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First record of the alien aquatic oligochaete species *Monopylephorus limosus* (Hatai, 1898) (Annelida) in Central Europe

by

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Abstract

The paper reports on the first record of the Asian aquatic oligochaete species *Monopylephorus limosus* (Hatai, 1898) in Central Europe. The species was found in the lower course of the Bolina River (S Poland), which is contaminated with saline mine waters. One immature individual was collected in the late summer of 2017. *M. limosus* co-occurred with *Paranais litoralis*, *Nais elinguis* and juvenile Enchytraeidae. To date, *M. limosus* is one of the 29 non-native annelids that are known to occur in Poland.

Key words: non-indigenous oligochaete species, anthropogenic salinization, saline mine drainage, river, Poland

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Introduction

Monopylephorus limosus (Hatai, 1898), originating in Asia (Erséus & Paoletti 1986; Brinkhurst & Marchese 1987; Paoletti 1987; Erséus et al. 1990; Naidu 2005; Chiu et al. 2012), was described in 1898 from drainage ditches in the city of Tokyo, Japan (Hatai 1898). In the following years, the species was found in other cities of Japan, i.e. Chiba, Okinawa, Sapporo (Nomura 1915; Yamaguchi 1953; Takashima & Mawatari 1996) and in different provinces of Eastern and Mainland China – Chongqing, Guangdong, Hubei, Jingsu (Chen 1940; Erséus 1984; Erséus & Qi 1985; Yanling 1987; Brinkhurst et al. 1990; Wang & Cui 2007). *M. limosus* was also recorded in Taipei in Taiwan (Erséus & Hsieh 1997) and in India, in Kadinamkulam backwaters near Trivandrum, Kerala (Naidu 2005). Outside Asia, it was found on the south-eastern coast of Australia, in Sydney (Pinder 2003) and in Europe. *M. limosus* was recorded for the first time in Europe in a polluted park ditch connected with the estuarine Lambro River in Milan, Italy (Erséus & Paoletti 1986). It was also reported in Belgium (Soors et al. 2013), in the Netherlands (van Haaren & Soors 2013) and in the European part of Russia – Kondopoga, Volgerenchensk (Arhipova 2005; Fig. 1). To date, no data from Central Europe are available for this species.

M. limosus inhabits both freshwater and brackish waters. It was found in organically polluted saline gutters, ditches and estuarine habitats (Yamaguchi 1953; Erséus & Paoletti 1986; Naidu 2005; van Haaren & Soors 2013). It is able to establish abundant populations in heavily polluted habitats (Erséus & Paoletti 1986).

Materials and methods

The research was carried out in the Bolina River, a right-bank tributary of the Przemsza River, which in turn is a left-bank tributary of the Vistula River, the largest river in Poland. This area is characterized by

