Immigrated goby species in the Rhine system
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1. Origin and distribution

Today, four immigrated goby species have established in the Rhine area: The western tubenose goby, bighead goby, round goby, and the monkey goby. In the near future, the appearance of the racer goby (all 5 species of the Gobiidae-family) and of the Amur sleeper (Odontobutidae family) is expected. Today, the most frequently occurring goby species in the Rhine are the round goby, the bighead goby and the monkey goby (see Table 1).

**Origin**: ponto-caspian area: Black Sea, Caspian Sea, lower reaches of the tributaries to these areas

**Main migration corridor**: Danube, Main-Danube-Canal (accomplishment: 1992)

**Distribution**:
- Independent immigration through the Canal; in addition, migration over long distances due to:
  - transportation in ships' ballast water
  - transportation of egg batches on hulls
  - inadvertent stocking together with other fish species
  - release of bait fish
  - transfer of Danube water into R. Main

Additionally, anthropogenic modifications of waters support the establishing of stocks of goby, e.g.:
- Embankment consolidation with stone blocks to which gobies may clutch with their ventral fins having become sucker cups even under influence of waves (natural or caused by ships)
- Establishing of preferred feeding organisms from the original distribution area

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1 Wiesner et al. 2010
2 e.g. Ahnelt et al. 1998, Wonham et al. 2000
3 Sokolov et al. 1994
4 Friedl & Sampl 2000
5 Prášek & Jurajda 2005
6 Schöll 2008, Landwüst 2006

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Figure 1: Egg batch, round goby, photo: J. Fischer.
Table 1: Immigrated goby species and their distribution in the Rhine and its major navigable tributaries

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>English name</th>
<th>Other names</th>
<th>First detection (year) &amp; place/water body in the Rhine system</th>
<th>State of distribution in the Rhine system in 2011; habitats, nourishment</th>
<th>physiognomic characteristics; length</th>
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</thead>
<tbody>
<tr>
<td><strong>Gobiidae family (gobies)</strong></td>
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<tr>
<td>Proterorhinus semilunaris</td>
<td>Freshwater/wester tubenose goby</td>
<td>German: Mamoriierte Süßwassergrundel; French: gobie demilune; Dutch: Marmergrondel</td>
<td>1997 in R. Lohbach (drains into the R. Main system and is partly supplied with water from the Main-Danube Canal)</td>
<td>large sub-sections of the R. Main, Rhine and Moselle, mostly in low densities; lives hidden between stones and other water body structures, such as dead wood and water plants; opportunistic feeder with food preferences strongly depending on habitat, e.g. larvae of chironomids, water louse, chrysialides of ephemera, and many more; 8-10 marbled markings of the body; tubular prolonged opening of the nose; 7-9 cm</td>
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<tr>
<td>Ponticola kessleri</td>
<td>Bighead goby</td>
<td>German: Kesslergrundel; French: gobie de Kessler; Dutch: Kesslers grondel</td>
<td>2006 in R. Main near Freudenberg (unpublished BfG data); 2006 in the Rhine near Königswinter</td>
<td>very frequent in parts of the R. Main and the Rhine; with more than 50 % share of individuals one of the most frequent fish species on the banks of the Lower Rhine; settles on stone blocks of bank stabilization structures; according to studies on the Lower Rhine low share of fish as nutritive element</td>
<td>longest head of the 5 Gobiidae species in Central Europe; big mouth; up to 20 cm</td>
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<td>Neogobius melanostomus</td>
<td>Round goby</td>
<td>German: Schwarzmaulgrundel; French: gobie à taches noires; Dutch: zwartbekgrundel</td>
<td>2004 in the Netherlands; presumably the specimen were transported with the ballast water of ships from the Baltic Sea which these ships had gained via the canal- and river system of Eastern Europe</td>
<td>share of individuals in the Lower Rhine above 10 % (2009); high density of all age classes in the Rhine near Worms (as of September 2010, September 2012) and in the Moselle near Bernkasten-Kues (September 2012; unpublished data of the BfG); adult specimen often feed on molluscs and might be favoured by the occurrence of the immigrated migratory mussel Dreissena polymorpha (since about 1840) and the Quagga mussel D. Rostriformis geminus (since 2006) and the basket clam Corbicula sp. (“invasion meltdown”); according to an investigation on the Lower Rhine no fish as nutritive element</td>
<td>dark spot at the back end of the front dorsal fin; up to 30 cm</td>
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<td>Neogobius fluviatilis</td>
<td>Monkey goby</td>
<td>German: Flussgrundel; French: gobie fluviatile; Dutch: pontische stroomgrondel</td>
<td>2008 in the Rhine near Duisburg; 2009 in Dutch sections of the Rhine; settlements already existed in the Odra region; no information on migration corridor</td>
<td>prefers calm sections of the water body with sand and gravel river bottom substrate; frequent occurrence in such habitats in the Lower Rhine already in 2009; according to investigations on the Lower Rhine no fish as nutritive element</td>
<td>silvery-creamy to greyish-green base colour; series of dark pigment spots along the middle of the side; slimmer than other goby species; up to 15 cm</td>
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<td>Babka gymnnotrachelus</td>
<td>Racer goby</td>
<td>German: Nackthalsgrundel; French: gobie courier; Dutch: naaktshalsgrondel</td>
<td>so far not identified in the Rhine system; immigration from the German Danube where the species has already settled or the catchment of the Baltic Sea has been reached via the canals in Eastern Europe are expected</td>
<td>prefers sandy to muddy river bottom substrate and possibilities to hide, such as dead wood, macrophytes or stones; contrary to the bighead goby and the round goby, in the Austrian Danube this species rarely settles on stone blocks of bank stabilization structures or settles in low densities; opportunistic feeder with food preferences strongly depending on habitat, e.g. amphipods, midge larvae and chrysalides of diptera, etc.</td>
<td>dark, slanting spots/stripes on the sides; up to 16 cm</td>
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<td><strong>Odontobutidae family (Freshwater sleepers)</strong></td>
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<td>Percottus glenii</td>
<td>Amur sleeper, Chinese sleeper</td>
<td>German: Amur-Schläfergrundel, Chinesische Schläfergrundel; French: goujon de l’Amour; Dutch: amoergrondel</td>
<td>Origin: East Asia; at present no occurrence known in the Rhine system; however, immigration is to be expected, as the species has already settled in the catchment of the Baltic Sea and sections of the Danube following releases by aquarian hobbyists in the European part of Russia in the beginning of the 19th century.</td>
<td>overgrown banks of flowing and stagnant small to medium sized water bodies; dug into the mud during periods of frost or dry periods; they are said to be tolerant to variations in temperature and oxygen; opportunistic feeder with food preferences strongly depending on habitat, e.g. larvae of chironomids, ephemera, crustaceans, etc.</td>
<td>no ventral fin having become sucker cups; up to 25 cm</td>
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2. Possible impact on the ecosystem

