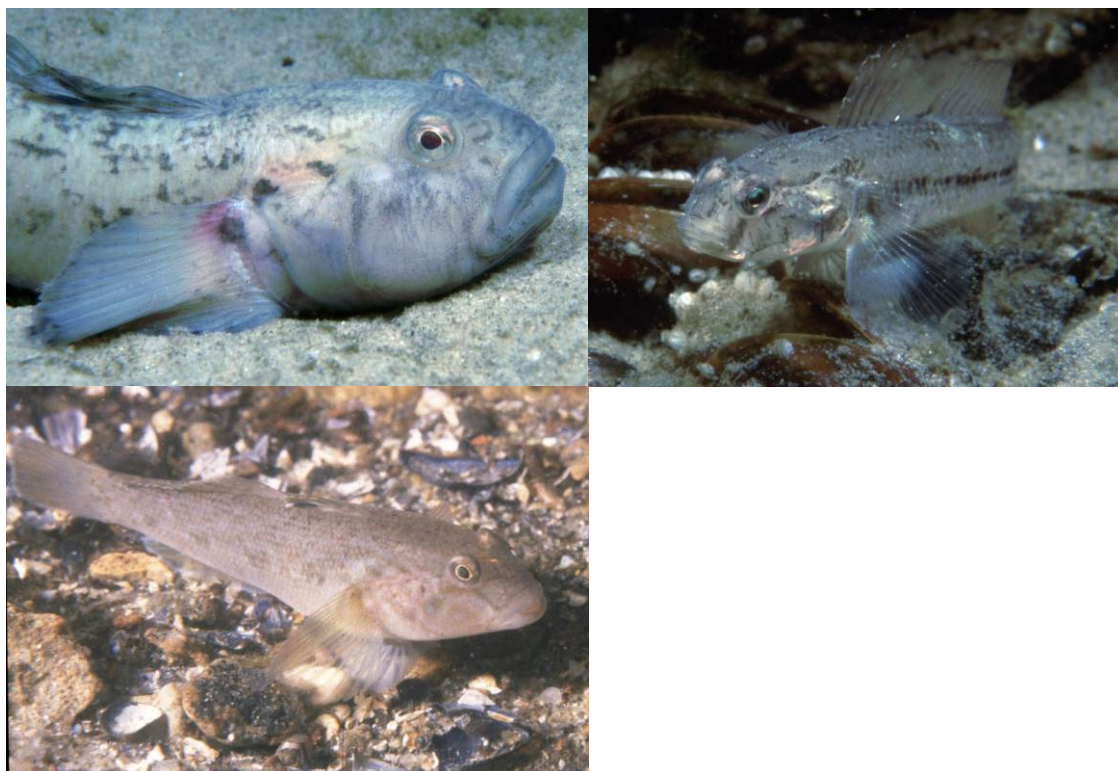


Fig. 1, 2. and 3. *Neogobius melanostomus* from the Gulf of Gdańsk, photo by Jarosław Samsel.

Species identification

N. melanostomus is a fairly small bottom-dwelling fish, resembling a large tadpole in general appearance. Maximum size differs in various localities, from 12 cm for males and 11 cm for females in the Laurentian Great Lakes Upper Detroit River (MacInnis and Corkum 2000), to 25 cm for males and 19 cm for females in the Gulf of Gdansk (Sapota 2005). Round gobies are yellowish grey, with lateral blotches and a large black spot on the first dorsal fin. Breeding males are black, with white or white-blue edged caudal fins. The species has a fairly large head, the depth of the head being equal to $0.9 \div 1.2$ of its width (Miller 1986). The body is soft and covered with fine scales that are definitely cycloid on the middle and anterior nape. The dorsal fin lack spines and the pelvic (bottom) fins are fused to form a suction disk that helps to anchor the fish to the substrate in flowing waters. For proper identification of *N. melanostomus* features like the number of rays in fins as well as the number of scales are important (Miller 1986).

