

FIRST RECORD OF THE NAKED GOBY, *GOBIOSOMA BOSCA* (ACTINOPTERYGII: PERCIFORMES: GOBIIDAE), FROM THE ZEESCHELDE, BELGIUM

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Abstract. In September 2018, the first specimen of the naked goby, *Gobiosoma bosc* (Lacepède, 1800), was caught in a mid-water beam trawl from an anchored boat in the Zeeschelde in the north of Belgium. This small goby is a North American fish species and was probably introduced to the newly reported location via ballast water discharge of transoceanic vessels.

Keywords: Non-native species, estuarine-dependent fish, ballast water, Gobiidae

INTRODUCTION

The naked goby, *Gobiosoma bosc* (Lacepède, 1800), originates from North America, and is present along the west Atlantic coast from Massachusetts through the Gulf of Mexico. This fish species has no scales and is therefore called naked goby. It inhabits a variety of shallow estuarine habitats and can be observed over a wide range of salinities but is more common in estuaries with low to moderate salinities (Dahlberg and Conyers 1973). Although it is categorized by some authors as a tropical species with a temperature range between 11 and 33°C (Darcy 1980), it is also found in temperate latitudes in the western Atlantic (Moore et al. 2018). Spawning occurs at a minimum temperature of 18 to 20°C (Dahlberg and Conyers 1973, Conn and Bechler 1996). However, natural reproduction of this species has been observed as far north as Chesapeake Bay (Shenker et al. 1983) where the larvae appear to be the most abundant species in the ichthyoplankton (Breitburg et al. 1995). This geographically widespread species requires complex but patchy microhabitat (e.g., oyster reefs, rubble, woody debris) for reproduction and refuge (Moore et al. 2018).

The maximum total length (TL) of this fish is about 6 cm (Robbins and Ray 1986). The colour varies from yellow to brown but is highly variable: the colour in life specimens is greenish to dusky dorsally, pale ventrally, the nape and sides have very narrow pale crossbars; the pectoral fin is mostly greenish; other fins are blackish, but the caudal fin slightly lighter than the dorsal fins. Males are generally darker than females (Fritzsche 1978

cited by Hendrickson and Cohen 2015). The species can be recognized by the 9–10 light-coloured vertical cross stripes on the body and the black spot in the anterior part of the dorsal fin (Robbins and Ray 1986).

The body shape is short and stout and the body depth is contained fewer than seven times in the standard length. The mouth position is terminal. Pelvic fin length is contained 1.6 to 2.0 times in the distance from the base of the pelvic fin to the origin of the anal fin (Hubbs et al. 1991). The body is naked (scaleless), the tongue is indented but not notched (Hubbs et al. 1991) and the caudal fin is short and round. The pelvic disc is short and the pectoral fins are broad and shorter than the head (Fritzsche 1978 cited by Hendrickson and Cohen 2015).

MATERIAL AND METHODS

In September 2018, one specimen of naked goby, *Gobiosoma bosc*, was caught in a mid-water beam trawl from an anchored boat in the Zeeschelde in the north of Belgium. The Schelde River is 435 km long and originates in France. The Schelde estuary can be divided in two sections: the downstream Westerschelde in the Netherlands from Vlissingen to Zandvliet and the upstream Zeeschelde in Belgium, from Zandvliet to Gent. The estuary is approximately 160 km long and has a complete salinity gradient from polyhaline to a tidal freshwater zone, including extensive freshwater, brackish and salt tidal mudflats and marshes to its ecosystem. It is a well-mixed estuary characterized by strong currents, high turbidity and large tidal amplitude up to 6 m (Van den Bergh et al. 2005).

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The *Gobiosoma bosc* specimen was captured in the low salinity tidal part of the Zeeschelde estuary near Steendorp (salinity 2.93‰)(51°06'54.96"N, 004°14'49.10"E) (Fig. 1) on 25 September 2018 at a depth of 6.5 m. The specimen has been deposited to the Royal Belgian Institute of Natural Sciences (Brussels, Belgium) as reference material (1 specimen, location: Steendorp, collection reference: RBINS 25338). A sample of caudal fin tissue was removed for identification of this species through DNA matching with GEN-bank.

