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New records of a non-indigenous polychaeta species *Boccardiella ligerica* (Ferronnière, 1898) (Spionidae) in the southern Baltic Sea

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Abstract

The non-indigenous *Boccardiella ligerica* is a polychaete introduced to the Baltic Sea. Although the species has been recorded in the Baltic Sea since the 1960s, this is the first time we have reported the repeated occurrence of *B. ligerica* in various new locations along the Polish coast. Between 2009 and 2018, the species was recorded in the Vistula Lagoon, the Gulf of Gdańsk and Puck Bay. Samples of the species were collected from hard substrates and bottom sediments at depths ranging from approximately 1.0 m to 13.3 m using a range of sampling gear, including van Veen and Ekman-Birge grab samplers, a HAPS corer and settlement plates, as well as by scraping vertical surfaces during diving. The highest densities, reaching up to 1689 ind. m^{-2} and 414 ind. m^{-2}, were recorded in the Gulf of Gdańsk and the Vistula Lagoon, respectively. The lowest abundance (13 ind. m^{-2}) of this polychaete was recorded in Puck Bay. The results obtained contribute to the understanding of the dynamics of this non-indigenous species in the brackish environments of the Baltic Sea. They provide a basis for further research on this species, considering that *B. ligerica* may play an important role in food webs, as it feeds on phytoplankton and detritus, and serves as food for small fish and invertebrates.

Keywords

Boccardiella ligerica; Non-indigenous species; Baltic Sea; Range expansion; Benthic communities

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The introduction and transport of non-indigenous species into new environments can pose a threat to biodiversity, ecosystem services and the economy (Pyšek et al., 2020; Diagne et al., 2021; Gallardo et al., 2024). There are several pathways and mechanisms by which these species are transported and spread in the marine environment, including shipping (ballast water and biofouling), aquaculture, and plastic litter (García-Gómez et al., 2021; Pratt et al., 2025). One such marine region is the Baltic Sea, which is young in geological terms, semi-enclosed, brackish, and characterised by very intense shipping (Leppäkoski et al., 2002; Vivó-Pons et al., 2023; Hegele-Drywa et al., 2024). Consequently, it is highly susceptible to the introduction of non-indigenous species, which are most frequently introduced in coastal areas, including ports and marinas, where they are often first identified, particularly through various types of monitoring (Zaiko et al., 2024; Pagnier et al., 2025).

One such species is the spionid polychaete representing the *Polydora*-complex, *Boccardiella ligerica*, a small, tube-dwelling, infaunal organism. It was originally described as *Boccardia ligerica* by Ferronnière (1898) from the Loire estuary in France. Horst (1920) described *Polydora redeki* from the Netherlands, and Rullier (1960) redescribed it from France as *Polydora (Boccardia) redeki*. Blake and Woodwick (1971) compared other Dutch and French specimens with published descriptions by Ferronnière (1898), Horst (1920) and Rullier (1960), concluding that *B. liger-*