Native range

N. melanostomus occurs in all shallow water regions of the Black Sea, the Caspian Sea, the Marmara Sea and in all areas of the Sea of Azov (Berg 1949) (Fig. 4). Lower abundance in the southern regions of the Black Sea (Ozturk 1998) seems to be mainly connected with the higher salinity of that area, which is caused by a lower number of riverine outflows in the region (Sapota 2005). Gobies ascend the tributaries of the Black and Caspian seas, including the Dniester River as far as the Smotrich River (near the city of Kamenets-Podolsky, Ukraine); the Yuzhnyi Bug River as far as the city of Ladyzhino, Ukraine; the Dnieper River as far as the city of Dnepropetrovsk, Ukraine; and the River Don as far as the city of Rostov, Russia (Berg 1949, Charlebois *et al.* 1997). In the Danube *N. melanostomus* is native to the delta region.



Fig. 4. Native distribution of *N. melanostomus* (from Sapota 2005).

Alien distribution

History of introduction and geographical spread

At the end of 1950s, the first transfer of *N. melanostomus* outside its native range occurred when it was moved to the Aral Sea (Miller 1986). Most likely introduction took place together with stocks of grey mullet from the Caspian Sea (Moskalkova 1996). However, that population went extinct because of increasing salinity in the Aral Sea (Corkum *et al.* 2004).

During the last twenty years, *N. melanostomus* have been noticed in several separate areas, outside the range of their natural distribution. In 1985, *N. melanostomus* was found in the Moscow River near Moscow City (Sokolov *et al.* 1989). In 1990, the first round gobies were observed in the Baltic, in the Gulf of Gdańsk (Skóra and Stolarski 1993, 1995, 1996). In the same year *N. melanostomus* was found in the Great Lakes in North America (Crossman *et al.* 1992, Jude *et al.* 1992). Consequently, invasion of this region took place. By early summer 1999, fishermen reported the first round gobies in German Baltic waters at Rugia Island (H. Winkler, University of Rostock, unpubl. data cited in Corkum *et al.* 2004). In May 2003, *N. melanostomus* had been reported at several locations along the entire Baltic Sea coast of Germany, west to Rostock (K. Skóra, University of Gdansk, unpubl. data cited in Corkum *et al.* 2004). In addition to the invasion into the Baltic, *N. melanostomus* has spread up the rivers entering the Black Sea. In 2001, surprisingly, they were detected in the Danube River in Vienna. (Corkum *et al.* 2004). In May 2002, round goby was caught in Riga Bay, in the eastern part of the Baltic (Henn Ojaveer, pers. comm.). In 2004, it was caught on open Baltic waters near Liepaja City (Atis Minde, pers. comm.) In 2005, it was reported from the Finish waters (Erkki Leppakoski, Henn Ojaveer, pers. comm.). It also occurs in the Lithuanian Baltic waters (Sergej Olenin, pers. comm.). Along the Polish coast, round goby can be detected in small quantities in lakes connected with the sea and in coastal zones of the Pomeranian Bay.

Until now, the introduction of *N. melanostomus* has only developed into a serious invasion in the Gulf of Gdańsk, where rapid dispersal over large areas of that basin has taken place (Fig 5.). The population from the Gulf of Gdańsk was probably the base for introduction into others regions of the Baltic.

For the first time, round goby was noticed in the Gulf of Gdańsk in 1990, in the harbours of Hel and Gdynia. A sign of a successful introduction and basing stage for subsequent invasion was the small growth of the occupied area, two years later. In 1997 *N. melanostomus* occupied an area of about 270 km². Then, due to the limitation of suitable living areas, the rate of invasion decreased. In 2001, more than 400 km² were colonized. This will most likely be the final range of round goby occurrence in that part of the Gulf of Gdańsk (Sapota 2005). In the area surrounding the pier of the Hel harbour, the highest abundance, about four individuals per m², was observed in July (Sapota and Skóra 2005). Sometimes, mostly in summer months, quantities in shallow waters are locally much higher, so many that it can be difficult to count. On the other hand, in deeper sandy areas, observed quantities are as low as a few individuals per hundred m². Additionally, mostly small young of the year fish occur in that zone.

