

Distribution and ecology of leeches (Hirudinea) in brackish waters of the German Baltic

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Abstract

The knowledge about records of leeches (Hirudinea) in Baltic brackish waters of north-east Germany (Mecklenburg-West Pomerania) will be summarized. Observations were made from estuaries of rivers (Stepenitz and Warnow) and lagoons (Darss-Zingst, Stettin) as well in Baltic offshore waters (especially at the Adlergrund/Rønnebank). Altogether 33 taxa are established probably including a new *Piscicola* species. All species of Glossiphoniidae, Haemopidae and Erpobdellidae could live both in freshwater and oligohaline brackish water up to salinities of 2 psu, few of them even up to 3.6 psu. Only species of the family Piscicolidae are able to penetrate (or to find their optimum?) into mesohaline waters (here up to 13 psu). In the present study several first records for Germany were made in brackish waters (*Piscicola kusznierzi*, *P. elishebae* and *P. wiktori*). Further noteworthy observed species were shortly introduced (*Glossiphonia paludosa*, *Placobdella costata*, *Italobdella epshteini*, *Haemopis elegans* and *Dina apathyi*). 7 host fish species could be observed so far.

Key words: Hirudinea, Baltic Sea, Germany, distribution, ecology, brackish water, salinity, host fishes.

Introduction

Leeches (Hirudinea) originally occurring in freshwater habitats only and evolved there more than 10 families. However, from there both marine (Piscicolidae, Ozobranchidae) and terrestrial (e.g. Haemadipsidae) species have developed as well.

Only very few literature sources deal with leeches living in brackish waters of the Baltic Sea (e.g. Sander 1953, Bielecki 1995, Koli 1960). In recent times a relative high number of records were made in brackish waters of northern Germany. Altogether 458 records were analysed where of 433 were localised in inner coastal waters and 25 originate from offshore areas. The majority of these observations were made by the Leibniz Institute of Baltic Sea research. Other data come from colleagues and museum material. Some of these notable records were published already (Grosser 2003, Jueg & Rödiger 2004, Jueg *et al.* 2004, 2012, Jueg 2013). In the present study we would like to summarize the information on distribution and ecology of brackish water leeches in German Baltic waters.

Investigation area

All marine and brackish water influenced areas along the coastline of the Federal State Mecklenburg-West Pomerania in North-East Germany were examined on occurring of leeches within the last 20 years. Some

few additional records from the Baltic Sea off Denmark and Poland and off the German EEZ were considered as well.

The outer coastline of Mecklenburg West Pomerania has a length of about 350 km. The inner coastal waters span more than 1358 km (Winker *et al.* 2007). In the present study we consider the estuaries of the Rivers Stepenitz and Warnow and the lagoons of Darss-Zingst, Greifswald and Stettin and the offshore area around Adlergrund/Rønnebank (Fig. 1).



Figure 1. Study area – the southern Baltic Sea.

Some abiotic parameters including water depth and salinity of the considered water bodies are listed in table 1.

Table 1. Some parameters of relevant inner coastal waters of Germany (after Winkler *et al.* 2007 and IOW).

Water bodies	area in km ²	Mean depth in m (max. depth)	Salinity psu
Lake Dassow/Stepenitz Estuary	8	2-3 (4,5)	0,5 - 12
Wismar Bay (with Salzhaff)	168,9	6 (121,0)	11 (8–24)
Warnow Estuary (with Breitling)	12,5	4 (11)	0,5-18
Darß-Zingst Lagoon	196,8	2 (12)	0,5-12
Strelasund	64,6	3,9 (16)	7,5 (7-12)
Greifswald Lagoon	510,2	5,9 (13,5)	6-8
Peenestrom, Achterwasser	163,9	2,6 (16)	0,5-1,5
Stettin Lagoon	277,2	3,7 (7,8)	0,5-5
Adlergrund/Rønnebank	234	10 (30)	7,2-10,7

Material and methods

Basing on data and material mainly collected during different projects and diploma/master theses of the Leibniz Institute of Baltic Sea Research (IOW) in the last two decades the present study comprises all data

on brackish water leeches in German Baltic Sea waters (IOW-data base, Rödiger 2003, Wittfoth 2011). Additionally some records of colleagues were used as well (F. Wolf, A. Berlin und H. Menzel-Harloff).

Furthermore the material of some collections and museums (Zoological Museum Hamburg, Zoological Collection of the University of Greifswald, German Oceanographic Museum Stralsund) were checked by the first author.