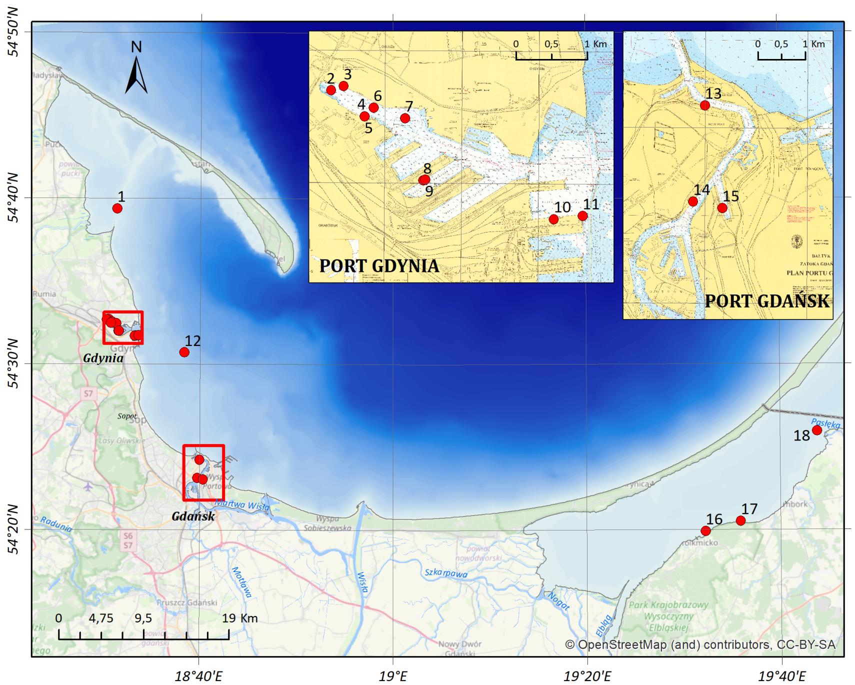

Figure 1. Sampling regions in the Gulf of Gdańsk (sites No. 1–15) and the Vistula Lagoon (sites No. 16–18).

Table 1. Geographical coordinates and depth of designated sampling sites. The numbering of the points in the table corresponds to the numbering given in Figure 1.

No.	Sampling site	Date	Latitude (N)	Longitude (E)	Gear	Depth (m)
1	Puck Bay	14.06.2017	54°39.400'N	18°31.300'E	van Veen grab sampler	4.5
2	Port of Gdynia	04.03.2014	54°32.700'N	18°30.300'E	van Veen grab sampler	12.3
3	Port of Gdynia	01.08.2012	54°32.730'N	18°30.460'E	collected by a scuba diver	12.8
4	Port of Gdynia	07.08.2018	54°32.505'N	18°30.732'E	scraper	1.0
5	Port of Gdynia	08.08.2018	54°32.505'N	18°30.732'E	settlement plates	1.3 and 7.0
6	Port of Gdynia	04.03.2014	54°32.570'N	18°30.850'E	van Veen grab sampler	11.0
7	Port of Gdynia	04.03.2014	54°32.490'N	18°31.260'E	van Veen grab sampler	10.4
8	Port of Gdynia	01.08.2012	54°32.023'N	18°31.502'E	collected by a scuba diver	9.7
9	Port of Gdynia	08.08.2018	54°32.028'N	18°31.529'E	settlement plates	1.3 and 7.0
10	Port of Gdynia	01.08.2012	54°31.735'N	18°33.204'E	collected by a scuba diver	10.3
11	Port of Gdynia	08.08.2018	54°31.762'N	18°33.580'E	settlement plates	1.3 and 7.0
12	Gulf of Gdańsk	06.03.2014	54°30.740'N	18°38.340'E	van Veen grab sampler	13.3
13	Port of Gdańsk	11.08.2012	54°24.257'N	18°39.989'E	collected by a scuba diver	7.4
14	Port of Gdańsk	11.08.2012	54°23.159'N	18°39.770'E	collected by a scuba diver	8.3
15	Port of Gdańsk	11.08.2012	54°23.088'N	18°40.342'E	collected by a scuba diver	11.0
16	Vistula Lagoon	07.08.2013	54°19.932'N	19°32.254'E	HAPS corer	2.5
17	Vistula Lagoon	28.08.2009	54°20.528'N	19°35.904'E	HAPS corer	1.50
18	Vistula Lagoon (A)	10.08.2009	54°25.953'N	19°43.869'E	HAPS corer	2.70
	Vistula Lagoon (B)	10.08.2009	54°25.953'N	19°43.869'E	Ekman-Birge grab sampler	2.30

ica and *P. redeki* are synonyms. Polydorid species with branchiae anterior to setiger 5 and with only one type of main spines on setiger 5 were then transferred by Blake and Kudenov (1978) to the newly created genus *Boccardiella*.

