

Case study of the diet and parasite fauna of and extremely rare fish species *Lumpenus lampraetaeformis* (Perciformes, Stichaeidae) from the Gulf of Gdańsk (south Baltic Proper)

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Abstract. The snakeblenny, *Lumpenus lampraetaeformis*, is a post glacial relict from the last ice age in the Baltic Sea. Reliable data on its diet, parasite fauna, distribution, population size, and population trends in the Baltic Sea are lacking. In the Polish zone it has been observed only in ICES subdivisions 25 (Ślupsk Furrow) and 26 (Puck Bay, Krynica Morska, Władysławowo and Vistula mouth fishing grounds) at depths of 30-70 m; however, in recent decades only one finding of snakeblenny in Polish waters has been reported. This paper reports the record of one female specimen from the Gulf of Gdańsk. The individual's morphological characters, stomach contents, parasitic fauna, age and gonadosomatic index were examined. The parasitological examination, which was undertaken for the first time on a specimen from the Baltic Sea since the 1930s, revealed that *L. lampraetaeformis* was the host of one parasite species, namely a juvenile acanthocephalan *Echinorhynchus gadi*. Additionally, *Pontoporeia fermorata* and *Halicryptus spinulosus* were recorded in the stomach of snakeblenny for the first time in the Baltic Sea.

Keywords: *Lumpenus lampraetaeformis*, *Pontoporeia fermorata*, *Halicryptus spinulosus*, *Echinorhynchus gadi*, Gulf of Gdańsk

Data concerning fish species that are caught occasionally or are not commercially significant in the Polish zone of Baltic Sea are available sporadically, because monitoring is performed only for several commercial fish species including herring, *Clupea harengus* (L.), Atlantic cod, *Gadus morhua* L., and flounder, *Platichthys flesus* (L.) (Psuty-Lipska and Garbacik-Wesołowska 1998, Dudko 2008, Dudko et al. 2015). The appearance of rare non-commercial or visiting fish species in Polish research catches in the east Baltic Proper in 1976-2004 was reported by Grygiel and Trella (2007).

Lumpenus lampraetaeformis (Walbaum) is distributed in the North Atlantic. The isolated population in the Baltic Sea is a post glacial relict from the last ice age, and it probably reached the Baltic Sea during the early saltwater stage of the sea. It occurs on soft bottoms from the Kattegat to the Gulf of Bothnia and is mainly distributed at depths between 30 and 120 m (Muus and Nielsen 1999). In their monitoring surveys in the Polish zone, Grygiel and Trella (2007) reported the sporadic occurrence of this species in 1981-1994 in ICES subdivisions 25

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(Słupsk Furrow) and 26 (Puck Bay, Krynica Morska, Władysławowo, and Vistula mouth fishing grounds) at depths of 30-70 m; however in recent decades only one finding of snakeblenny from Polish waters (Puck Bay) has been reported (Piecki and Wawrzyniak 2016). Skóra (1996) lists 71 species as currently or previously occurring permanently or temporarily in the waters of the Gulf of Gdańsk (ICES SD 26) (70% of them are local fishes), and one of them is *L. lampraeformis*. However, reliable data on its distribution, population size, population trends, diet, and parasite fauna in the Baltic Sea are lacking. In the Baltic Sea the species is of no direct economic importance, and it is hard to catch using standard commercial trawls because of its elongated, almost eel-like body and its small size. It also occurs rarely and at great depths with a tendency to burrow in the mud, and these are probably among the reasons why *L. lampraeformis* has not been thoroughly studied in Baltic Sea to date. The parasitological examination undertaken in this paper is the first to be done on a specimen from the Baltic Sea since Markowski (1933). Moreover, to date, no examinations of the diet or gonadosomatic index of snakeblenny have been performed on specimens from the Polish zone of the Baltic Sea.

The aim of the study was to present the unique record of *L. lampraeformis* in the Gulf of Gdańsk (southern Baltic) and to supplement knowledge of its diet, age, parasite fauna, and gonadosomatic index.