In the following paragraphs we are using the Venice system to classify the salinity ranges:

Freshwater (limnic)	< 0,5 psu
Brackish water (mixohaline)	0,5 – 30 psu
- oligohaline	0,5 – 5 psu
- mesohaline	5 – 18 psu
- polyhaline	18 – 30 psu
Marine (euhaline)	> 30 psu

Results

All water bodies with records of leeches will be introduced shortly in the following paragraphs.

Estuaries of River Stepenitz und River Warnow

Along the German Baltic coastline several estuaries exist. These of the rivers Recknitz and Barthe will be considered at the Darss-Zingst Lagoon and the River Peene at the Stettin Lagoon.

River Stepenitz is a lowland river which flows near Dassow into the Lake Dassow, a 8 km² brackish water lake with salinities ranging between 0.5 and 12 psu. The lake is connected via the Trave Estuary with the open Baltic Sea (Lübeck Bay). Altogether 7 leech species were recorded so far in this estuary. All of them are common species preferring muddy sediments of flowing waters.

The River Warnow has the second largest drainage area in Mecklenburg-West Pomerania. It has a 10 km long mouth into the Baltic with salinities ranging between 0.5 and 18 psu. Whereas in low saline waters (around 1.5 psu) 5 species could be observed in the lower Warnow near its mouth to the open sea with salinities above 10 psu only *Piscicola* cf. *annae* were found.

Wismar Bay with Salzhaff

The Wismar Bay including the Salzhaff has the highest salinities comparing to other considered inner coastal waters. Therefore only species of the Piscicolidae with few species are occurring in the Bay. In the German Oceanographic Museum Stralsund some samples exist collected in 1968 respectively in 1971. These are *Piscicola* cf. *pojmanskae* und *Piscicola* cf. *annae*. From the Salzhaff additionally some *Piscicola* sp. records parasitizing on *Zoarces viviparus*, *Pungitius pungitius*, *Platichthys flesus* and *Scophthalmus maximus* were published by Palm *et al.* (1999). Probably it is not *P. geometra* as indicated by the authors.

Darss-Zingst Lagoon

Between the peninsula Fischland-Darss-Zingst and the main land a chain of four lagoons extends. The salinity increases from 0.5 psu in the innermost part in the west to 10-12 psu at the connection with the open sea in the east. At the mouths of two inflowing rivers (Recknitz and Barthe) almost freshwater conditions persist. Altogether 16 species were recorded. Whereas 9 species belong to Piscicolidae, occasionally few species of Glossiphoniidae and Erpobdellidae were observed in the innermost (oligohaline) areas of the Lagoon. Especially the species of *Piscicola* are noteworthy (see paragraph 5).

Greifswald Lagoon with Strelasund and coastal lakes

The Greifswald Lagoon is one of the largest coastal waters in Mecklenburg-West Pomerania. At the southern coast some coastal lakes (irregular flooded by brackish waters) exist. The Strelasund is separating the Island of Rugia from the main land. Due to the mesohaline conditions in all parts of the Lagoon only leech species of the genus *Piscicola* could survive. So far *Piscicola geometra*, *P. cf. annae* and *Piscicola* spp. were found.

Stettin Lagoon with Peenestrom and Achterwasser

The highest leech species diversity of the considered areas was observed in the Stettin Lagoon and adjacent waters. Due to several river runoff (e.g. Oder, Uecker, Randow, Peene) the salinity of this coastal lagoon is

very low. Occasionally saltwater inflow takes place via the connection to the open sea (Peenestrom, Dzwina, and Swina). The near bottom water salinity ranges between 0.5 to 5 psu. Altogether 31 leech species could be detected during the last decades. In comparison to the leech diversity of the whole state Mecklenburg-West Pomerania where 36 species are known, the species richness in the Stettin Lagoon is very high. More than one third of these species belong to the family Piscicolidae. Species of the families Glossiphoniidae, Haemopidae and Erpobdellidae were observed everywhere in the lagoon and are partly very common. Noteworthy are the very high abundances of *Alboglossiphonia heteroclita*, *A. striata*, *Dina lineata* and *Erpobdella monostrata*. Additionally very rare species of Germany were also observed in the Lagoon, e.g. *Glossiphonia paludosa*, *Placobdella costata*, *Haemopsis elegans* and *Dina apathyi* (see paragraph 5). The oldest records of brackish water leech species (*Glossiphonia complanata* and *G. concolor*) in northern Germany originate from the Peenestrom and were collected by Crepelin in 1835 and are stored in the Zoological Collection of the University of Greifswald.



Figure 2. Stettin Lagoon near Kamminke (Island Usedom).