The following interactions of goby species existing in the Rhine or to be expected with already existing organisms exist or are to be expected but are difficult to appreciate or to predict\(^2\).

- food competition $\rightarrow$ reduction of stocks of some indigenous species
- effects on feeding organisms (indigenous invertebrates, small fish, fish eggs and larvae)
- impact on the stocks of predators (predator fish, cormorant)
- competition for habitats (e.g. gaps), spawning grounds (e.g. bottom side of stones) etc. $\rightarrow$ possibly reduction of stock of bullheads (*Cottus* spec.)
- introduction of parasites (so far no evidence)

3. Recommendations

Since anthropogenic modifications are in particular most favourable to goby species in the navigation lanes, it will most probably not be possible to considerably drive back

goby species which have already established in the Rhine catchment. At the same time it is highly unlikely that, on the long run and with reasonable efforts, it will be possible to prevent the introduction of species still to be expected, such as the racer goby. Presumably, it will only be possible to avoid the introduction of gobies to standing waters, for which stocking restrictions might be issued. However, it is no longer possible to protect the indigenous fauna of the Rhine and its tributaries from a confrontation with invasive species. An attempt should however be made to stabilize the stocks of particularly concerned indigenous species still to be determined by renaturing measures, improvement of river continuity, targeted support programmes for species to such an extent that a permanent preservation of stocks is possible which coexist with immigrated goby species and eventually with further invasive species. Therefore, within the on-going determination of stocks of fish and of the macrozoobenthos, indications of detrimentally impacted indigenous species must be followed in order to eventually introduce targeted investigations into the impacts of gobies on the indigenous fauna of the Rhine system. These investigations may then be followed by measures taken in favour of these species targeted at a permanent securing of their stocks and coexistence with the introduced goby species.
4. Literature

Adamek, Z., Jurajda, P., Prasek, V. & Sukop, I. (2010): Seasonal diet pattern of non-native tubenose goby (Proterorhinus semilunaris) in a lowland reservoir (Musov, Czech Republic). Knowledge and Management of Aquatic Ecosystems 397 (2), 02-02