The currently known distribution range of *B. ligerica* includes habitats in the Atlantic Ocean and Pacific Ocean, as well as in the Baltic Sea (Blake, 1983; Kravitz, 1987; Cohen and Carlton, 1995; Orensantz et al., 2002; Jaubet et al., 2021). The first observation of the species in the Baltic Sea, referred to *Polydora* (*Boccardia*) *redeki*, took place in southwestern Finland in 1963 (Eliason and Haahtela, 1969). This species was also reported from the Gulf of Finland in 1972 and the Åland Islands in 1979 (Bonsdorff, 1981). In 1998, the species was also found for the first time in the south-western part of the Baltic Sea, in the Bay of Mecklenburg (Zettler, 2025). According to BALSAM (Heyer, 2015) and Kocheshkova and Ezhova (2018), *B. ligerica* was recorded in the Baltic Sea in the Gulf of Finland, the Gulf of Bothnia, the southern Baltic Proper, as well as the Vistula Lagoon, where the species was first found in 2008 (Kocheshkova and Ezhova, 2018). Although the presence of *B. ligerica* in the Baltic Sea has been known since the 1960s, its distribution along the Polish coast remains poorly documented.

This spionid is characteristic of brackish water environments (Kravitz, 1987; Peterson and Vayssieres, 2010; Jaubet et al., 2021), where it has been recorded on a wide variety of bottom types, from muddy and clay sediments to fine sand or even hard substrates (Wolf, 1973; Blake, 1983; Kravitz, 1987; López Gappa et al., 2001; Jaubet et al., 2021). It is known to occur in *Ficopomatus enigmaticus* reefs, which can strongly support population abundance by enhancing habitat protection against predation or physical stress (Jaubet et al., 2021). As *B. ligerica* is frequently reported from harbours and their vicinity, and polydorid larvae have been found in ballast water of commercial ships, it is believed that this species is introduced to new areas via shipping (Blake, 1983; Carlton, 1985; Leppäkoski and Olenin, 2000).

Therefore, any new occurrence of *B. ligerica* is of great interest, as its range remains limited. Accordingly, this paper reports new records, updates information on the distribution, and describes new localities and abundance patterns of *B. ligerica* in the southern Baltic Sea.

The sampling sites were located in the coastal area of the Gulf of Gdańsk in the southern Baltic Sea, including the ports of Gdańsk and Gdynia, as well as in the Vistula Lagoon (Figure 1). Sampling took place between 2009 and 2018 during 10 different survey campaigns at a depth ranging from 1.0 m to 13.3 m. Salinity at the sampling points ranged from 6.5 to 7.3 in the Gulf of Gdańsk and from 2.9 to 3.5 in the Vistula Lagoon. The sediments were characterised by the presence of sand/silt, gravel, stones, and submerged rooted plants. Samples were collected using various devices, such as an Ekman-Birge grab sampler, a HAPS corer, and a van Veen grab sampler. The scuba diver scraped biological material from vertical surfaces several times using a 15 × 15 cm metal frame. In addition, biological material was collected from settlement plates deployed in the Port of Gdynia between 18 April and 08 August 2018 (Table 1). The estimated densities of *B. ligerica* were standardised per sampling site. The collected material was preserved in a 4% buffered formaldehyde solution. In the laboratory, specimens were examined using optical equipment (microscope and/or stereomicroscope) to compare diagnostic features with specimens described by Ferronnière (1898), Blake and Woodwick (1971) and Hartmann-Schröder (1971). The prostomium is slightly incised at the anterior margin and extends posteriorly as a caruncle to chaetigers 2 or 3 (Figure 2). It features four eyes arranged in a flat trapezoid (Figure 3). Palps, very long and thin (approximately 3.5 mm), extend from the 10th to the 20th chaetiger, however they easily fall off during or after sampling. Chaetiger 5 is strongly modified, twice as large as the other chaetigers in the anterior part of the body, with 9–11 thick, single-armed, smooth, slightly curved spines with smaller, lanceolate accompanying chaetae and capillary chaetae in the notopodium

Figure 2. Anterior segments of a methyl green-stained specimen of *Boccardiella ligerica*, with a characteristic slightly incised prostomium (palps are missing) (indicated by the white arrow).