Open Baltic Sea

Whereas some genuine marine leech species (e.g. the genera *Abranchus*, *Callobdella*, *Ottonia*, *Oxytonostoma*, *Platybdella*, *Pontobdella*) are known from the North Sea, Skagerrak and Kattegat (e.g. Malm 1863), in offshore waters of the German Baltic Sea only representatives of the genus *Piscicola* are observable. Altogether 16 records were made in offshore waters, all located at the Adlergrund/Rønnebank area, a shallow water stony reef with boulders, macrophytes and sandbanks in water depths between 7 and 35 m. Previously these species were identified as *Piscicola pomorskii* (Jueg *et al.* 2004). After recent knowledge this species is probably undescribed and new to science. Similar specimens were collected at the Møn Bank (Denmark) and Stolpe Bank (Poland). Off Rugia we could find *Piscicola annae* on *Platichthys flesus* and off Boltenhagen on *Pleuronectes platessa*. Without information of the host one record comes from the Wismar Bay. With *Piscicola borowieci* on *Gadus morhua* near Sassnitz and *Piscicola pojmanskae* from the Wismar Bay two additional species were identified. It is arguable if *Piscicola geometra* is occurring in offshore waters of the southern Baltic as well.

Distribution

Many of the German Baltic coastal waters are occupied by leech species. However, for some of the lagoons around Rugia no information is available until now. Whereas the oligohaline waters of the Darss-Zingst and Stettin Lagoon are colonised by a high number of hirudinean species, the waters with high fluctuating salinity are poor in species diversity. Hirudinea (except Piscicolidae) with highest frequency in northern Germany are *Glossiphonia complanata*, *Glossiphonia concolor*, *Helobdella stagnalis*, *Haemopsis sanguisuga*, *Dina lineata*, *Erpobdella testacea* and *Erpobdella octoculata*. In offshore waters only Piscicolidae are known, whereas the species determination is possible only in few cases. A high need of further research is obvious.

Table 2. Hirudinea of Baltic inner coastal and offshore waters in Germany. Red List of Mecklenburg-West Pomerania (MV) [n.i. = not included, 0 = Regionally extinct, 1 = critically endangered, 2 = endangered, 3 = vulnerable, R = rare, G = indeterminate, D = data deficient).

Species	River-estuaries		Inner coastal waters (partly estuaries)						Red List MV
	Stepenitz	Warnow	Wismar Bay with Salzhaff	Darß-Zingst Lagoon	Stettin Lagoon with Peenestrom	Greifswald Lagoon with Strelasund	offshore Baltic		
Glossiphoniidae									
<i>Alboglossiphonia heteroclita</i> (Linnaeus, 1758)					X			-	
<i>Alboglossiphonia hyalina</i> (O.F. Müller, 1774)					X			-	
<i>Alboglossiphonia striata</i> (Apáthy, 1888)					X			3	
<i>Glossiphonia complanata</i> (Linnaeus, 1758)	X			X	X			-	
<i>Glossiphonia concolor</i> (Apáthy, 1883)	X			X	X			-	
<i>Glossiphonia paludosa</i> (Carena, 1824)					X			2	
<i>Helobdella stagnalis</i> (Linnaeus, 1758)		X		X	X			-	
<i>Hemiclepsis marginata</i> (O.F. Müller, 1774)				X	X			-	
<i>Placobdella costata</i> (Fr. Müller, 1846)					X			3	
<i>Theromyzon tessulatum</i> (O.F. Müller, 1774)					X			-	
Piscicolidae									
<i>Caspiobdella fadejewi</i> (Epshtein, 1961)					X			-	
<i>Italobdella epshteini</i> Bielecki, 1997				X	X			n.i.	
<i>Pawłowskiella stenosa</i> Bielecki, 1997				X	X			D	
<i>Piscicola annae</i> Bielecki, 1997		X cf.	X cf.	X	X cf.	X cf.	X	D	
<i>Piscicola borowieci</i> Bielecki, 1997				X			X	D	
<i>Piscicola elishebae</i> Bielecki, 1997				X	X			n.i.	
<i>Piscicola fasciata</i> Kollar, 1842					X			2	
<i>Piscicola geometra</i> (Linnaeus, 1758)				X	X	X	X?	-	
<i>Piscicola kusznieczy</i> Bielecki, 1997					X			R	
<i>Piscicola margaritae</i> Bielecki, 1997					X			D	
<i>Piscicola pawlowskii</i> sensu Nesemann, 1999					X			D	
<i>Piscicola pojmanskae</i> Bielecki, 1997			X cf.	X	X		X	D	
<i>Piscicola</i> sp. nov.							X	n.i.	
<i>Piscicola</i> spp. (indet.)		X	X	X	X	X	X		
<i>Piscicola wiktoriae</i> Bielecki, 1997				X				R	
Haemopidae									