RESULTS

The first *Gobiosoma bosc* specimen (Fig. 2) in Belgium was caught during a fish monitoring programme of the Research Institute for Nature and Forest in the context of the Water Framework Directive. It featured the total length (TL) of 47.5 mm and standard length (SL) of 39.6 mm. The morphometric characteristics and meristics of this specimen (Table 1) were similar to those reported in the literature (Murdy and Hoese 2003) and compared to the data of three specimens caught in Germany in 2009 by Thiel et al. (2012).

DISCUSSION

In 2009, naked goby was first found in Europe in the Weser River, Germany (7 specimens caught by a stow net vessel) (Thiel et al. 2012). Thiel et al. (2012) give meristic and morphometric data of three specimens; our specimen (Table 1) corresponds best with the largest of the German specimens with the same counts of spines and rays and very similar relative length ratios of body depth, orbit diameter and fin lengths. A recent genetic study of *Gobiosoma bosc* (see Moore et al. 2018) found that all analysed German sequences ($n = 5$) aligned within the Atlantic network, with two individuals sharing haplotypes with Atlantic Florida and the mid-Atlantic. There was no evidence for a connection to the Gulf of Mexico. In the Netherlands, a first specimen was recorded during a fish monitoring project in the North Sea canal in March 2017 and probably was transported with ballast water to the port of Amsterdam (Anonymous 2017). A second specimen of the naked goby in the Netherlands was caught by an angler in the same canal in October 2018 (van Emmerik and Beelen 2018). *Gobiosoma bosc* was also once reported from the Orinoco delta (Venezuela, South America) in December 2002 (Lasso-Alcalá et al. 2005).

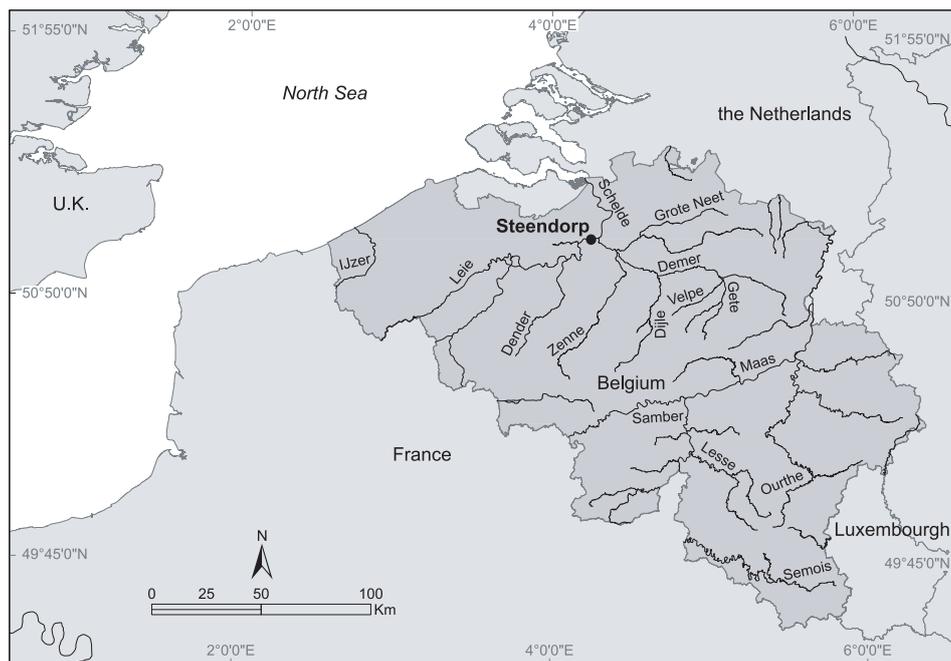


Fig. 1. Location of first record of *Gobiosoma bosc* in Belgium (●)

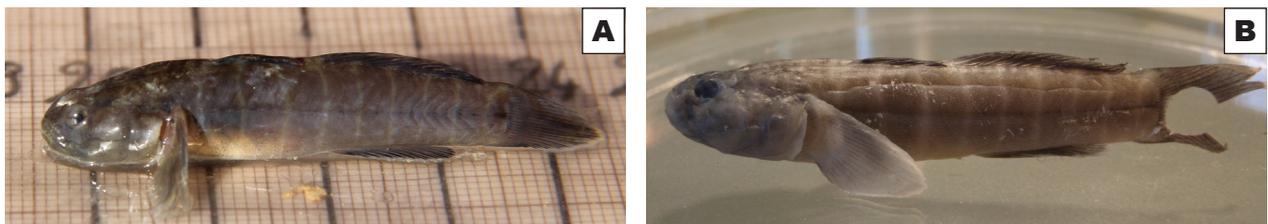


Fig. 2. First specimen of *Gobiosoma bosc* caught in Belgium: (A) freshly caught, (B) after preservation in ethanol and removal of caudal fin tissue for DNA identification