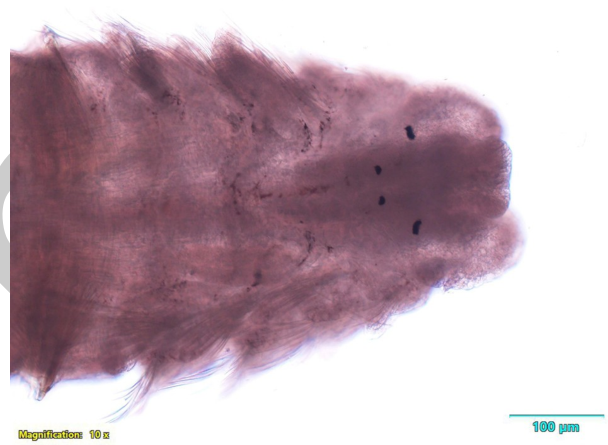

Figure 3. Anterior segments of *Boccardiella ligerica* with characteristic four eyes.

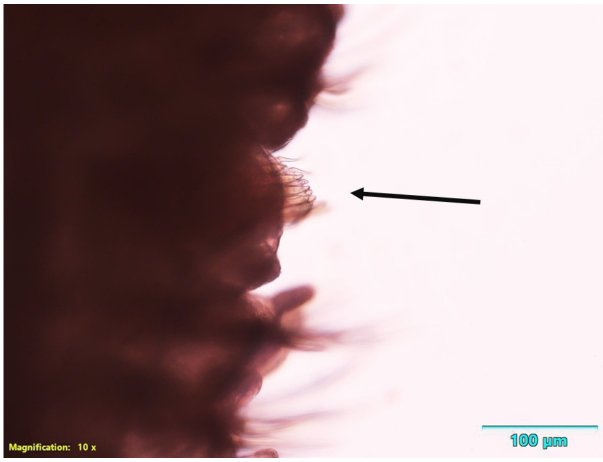

Figure 4. Strongly modified chaetiger 5 with characteristic thick spines and chaetae (indicated by the black arrow).

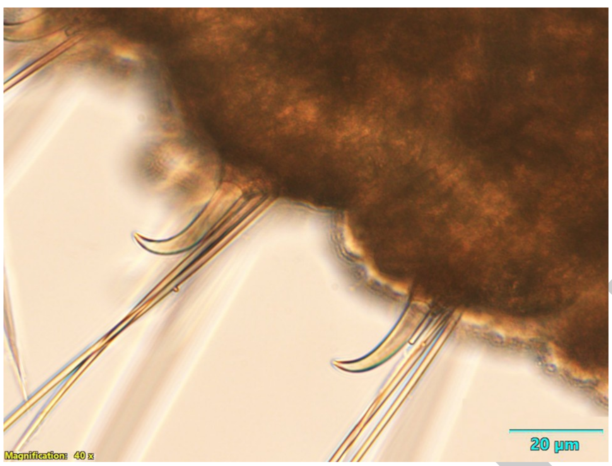

Figure 5. Specialized recurved notopodial hooks.

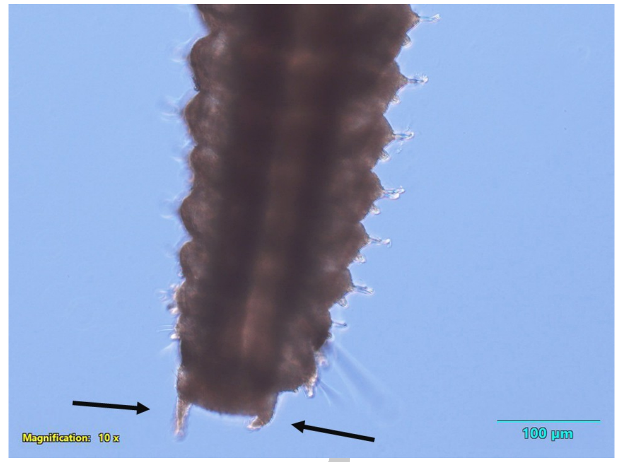

Figure 6. The pygidium of *Boccardiella ligerica* with two prominent dorsal cirri (indicated by the black arrow).

and neuropodium (Figure 4). The last 8–14 chaetigers are armed with specialised, recurved hooks in notopodia. Gills are present on chetigers 2, 3, 7 and the subsquent chaetigers (but they are absent on chaetigers 4, 5 and 6) at approximately one-third of the length of the worm (Figure 2). The pygidium is a flattened plate with two prominent dorsal cirri (Figure 6).