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Table 2. (Continued)

<i>Haemopsis elegans</i> (Moquin-Tandon, 1846)					X			G
<i>Haemopsis sanguisuga</i> (Linnaeus, 1758)	X		X	X				-
Erpobdellidae								
<i>Dina apathyi</i> Gedroyc, 1916					X			2
<i>Dina lineata</i> (O.F. Müller, 1774)	X	X			X			-
<i>Erpobdella monostriata</i> (Lindenf. & Pietrusz., 1890)	X			X	X			3
<i>Erpobdella nigricollis</i> (Brandes, 1899)				X	X			-
<i>Erpobdella octoculata</i> (Linnaeus, 1758)	X	X			X			-
<i>Erpobdella testacea</i> Savigny, 1820	X	X			X			-
total: 33 Taxa	7	6	3	16	29	3	6	7
	10			30			6	

Table 3. Salinity tolerance of Hirudinea in Baltic brackish waters of Germany.

Art	limnic	oligohaline	mesohaline
	< 0,5 psu	0,5 – 5 psu	5 – 18 psu
<i>Alboglossiphonia heteroclita</i>	X	X	
<i>Alboglossiphonia hyalina</i>	X	X	
<i>Alboglossiphonia striata</i>	X	X	
<i>Glossiphonia complanata</i>	X	X	
<i>Glossiphonia concolor</i>	X	X	
<i>Glossiphonia paludosa</i>	X	X	
<i>Helobdella stagnalis</i>	X	X	
<i>Hemiclepsis marginata</i>	X	X	
<i>Italobdella epshtei</i>	X	X	X
<i>Placobdella costata</i>	X	X	
<i>Theromyzon tessulatum</i>	X	X	
<i>Caspiobdella fadejewi</i>	X	X	
<i>Pawlowskiella stenosa</i>	X	X	X
<i>Piscicola annae</i>	X	X	X
<i>Piscicola borowieci</i>	X	X	X
<i>Piscicola elishebae</i>	X	X	
<i>Piscicola fasciata</i>	X	X	
<i>Piscicola geometra</i>	X	X	X
<i>Piscicola kusznerzi</i>	X?	X	
<i>Piscicola margaritae</i>	X	X	
<i>Piscicola pawlowskii</i>	X	X	
<i>Piscicola pojmanskae</i>	X	X	
<i>Piscicola</i> sp. nov.			X
<i>Piscicola wiktoria</i>	X	X	
<i>Haemopsis elegans</i>	X	X	
<i>Haemopsis sanguisuga</i>	X	X	
<i>Dina apathyi</i>	X	X	
<i>Dina lineata</i>	X	X	
<i>Erpobdella monostriata</i>	X	X	
<i>Erpobdella nigricollis</i>	X	X	
<i>Erpobdella octoculata</i>	X	X	
<i>Erpobdella testacea</i>	X	X	
total: 32 species	29	29	6

Ecology

Salinity:

Almost all hirudinean freshwater species are able to live in oligohaline waters as well (see Table 2 and 3). Solely *Glossiphonia nebulosa*, *Hirudo medicinalis* and *Erpobdella vilnensis* have never been observed in brackish waters so far. Our observations in North-East Germany are conforming to informations given by other authors. Salinities between 1 and 2 psu seem to be the limit of tolerance for all species (see also Sander 1953, and Bielecki 1995). Data of occurrence above 2.5 or 3 psu were given only sporadically for very few species, e.g. *Theromyzon tessulatum* up to 3.5 psu (Sander 1953), *Helobdella stagnalis* up to 2.6 psu (Erséus *et al.* 1998) and *Erpobdella octoculata* up to 2.6 and 3.06 psu respectively (Bielecki 1995, Erséus *et al.* 1998). In own observations *Glossiphonia complanata*, *Helobdella stagnalis*, *Haemopsis sanguisuga*, *Erpobdella testacea* and *Erpobdella octoculata* occur in salinities up to 3 psu. The mesohaline range is colonized by Piscicolidae only, however, only very few species are able to tolerate increased salinities well. Above salinities of 13 psu and in polyhaline waters of the investigation area no leeches have been observed so far.

Host fishes:

Most records of Piscicolidae were made on hard substrates (e.g. stones, wood, macrophytes, and mussel beds). Only few observations are directly linked to host species. In Table 4 all knowledge of our observations were summarised. In the Baltic Sea flat fishes (Scophthalmidae and Pleuronectidae) and cod (*Gadus morhua*) seem to be most suitable as host species for Piscicolidae.