Currently, three geographically separate groups of round gobies occur in the Gulf of Gdańsk and its vicinity. The stable and well-established group that occupies the shallow waters (down to a depth of 20 m) in the western part of the Gulf of Gdańsk has the highest abundances. The second group, on the western border of the Gulf of Gdańsk (Kuczyński 1995), has low abundances and is not increasing at a fast rate. The third group, found in the Vistula Lagoon (Borowski 1999), started to increase rapidly in abundance in 2001. There are no morphological or genetic differences between the groups.

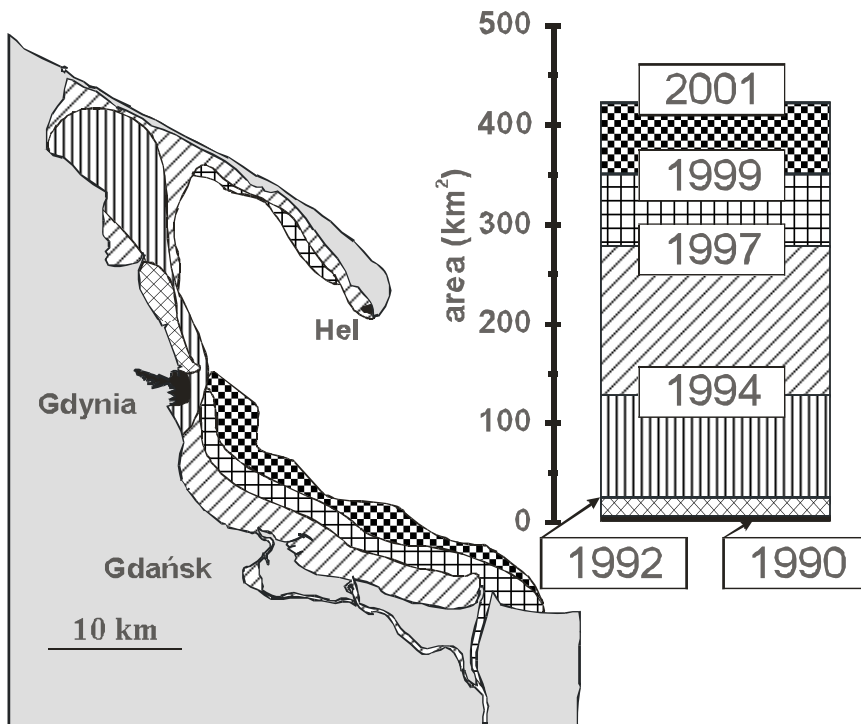


Fig. 5. Increase in the area occupied by round goby in the west part of the Gulf of Gdańsk, from the initial 4 km² near the harbours of Hel and Gdynia in 1999 to more than 400 km² covered in 2001.

Pathways of introduction

A patchy distribution and long distances between native regions of occurrence and newly settled areas is characteristic for the current world distribution of *N. melanostomus*. This points to the existence of an effective transport mechanism for moving round gobies long distances. Most probably, transport occurs in ballast waters.

Despite investigations, the origin of *N. melanostomus* population introduced into the Gulf of Gdańsk is still unknown. We also do not know the route of the vessels that transported *N. melanostomus* into the Gulf of Gdańsk. Theoretically, there are three possible ways (Fig. 6). The shortest one is about 2000 km long: from the Black Sea through Dniepr, Prypec, Pina, Bug and Vistula into the Gulf of Gdańsk. The second possible route is longer, about 3000 km in length, also mainly through fresh waters: from the Sea of Azov (through Don) or the Caspian Sea and then through the Volga, the Rybinski Reservoir, the Moscow River, Onega Lake, to the Gulf of Finland. Less probable but still possible is a route around Europe, covering about 9000 km, from the Sea of Marmara, through the Mediterranean, the Atlantic and the North Sea into the Baltic. It is worth noting that *N. melanostomus* was observed in the Moscow River near Moscow City from the middle of 1980s (Sokolov *et al.* 1989). This might indicate the route through Volga as the most probable (Sapota 2004).