Specimens of *B. ligerica* were found at 18 sites during different survey campaigns. The abundance of *B. ligerica* varied by region (Puck Bay, the Gulf of Gdańsk, and the Vistula Lagoon) and by sampling depth. The lowest density of this polychaete (13 ind. m^{-2}) was recorded in Puck Bay at a depth of 4.5 m (sampling site No. 1). The highest abundance (max. 1,689 ind. m^{-2}, average 288 $\pm$ 477 ind. m^{-2}) was recorded in the Gulf of Gdańsk in a sample collected from a settlement plate deployed at a depth of 7.0 m in the Port of Gdynia (sampling site No. 11). In the Vistula Lagoon, the maximum density reached 414 ind. m^{-2}, with the average of 263 $\pm$ 138 ind. m^{-2}. In the latter region, the most abundant sample was collected using the HAPS corer at a depth of 1.5 m (sampling site No. 17).

This study reports on the distribution of *B. ligerica* in the brackish waters of the southern Baltic Sea. Updating data on non-indigenous species is of great importance as it provides information on new occurrences or the spread of species and can help in assessing their potential impact on ecosystems and in developing management strategies.

In areas where *B. ligerica* had been introduced, it has so far been recorded at depths ranging from 0.8 m to 20 m in both the Baltic Sea and the Atlantic Ocean region (Eliason and Haahtela, 1969; Bonsdorff, 1981; Kravitz, 1987; Kocheshkova and Ezhova, 2018; Jaubet et al., 2020). The above results are consistent with those obtained in the present study, in which the species was found in both shallow waters (1 m) and at depths not exceeding 13.3 m. However, the observed abundance varied significantly across different non-native regions, ranging from 400 ind. m^{-2} in the south-eastern part of the Baltic Sea to 520 ind. m^{-2} in the north-eastern part of the Vistula Lagoon (Kocheshkova and Ezhova, 2018) and up to 4000 ind. m^{-2} in the Quequ´en Grande estuary in Argentina (López Gappa et al., 2001). It is worth noting that in the Scheldt estuary in Belgium (considered to be a part of the native region of the species), the estimated abundance of this species reached 479 ind. m^{-2} (Ysebaert et al., 2000). It can therefore be concluded that the abundance of *B. ligerica* estimated in the present study is comparable with data obtained from other localities. Nevertheless, the highest abundance recorded in the Gulf of Gdańsk (Port of Gdynia) was higher than that recorded in the native region. This is not surprising, as seaports are recognised as hot spots for the introduction and transfer of non-indigenous species via maritime shipping (Tempesti et al., 2020; Costello et al., 2022), and this particular species is considered to be introduced by heavily fouled hulls of ships or with discharged ballast water (Carlton, 1985; Llansó et al., 2011). On the other hand, *B. ligerica* larvae are clearly planktotrophic, even though the duration of their development is not known (Rullier, 1960). It can therefore be presumed that their occurrence can contribute to the secondary spread of the species in the introduced areas.

According to the literature, the species tolerates a broad range of environmental conditions and substrates, enabling it to occur in diverse habitats. Furthermore, when polychaetes encounter favourable conditions, they can increase significantly in number (Jaubet et al., 2020) and play a crucial role in the environment, eventually dominating other organisms, such as crustaceans (Warzocha et al., 2018). However, no negative impact of this species has been observed in the Baltic Sea region to date. Consequently, the positive role of this species cannot be discounted, as it is classified as a productive shallow-water endobenthic organism (Lecuyer et al., 2024), which serves as food for small fish and invertebrates.

Despite the above, continued monitoring and analysis of the biodiversity of coastal infaunal communities is essential for monitoring the flow and abundance of this species. Furthermore, the results obtained will allow conclusions to be drawn and suggestions to be made to improve the monitoring, assessment, and management of non-indigenous species in the Baltic Sea.

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Conflict of interest

None declared.

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