Although the adult gobies are demersal, the larvae have a planktonic phase (Moore et al. 2018) during which they can be easily picked up with ballast water intake (Cariton and Geller 1993). Despite the very stringent ballast water regulations in the US and Canada (Anonymous 2019b) and the coming into force of the global Ballast Water Management (BWM) Convention in September 2017 (Anonymous 2019a), ballast water exchange still seems to remain an important introduction pathway for non-native aquatic species. The BWM Convention currently requires existing vessels to apply ballast water exchange, replacing sea water with fresh water and vice versa. However, in the future they must meet strict ballast water quality standards which may reduce the negative impact of this pathway (Anonymous 2019a).

In recent years, several specimens of the naked goby, a North American estuarine fish species, were reported from west European waters (Thiel et al. 2012, van Emmerik and Beelen 2018, this paper). The fish were always caught in important shipping routes in the proximity of international harbours (i.e., Amsterdam, Antwerp, and Bremen) which supports the idea that the most likely introduction pathway was the exchange of ballast water from transoceanic vessels.

The probability of naked goby becoming invasive in West Europe is small due to its preference for warmer waters (Darcy 1980) but this could alter in future climate change

conditions (Britton et al. 2010). The number of reported *Gobiosoma bosc* specimens outside its native range is still very low but owing to the species' small size and cryptic nature, in all probability, introduced populations of *G. bosc* are underreported (Moore et al. 2018).

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REFERENCES

- Anonymous** 2017. Primeur: naakte grondel gevangen in het Noordzeekanaal. [Scoop: naked goby caught in the North Sea Canal.] *Nature Today*. <https://www.naturetoday.com/intl/nl/nature-reports/message/?msg=23329> [In Dutch.]
- Anonymous** 2019a. Ballast water. European Maritime Safety Agency. [Accessed on 16 April 2019.] <http://www.emsa.europa.eu/implementation-tasks/environment/ballast-water.html>
- Anonymous** 2019b. Ballast water. Great Lakes St. Lawrence Seaway System. [Accessed on 16 April 2019.] <https://www.nrc.gov/docs/ML0704/ML070470471.pdf>
- Breitbart D.L., Palmer M.A., Loher T.** 1995. Larval distributions and the spatial patterns of settlement of an oyster reef fish: Responses to flow and structure. *Marine Ecology Progress Series* **125**: 45–60. DOI: [10.3354/meps125045](https://doi.org/10.3354/meps125045)
- Britton J.R., Cucherousset J., Davies G.D., Godard M.J., Copp G.H.** 2010. Non-native fishes and climate change: Predicting species responses to warming temperatures in a temperate region. *Freshwater Biology* **55** (5): 1130–1141. DOI: [10.1111/j.1365-2427.2010.02396.x](https://doi.org/10.1111/j.1365-2427.2010.02396.x)
- Cariton J.T., Geller J.B.** 1993. Ecological roulette: The global transport of nonindigenous marine organisms. *Science* **261** (5117): 78–82. DOI: [10.1126/science.261.5117.78](https://doi.org/10.1126/science.261.5117.78)
- Conn C.H., Bechler D.L.** 1996. Reproductive strategies in a population of *Gobiosoma bosc* (Osteichthyes: Gobiidae) with slow and fast maturing individuals. *Gulf Research Reports* **9** (3): 177–182. DOI: [10.18785/grr.0903.04](https://doi.org/10.18785/grr.0903.04)
- Dahlberg M.D., Conyers J.C.** 1973. An ecological study of *Gobiosoma bosc* and *G. ginsburgi* (Pisces, Gobiidae) on the Georgia coast. *Fishery Bulletin* **71** (1): 279–287.
- Darcy G.H.** 1980. Comparison of ecological and life history information on gobiid fishes, with emphasis on the south-eastern United States. NOAA Technical Memorandum NMFS-SEFC-15.
- Hendrickson D.A., Cohen A.E.** 2015. Fishes of Texas Project Database (Version 2.0). Ichthyology Collection of the Texas Natural History Collections in the Biodiversity Collections of the Department of Integrative Biology at the University of Texas at Austin, Austin TX, USA. [Accessed on 11 March 2019.] DOI: [10.17603/C3WC70](https://doi.org/10.17603/C3WC70)