The individual collected was measured and weighed and basic metric and meristic measurements of taxonomical significance were taken and used to identify the specimen to the level of the species. According to Makushok (1986), the following characters are of taxonomical significance: dorsal fin spine and pelvic and anal finray counts; the presence or absence of palatine teeth and scales on the cheek; the shape of the caudal fin; body depth. These characters were measured using ToupView 3.7 image analysis software. Additionally, the stomach contents, age (estimated by otolith reading), and the sex of the specimen examined were determined using macroscopic and microscopic methods. The specimen's maturity stage was estimated using Maier's

scale (Williams 2007). The gonadosomatic index was calculated with the formula: $GSI = Wg \times W^{-1} \times 100\%$, where Wg – weight of the gonads, W – wet weight of the fish.

The stomach contents were identified using Nikon SMZ 1000 and Motic Series K stereoscopic microscopes. The species of prey items were identified using references keys and species descriptions in the works by Żmudziński (1990) and Hayward and Ryland (2011). The parasitological examination focused on the skin, vitreous humor, eye lens, mouth and nasal cavities, gills, gonads, gastrointestinal tract, kidneys, swim bladder, urinary bladder, gall bladder, peritoneum, and muscles. The parasites found were prepared for species determinations (Popiołek 2016) by viewing specimens in fresh preparations on glass slides or after immersion in glycerin under transient light using an Olympus BX 50 microscope fitted with an AxioCamERc5S digital camera.

One specimen of snakeblenny, *L. lampraeformis*, was collected on April 8, 2015 as bycatch in a commercial fish species monitoring survey conducted from a research vessel in the Gulf of Gdańsk with a standardized bottom trawl used in accordance with ICES recommendations (International Baltic Fish Survey Trawl, 20 mm mesh size in the codend), at a depth of 40.9 m (54°32'–54°31' N, 18°45'–18°46' E) (Fig. 1). The specimen appeared to be a female aged 6+, measuring 26.3 cm total length (TL) and 23.6 cm body length (SL). The weight of the specimen was 25.0 g. The shape of otoliths (sagitta) and the age determined are presented in Fig. 2.

Lumpenus lampraeformis had a very elongated body, with a maximum body depth that was 6.57% of its standard length SL. The head length constituted 11.86% of SL, while head depth was 3.89% of SL. The horizontal eye diameter was 10.71% of head length. Palatine teeth were absent. The dorsal fin was long, with 69 spines, and it was well separated from the caudal fin with 16 fin rays that were long and pointed. The anal fin had 48 fin rays with five spines and 43 soft fin rays. The pelvic fins with one spine and three soft rays each were situated anteriorly to