It is presumed that *N. melanostomus* came to the Gulf of Gdańsk as fertilized eggs or young fish (there is almost no larval stage in round goby development; Moskalkowa 1996, Sapota 2005). Taking into account the longest possible time of round goby embryogenesis (calculated to 18 days) and the length of possible routes, the average speed of ships should be at least 5 km/h on the first route and 7 km/h on the second one. In both cases, survival of round goby embryos in such conditions is highly possible. At speeds of 17 km/h it is even possible to make the trip following the route around Europe in the period of the eggs' development. It is also probable that round gobies hatched in ballast tanks of ships. Results of genetic investigations do not point to founder and bottle neck effects in the Gulf of Gdańsk population (Dilon and Stepien 2001), it thus seems probable that many eggs originating from many parents were transported during the beginning stage of introduction. The hypothesis of multiple introductions prolonged in time also cannot be rejected.

The invasion of round goby into the Gulf of Gdańsk and into the Great Lakes was observed at about the same time. So theoretically, it is possible that round gobies came to the Gulf of Gdańsk from North America. However, genetic analyses reject this hypothesis.

Transport of eggs or larvae with ballast waters seems more likely than the migration of fish. This species is not a good "swimmer" and it is difficult to imagine the fish covering such a long distance, mostly upstream.



Fig. 6. Theoretical possible routes of round goby introduction into the Gulf of Gdańsk.

Alien status in region

The species is typical for the Gulf of Gdańsk – Poland, it is also noticed but still in small quantities in Germany, Lithuania, Estonia and Finland (Sapota 2005) (see also table 1).

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 *Neogobius melanostomus*, 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

N. melanostomus live in brackish and freshwater environments. In this scale, the Baltic can be included into the brackish waters category. Hypothetically, round gobies can also live in full oceanic salinity, but no such population exists. *N. melanostomus* is a bottom dwelling fish. It is typically found near sandy, stony bottoms, marine structures (piers, wharves) and sunken objects and among mussel beds, In the Puck Lagoon, which is a part of the Puck Bay, round gobies inhabit the muddy, sandy, humus containing bottom overgrown with benthic flora. This fish mostly stays in one place with noticeably restricted movement. Even in areas of rather strong water currents round gobies mostly stay in one place with only limited repositioning of pectoral fins (Charlebois *et al.* 1997, Corkum *et al.* 2004, Miller 1986, Sapota 2005, Sapota and Skóra 2005).

Reproduction and life cycle

In the Gulf of Gdańsk, *N. melanostomus* spawning takes place from the beginning of May to the end of September. In that area, the male to female ratio is three or two to one (Sapota and Skóra 2005, Sapota 2005); in contrast, native populations have more or less equal sex proportions. Round gobies are multi-spawners; females can spawn repeatedly during the spawning season. In the Gulf of Gdańsk spawning takes place two to four times. Round gobies lay their eggs in nests guarded by males. More than one female can lay eggs in one nest.

The nests require solid substrate, but in general the Gulf of Gdańsk has a sandy bottom. All solid elements on the bottom can be used as a basis for round goby nests, including: stones, rocks, parts of wood, roots of vascular plants, and even dumped waste. Despite this, places suitable for nests are limited in the Gulf of Gdańsk, and the distance between nests is much shorter than in other regions. Females are sexually mature at the age of 2 or 3 years, males one year later. After the spawning and nest defense period, males die. Some females can achieve reproduction in the year following the first spawning.

There is a wide range of fecundity in the Gulf of Gdańsk from 89-3841 eggs per female (Wandzel 2000, Sapota 2005), which means 9-143 eggs per gram of female body mass. Relative fecundity grows linearly with the growth of female body weight.

The life span of *N. melanostomus* is rather short – three to four years. Females generally live about three years. Males can live one year longer and reach a bigger size. In the Gulf of Gdańsk, *N. melanostomus* can grow up to 25 cm in total length. Mostly individuals between 8 and 18 cm in total length are observed (Sapota and Skóra 2005). *N. melanostomus* is the biggest or one of the biggest fish in the invaded area.