Table 1

Biometric characteristics of the first specimen of *Gobiosoma bosc* caught in Belgium in the Zeeschelde estuary near Steendorp (51°06'54.96"N, 004°14'49.10"E) on 25 September 2018

Parameter	Weight [g]	Morphometrics		Count
		[mm]	[%SL]	
Total weight	1.168			
Total length (TL)		47.50		
Standard length (SL)		39.58		
Body depth			20.11	
Orbit diameter			4.40	
Interorbital width			8.59	
Head length			30.09	
Orbit diameter/Head length			0.15	
Pelvic fin length (PFL)			17.48	
Pelvic fin insertion to anal fin origin (PFIAFO)			32.92	
PFIAFO/PEL			1.88	
Pectoral fin length			21.25	
Second dorsal fin base length			27.08	
Caudal peduncle depth			14.30	
Anal fin base length			21.60	
First dorsal fin spines				VII
Second dorsal fin spines and rays				I/12
Anal fin rays				10
Pectoral fin rays				18
Pelvic fin rays				1/5
Sex				Female

- Hubbs C., Edwards R.J., Garrett G.P.** 1991. An annotated checklist of the freshwater fishes of Texas, with keys to identification of species. *Texas Journal of Science, Supplement to* **43** (4): 1–56.
- Lasso-Alcalá O., Lasso C.A., Smith M.L.** 2005. The first record of the naked gobi *Gobiosoma bosc* (Pisces: Gobiidae) from the north coast of South America. *Revista de Biología Tropical* **53** (1–2): 211.
- Moore C.S., Ruocchio M.J., Blakeslee A.M.H.** 2018. Distribution and population structure in the naked gobi *Gobiosoma bosc* (Perciformes: Gobiidae) along a salinity gradient in two western Atlantic estuaries. *PeerJ* **6**: e5380. DOI: [10.7717/peerj.5380](https://doi.org/10.7717/peerj.5380)
- Murdy E.O., Hoese D.F.** 2003. Gobiidae. Gobies. Pp. 1781–1796. *In*: Carpenter K.E. (ed.) *FAO species identification guide for fishery purposes. The living marine resources of the Western Central Atlantic. Vol. 3: Bony fishes part 2 (Opistognathidae to Molidae), sea turtles and marine mammals.* FAO, Rome.
- Robins C.R., Ray G.C.** 1986. *A field guide to Atlantic coast fishes of North America.* Houghton Mifflin Company, Boston MA, USA.
- Shenker J.M., Hepner D.J., Frere P.E., Currence L.E., Wakefield W.W.** 1983. Upriver migration and abundance of naked gobi (*Gobiosoma bosc*) larvae in the Patuxent River estuary, Maryland. *Estuaries* **6** (1): 36–42. DOI: [10.2307/1351804](https://doi.org/10.2307/1351804)
- Thiel R., Scholle J., Schulze S.** 2012. First record of the naked gobi *Gobiosoma bosc* (Lacepède, 1800) in European waters. *BioInvasions Records* **1** (4): 295–298. DOI: [10.3391/bir.2012.1.4.09](https://doi.org/10.3391/bir.2012.1.4.09)
- Van den Bergh E., Van Damme S., Graveland J., de Jong D., Baten I., Meire P.** 2005. Ecological rehabilitation of the Schelde estuary (The Netherlands–Belgium; northwest Europe): Linking ecology, safety against floods, and accessibility for port development. *Restoration Ecology* **13** (1): 204–214. DOI: [10.1111/j.1526-100X.2005.00025.x](https://doi.org/10.1111/j.1526-100X.2005.00025.x)
- van Emmerik W., Beelen P.** 2018. Eerste hengelvangst naakte grondel. [First naked gobi caught by angling rod.] *Kijk op exoten* **25**: 11. [In Dutch.]

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