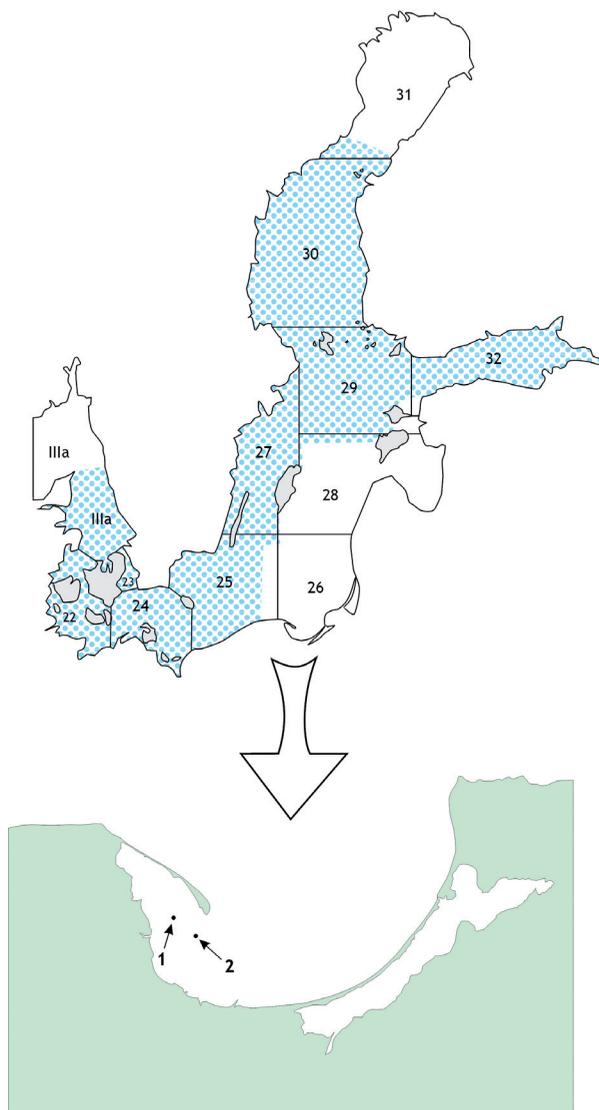


Figure 1. Distribution of *Lumpenus lampraetiformis* in the Baltic Sea (HELCOM area) with the locations of two findings. 1 - in the Puck Bay (Piecki and Wawrzyniak 2016), 2 - current study. Map available at (<http://www.helcom.fi/Red%20List%20Species%20Information%20Sheet/HELCOM%20Red%20List%20Lumpenus%20lampraetiformis.pdf>); modified for the present study.

the pectoral fins. The entire cheek was covered with scales.

Ten specimens of *Pontoporeia ferromata* Krøyer, 1842 (Malacostraca, Amphipoda, Gammaridea, Pontoporeiidae) and one specimen of *Halicryptus spinulosus* von Siebold, 1849 (Cephalorhyncha, Priapulida, Priapulidae) were noted in the stomach of *L. lampraetiformis* as food items. Four parasites were

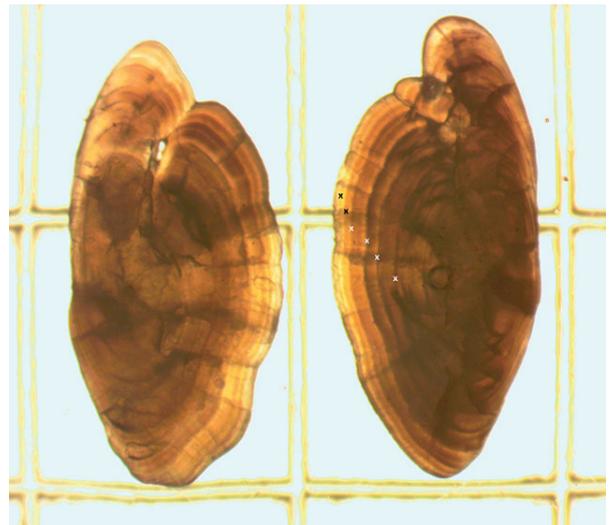


Figure 2. Otoliths (sagitta) of snakeblenny, *L. lampraetiformis* (aged 6+). x - annual rings.

also found in the stomach; these were juvenile acanthocephalan *Echinorhynchus gadi* Zoega in Müller, 1776 (Acanthocephala, Palaeacanthocephala, Echinorhynchidae). The gonads were in stage VII on Maier's scale (stage spent I); the ovaries were not fully empty, and a few opaque eggs remained. The gonad weight was 0.37 g, and the gonadosomatic index GSI was 1.48%.

Monitoring the most important commercial species (cod, herring, sprat, *Sprattus sprattus* (L.), salmon, *Salmo salar* L., and sea trout, *Salmo trutta* L.) is conducted by all Baltic countries according to guidelines and procedures agreed upon in forums such as the International Council for the Exploration of the Sea (ICES) and the European Union. These surveys collect many other species as bycatch (such as the *L. lampraetiformis* specimen presented in this work), which, potentially, can be used to monitor changes in overall fish communities and biodiversity (e.g., changes caused by fishing, species introductions, or climate change). In the current study, the specimen was caught at a depth of 40.9 m, which corresponds with data presented by Makushok (1986) who reported the presence of this species at 30-200 m, but usually at 40-100 m. Similarly, Piecki and Wawrzyniak (2016) noted one individual at 42.1 m in the Puck Bay.