Table 4. Own observation of fish host species of Piscicolidae in German Baltic brackish waters.

Leech species	Fish species (host)
<i>Piscicola annae</i>	Pleuronectidae: <i>Pleuronectes platessa</i> , <i>Platichthys flesus</i>
<i>Piscicola borowieci</i>	Gadidae: <i>Gadus morhua</i>
<i>Piscicola</i> sp. n.	Gadidae: <i>Gadus morhua</i>
	Pleuronectidae: <i>Platichthys flesus</i>
<i>Piscicola</i> spp. (indet.)	Zoarcidae: <i>Zoarcetes viviparus</i>
	Cottidae: <i>Myoxocephalus scorpius</i>
	Scophthalmidae: <i>Scophthalmus maximus</i>
	Pleuronectidae: <i>Platichthys flesus</i>
	Gasterosteidae: <i>Pungitius pungitius</i>

Remarks to selected species

Glossiphonia paludosa (Carena, 1824)

Glossiphonia paludosa belongs to the rarest species in central Europe. This species was found once in a yacht harbour near Dargen in the Stettin Lagoon. This record and a monographic review of this species in Germany were published by Jueg & Rödiger (2004b). An additional record exists from the Großlabenzer Lake in Mecklenburg-West Pomerania.

Placobdella costata (Fr. Müller, 1846), *Haemopsis elegans* (Moquin-Tandon, 1846) and *Dina apathyi* Gedroyc, 1916

Dina apathyi is an east-European species and is restricted in Germany to the North-East. *Haemopsis elegans* has a scattered distribution pattern in the northern glacial area. The distribution range of *Placobdella costata* seems to be increased during the last decades probably due to the increasing population of host species (beaver and otter). These three species, only sporadically observed in Germany, were found in Lake Neuwarf, a southern bay of the Stettin Lagoon (e.g. Grosser 2003).

Piscicolidae

For brackish waters of the Baltic Sea in the past only *Piscicola geometra* was given in the literature (e.g. Meißner 1964, Palm 1999, Subklew & Günther 1975, Wohlrab 1959). Recent knowledge shows that several different species are responsible for records in offshore and inner coastal waters respectively. Older records without any material cannot be proofed and we have to ignore them. Currently 26 species of limnic Piscicolidae are known in Europe. In Germany 18 species were observed so far. Marine species from the North Atlantic and the North Sea will not be considered here. All piscicolid leeches of north-east Germany are occurring in brackish waters as well. Significantly are some first and only records for Germany (*Piscicola elishebae*, *Piscicola kusznerzi*, *Piscicola wiktorei*). In comparison to freshwater habitats *Pawlowskiella stenosa* and *Piscicola annae* occur more than double frequent in brackish waters. Some others (*Caspiobdella fadejewi*, *Piscicola borowieci*, *Piscicola margaritae* und *Piscicola pojmanskae*) seem to find their optimum in freshwaters but were frequently observed in brackish waters as well.

***Italobdella epshteini* Bielecki, 1997**

Previously this species was only known from the River Danube (Bielecki *et al.* 2008). Own observations in the Darss-Zingst Lagoon (2010) and in the Stettin Lagoon near Kamminke (2005) were the first records in northern Germany and in brackish waters respectively.

***Piscicola elishebae* Bielecki, 1997**

This species was previously known from Poland only. Own records in the Stettin Lagoon near Mönkebude (2000) and Darss-Zings Lagoon near Dierhagen (2005) are the first observations for Germany at all.

***Piscicola kusznerzi* Bielecki, 1997**

After publication of the observation of *Piscicola kusznerzi* in Achterwasser near Warthe by Jueg *et al.* (2012) we recognized a second location in Peenestrom near Lassan. Both locations are in the vicinity of the Stettin Lagoon.

***Piscicola wiktorei* Bielecki, 1997**

The first record for Germany was in 1996 and came from the Darss-Zingst Lagoon and was already published (Jueg *et al.* 2004a). In the last 10 years three additional observations were made in the Stettin Lagoon near Kamminke (2005), in the Darss-Zings Lagoon near Dierhagen (2010) and in the Peenestrom near Zecherin (2011).

***Piscicola* sp. nov.**

During our study we found several specimens of the genus *Piscicola* at the Adlergrund/Rønnebank between the Islands of Rugia and Bornholm belonging to none of described species. We are quite sure that this is a new species for science. The species have a flatted body predominantly dark pigmented. Elucidations are visible at the sucker and gonophores. A detailed description will be follow later in a separate publication.

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