Investigations of the reproduction and lifecycle of *N. melanostomus* in the Baltic Sea in regions other than the Gulf of Gdańsk have not yet been conducted.

Dispersal and spread

The range of round goby migration is small, mostly within some hundred meters distance. The longest migrations (up to some kilometers) take place in late autumn and early spring, when part of the population migrates to and from deeper waters. Given the very short range of the natural migrations of *N. melanostomus*, an active means of transport is needed for spreading the fish from one region to another. In the invaded areas, the spread of *N. melanostomus* is rather slow. The Gulf of Gdańsk example showed that the first years of invasion were characterized by slow growth of round gobies numbers in limited areas. Then, subsequent colonization of new areas occurred until occupation of all suitable habitats was completed.

Impact

Affected habitats and indigenous organisms

In the beginning of the 1990s, shallow water fish communities of the west part of the Gulf of Gdańsk were dominated by three spined sticklebacks (Skóra 1993, Sapota and Skóra 1996). Now *N. melanostomus* is also a dominating fish. There are not any direct influences between these species, as stickleback is more pelagic whereas the round goby is typically a bottom living fish. In the Puck Lagoon *N. melanostomus* exclusively dominates the shallow water zone. Two species: flounder (*Platichthys flesus*) and viviparous blenny (*Zoarces viviparous*) live in the same or similar habitats as the round goby. Both slightly changed their area of occurrence, leaving the shallowest waters for round goby. Aside from this we have not observed any changes in populations of these species. This situation may change if the number of round gobies significantly increases in the Gulf of Gdańsk. Round gobies are typical bivalve-eaters. Bivalves (mainly blue mussel) constitute about 60% of *N. melanostomus* diet in the Gulf of Gdańsk. Arthropods (chiefly *Idotea*) are also an important food resource. (Skóra and Rzeźnik 2001, Wandzel 2003) Arthropods are most prominent as food for young, small individuals and in places of smaller bivalve quantities.

Round goby could be a food supply for other fish, but in the altered shallow water ecosystem of the Gulf of Gdańsk there are almost no predatory fish (Skóra 1993). Due to lack of predators in the shallow water zone, the round goby is not an important food supply for other fishes. That situation may change in the case of restoration of predatory fish in the shallow water zone of the Gulf of Gdańsk. From time to time, young cod feeds on round goby in the shallow waters of the Gulf of Gdańsk.

N. melanostomus is a very important food source for Black cormorants, constituting at least 60% of fish eaten by this bird (Bzoma 1996, Bzoma and Stepniewicz 2001).

Genetic effects

No genetic effects have been described.

Human health effects

No human health effects have been described.

Economic and societal effects (positive/negative)

N. melanostomus is not important for the local fishery, but in the future could be commercially exploited. In the Gulf of Gdańsk, fishermen sometimes catch huge quantities of round gobies, as by-catch. The population size would allow the start of commercial exploitation, but lack of market for this fish prevents it. *N. melanostomus* is the main catch of near shore, shallow water angling, but decreases anglers' success in catching flounder.

Management approaches

Prevention methods

No prevention methods have yet been attempted. Control of ballast waters and the improvement of the state of local populations of predators should be considered as the best prevention methods.

Eradication, control and monitoring efforts

Except for the Azov Sea case, there are no examples of effective eradication of *N. melanostomus*. In the Azov Sea *N. melanostomus* population went extinct due to the abnormal increase of salinity and the removal of other elements of the biocenosis (Corkum *et al.* 2004).

Control and monitoring of size and structure of resources is not easy as settled habitats are mainly inaccessible for trawling nets. It is very important to inspect local near shore fishery catches, especially from trap nets, and catches by anglers as well as to carry out underwater inspections of favourable habitats.