Both the metric and meristic characters of the specimen examined are within the ranges reported in Makushok (1986) for specimens from the northeastern Atlantic; however, no data on the morphometrics of *L. lampretiformis* from the Baltic Sea are available. The female individual examined in this work, aged 6+, which was caught in April, had a low GSI that was typical of the post-spawning stage. According to Fricke et al. (1987), adults mature at the age of 3+ and at a total length of 20 cm, while the maximum length for the species is 50.0 cm. Their spawning season is from December to January.

This species feeds on small crustaceans, mollusks, brittle stars, and worms (Makushok 1986). The stomachs of individuals found in bottom trawl catches in 1967-69 in Estonian waters were full of copepods (Ojaveer et al. 2003). In this study, Amphipoda and Priapulidae were noted in the stomach of the snakeblenny for the first time in a specimen from the Baltic Sea. Four juvenile acanthocephalan *E. gadi* were also found in the specimen's stomach. This parasite is the most common acanthocephalan in the southern Baltic, and it has been reported previously in specimens of this species only in Markowski (1933) from the Gulf of Gdańsk. From then until now the parasitological studies on snakeblenny have not been conducted on specimens from the Baltic Sea.

Little is known about the life cycle of *E. gadi*. This parasite has a wide spectrum of intermediate (Amphipoda) and final hosts (many fish species). Acanthocephalan larvae that are ingested with the food enter the alimentary tract of fish and most often mature in the intestine and/or pyloric caeca (Popiołek 2016). The acanthocephalans from the stomach of the *L. lampretiformis* specimen in this study were juveniles, which probably means that they could have been ingested along with invertebrates (such as *Pontoporeia femorata* found in the stomach) that inhabit the Gulf of Gdańsk (Jęczmień and Szaniawska 2000) just before the individual was caught.

Fish that are definitive hosts become infected when they ingest amphipods containing mature cystacanth larvae. In the initial stage of life, *L. lampretiformis* feeds on small crustaceans

including Amphipoda, and the intermediate hosts of *E. gadi* are most likely amphipods. Additionally, the parasites mentioned could also have paratenic hosts, which include, among others, fish (Valtonen et al. 1983). The presence in the snakeblenny stomach the postlarval *E. gadi* suggest that this species is not a paratenic host.

L. lampretiformis was designated as threatened in a 2007 assessment, and eutrophication and habitat loss are mentioned as the main threats to the species (HELCOM 2013). It is most likely negatively affected by the increase of areas with anoxic conditions in the Baltic Proper, consequently, its range of occurrence has decreased, and the quality of its habitat has deteriorated. *L. lampretiformis* require cold, well oxygenated waters, therefore the potential impacts of climate change on the species must also be taken into consideration.

At present, since both its distribution area and population size are well above threshold levels, this species is currently considered as least concern (LC) and no protection actions are currently needed in the HELCOM area (HELCOM 2013), but more data should be collected on the status of this species. This statement is not reflected in the literature because of the lack of publications on *L. lampretiformis* from the Baltic Sea region. According to Ojaveer et al. (2003), in recent decades no findings of snakeblenny from Estonian waters have been reported. Obviously, like in German waters (Fricke et al. 1996) the species is very rare now and is threatened with extinction. *L. lampretiformis* is also very rare in the Kattegat and the North Sea where it is rarely caught in large numbers (Knijn et al. 1993). In Poland, *L. lampretiformis* is partially protected by law (Regulation of the Minister of the Environment of 16 December 2016, on the protection of animal species; Journal of Laws, item 2183).

Author contributions. B.W. designed and performed the morphological study, analyzed the stomach contents, and wrote the paper; E.S. designed and performed the parasitological study; K.G. analyzed the data (age) and prepared part of the literature; M.S. analyzed the data and collected the specimen.

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