Education and awareness

Occurrence of *N. melanostomus* in the Baltic Sea was most probably noticed in the first stage of invasion, which enabled description of subsequent stages of colonization, and warned the scientific community about the invasion. In Poland, the problem of *N. melanostomus* invasion was widely announced in TV, radio and newspapers. *N. melanostomus* is one of the most known invasive species. Many people know about the possible consequences of its introduction.

Knowledge and research

Since the first description of *N. melanostomus* from the Gulf of Gdańsk, various investigations have been carried out in that region. The research covers a wide range of aspects of the biology and ecology of the population of *N. melanostomus* from the Gulf of Gdańsk. Comparisons of populations from various regions, native and invasive have attempted to establish the origin of the round gobies which are invading the Baltic. Changes in the food web and the flow of energy in the Gulf of Gdańsk ecosystem are also being investigated. In other regions of the Baltic Sea investigations are focusing on describing the occurrence of a few individuals of *N. melanostomus*.

Recommendations or comments from experts and local communities

The first and most important defence against *N. melanostomus* should be the prevention of its spread through transport into new regions. When established, *N. melanostomus* is very difficult to eradicate. It is important to raise awareness among anglers about the negative consequences of deliberate transport of the species, used as live bait, to new water bodies, both marine and fresh water. An important element of awareness campaigns should be guidance on the proper identification of *N. melanostomus*, because the species is often misidentified as the black goby (*Gobius niger*), which is native for the Baltic Sea (Sapota 2005).

References and other resources

Contact persons

Stefan Nehring (DE), AeT umweltplanung, Bismarckstrasse 19, D-56068 Koblenz, Germany
tel. +49 261 1330398, fax +49 261 1330399, E-mail: nehring@aet-umweltplanung.de

Helmut Winkler (DE) Fachbereich Biowissenschaften / Zoologie, University of Rostock
Universitätsplatz 2, D-18055 Rostock, Germany, tel. +49 381 4981945, +49 381 4981942, fax +49
381 4982011, E-mail: helmut.winkler@biologie.uni-rostock.de

Peter Rask Møller (DK) Zoological Museum, University of Copenhagen, Universitetsparken 15,
DK - 2100 Copenhagen Ø, Denmark, Tel.: +45 3532 1001, Fax: +45 3532 1010
E-mail: PDRMoller@snm.ku.dk

Henn Ojaveer (EE) Estonian Marine Institute, University of Tartu, Mäealuse 10a, EE-12618, Tallin
Estonia, E-mail: henn.ojaveer@ut.ee

Erkki Leppäkoski (FI) Environmental and Marine Biology, Åbo Akademi University, FIN-20500
Turku/Åbo Finland, Tel.: +358-40-595 5488, E-mail: eleppako@abo.fi

Atis Minde (LV) Latvian Fish Resources Agency, Daugavgrivas Str. 8, LV-1048, Riga, Latvia, E-mail: atis.minde@latzra.lv

Sergej Olenin (LT) Coastal Research and Planning Institute, Klaipeda University, H. Manto gat. 84, LT-5808 Klaipeda, Lithuania, tel. +370 6 398847, Fax +370 6 398845, E-mail: serg@gmf.ku.lt

Mariusz Sapota (PL) Al. M. Piłsudskiego 46, PL- 81-378 Gdynia Poland, E-mail: ocems@univ.gda.pl

Krzysztof Skóra (PL) University of Gdańsk Institute of Oceanography Hel Marine Station ul. Morska 2, PL- 84-150 Hel Poland, E-mail: oceks@univ.gda.pl

Gustav Almquist (SE) National Board of Fisheries, Institute of Coastal Research, Oregund, Sweden, E-mail: Gustaf.Almqvist@fiskeriverket.se

Links

[Fishbase on *Neogobius melanostomus*](#)

Hel Marine Station – [identification key – with drawings](#)

Baltic Sea Alien Species Database - [Neogobius melanostomus](#)

University of Gdańsk Institute of Oceanography Department of Marine Biology and Ecology – [new invader *Neogobius melanostomus*](#)

Global Invasive Species Database – [fact sheet on *Neogobius melanostomus*](#)

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