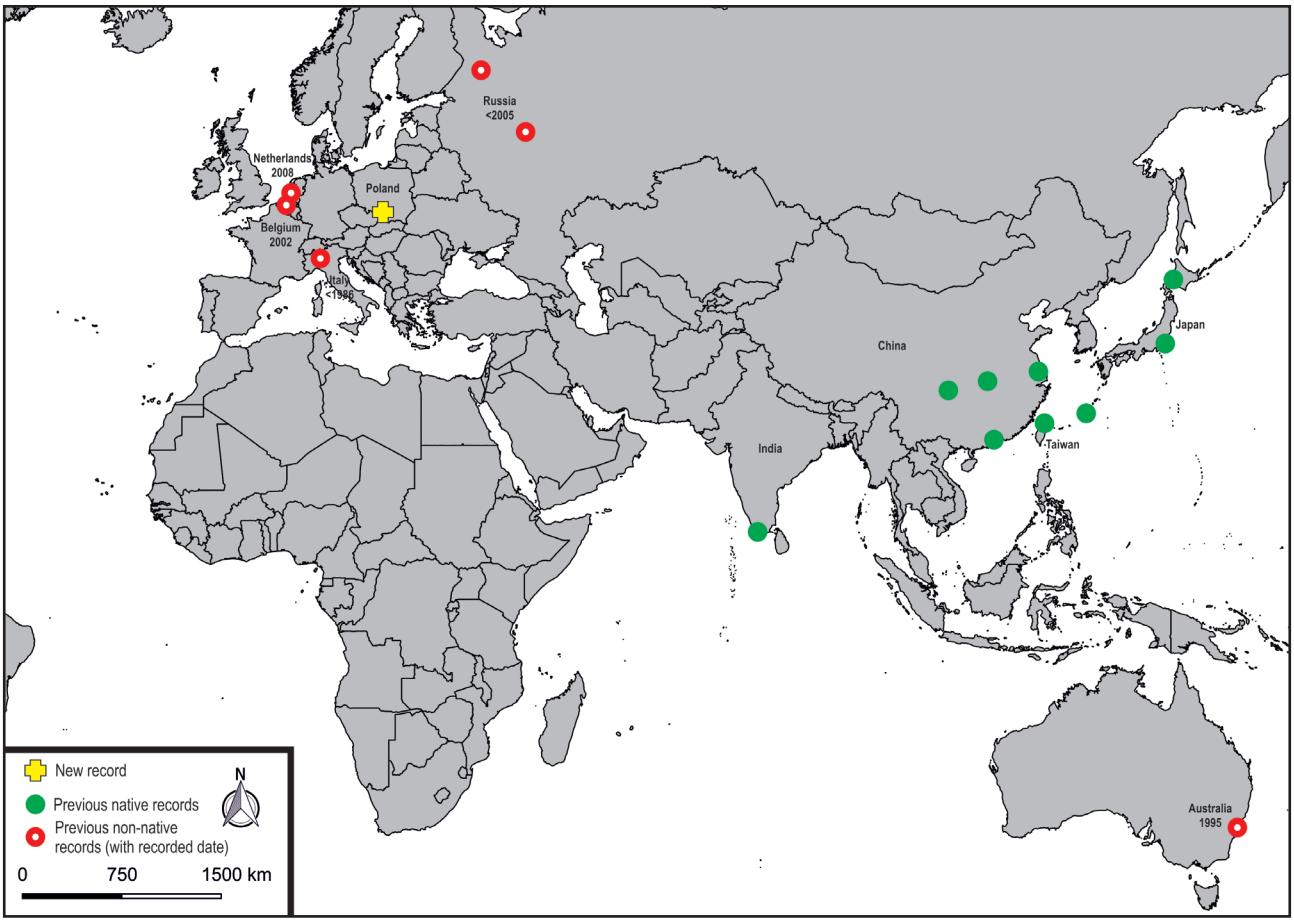

Figure 1

Worldwide distribution of *M. limosus*

a large number of coal mines (Upper Silesian Coal Basin), which have caused the secondary salinization of aquatic habitats. The study was conducted from June 2017 to January 2018 in the lower course of the river (50°14'43.7N; 19°06'02.9E; Fig. 2). During this period, samples were collected four times – in June, September, October and January. Quantitative samples were collected using a 0.25 × 0.25 m quadrat frame with a height of 0.5 m. The frame was placed in four different places of the riverbed. The sediments were pooled together in a container and thus constituted one composite sample (the total area of one sample was 0.25 m^2). In the laboratory, the sediments were sieved using a 0.4 mm mesh sieve. Macroinvertebrates remaining on the sieve were sorted and preserved in 80% ethanol solution. Oligochaetes were mounted in Amman's lactophenol and then identified to the family or species level using the identification key of Timm (2009). The density of oligochaetes (per square meter) was calculated. Some water parameters were measured in the field (salinity, conductivity, total dissolved solids, dissolved oxygen, pH and temperature) using Hanna Instruments, Elmetron and WTW meters. Other parameters of the water (chlorides, sulfates, iron, ammonium, nitrites, nitrates, phosphates, total hardness, alkalinity, calcium and magnesium) were analyzed in the laboratory using Merck and Hanna Instruments meters. The total organic matter (%) in the bottom sediments was determined according to the loss-on-ignition method, which was carried out at 550°C for 7 h (Myślińska 2001).

Figure 2
The studied stretch of the Bolina River

Results

The riverbed in the examined river stretch is narrow (4.10–4.55 m) and shallow (0.20–0.26 m). The flow velocity is low (0.42–0.56 m s^{-1}). The bottom is built of post-mining waste and stones that are covered with silt and sand. The dissolved oxygen content in water ranges from 4.95 to 6.18 mg dm^{-3}. The water is brackish (salinity, conductivity and total dissolved solids range from 16.34 to 29.09 PSU, from 22 700 to 40 400 mS cm^{-1} and from 11 360 to 20 200 mg dm^{-3}, respectively) and nutrient-rich (nitrate, nitrite, ammonium and phosphate concentrations range from 4.43 to 31.01 mg dm^{-3}, from 2.30 to 7.08 mg dm^{-3}, from 1.25 to 6.80 mg dm^{-3}, and from 0.05 to 0.17 mg dm^{-3}, respectively). Other parameters such as chlorides (4800 to 14 115 mg dm^{-3}), sulfates (320 to 550 mg dm^{-3}), iron (0.22 to 0.48 mg dm^{-3}), total hardness (2268.2 to 4197.1 mg dm^{-3}), calcium (416 to 972 mg dm^{-3}) and magnesium (225 to 670 mg dm^{-3}) are also high. The content of organic matter in the bottom sediments ranges from 2.46 to 7.75%.

The benthic fauna in the surveyed stretch of the Bolina River was dominated by chironomids (4276 to 13 784 ind. m^{-2}, accounting for 60.53 to 99.48% of the benthic fauna). Only four oligochaete taxa were recorded in this section of the river. *Paranais litoralis* (Müller, 1780) was the dominant oligochaete in all samples (28 to 7604 ind. m^{-2}, accounting for 0.24 to 34.43% of the benthic fauna; Table 1). *Nais elinguis* (Müller, 1773) occurred only in the winter sample (808 ind. m^{-2}; 2.72% of the benthic fauna), *Monopylephorus limosus* was found only in the summer sample (4 ind. m^{-2}; 0.06% of the benthic fauna), while juvenile Enchytraeidae were present in all four samples (4 to 124 ind. m^{-2}; from 0.06 to 1.13% of the benthic fauna; Table 1). The percentage of Oligochaeta taxa is presented in Figure 3. The lowest density of oligochaetes was recorded in June (44 ind. m^{-2}) at the highest salinity, whereas the highest one in January (8536 ind. m^{-2}) at the lowest salinity.

One complete immature specimen of *M. limosus*, with a length of 13 mm and 70 segments, was collected in the Bolina River (Fig. 4). The second segment of the body contained four simple-pointed chaetae in the ventral bundles. In all other segments,

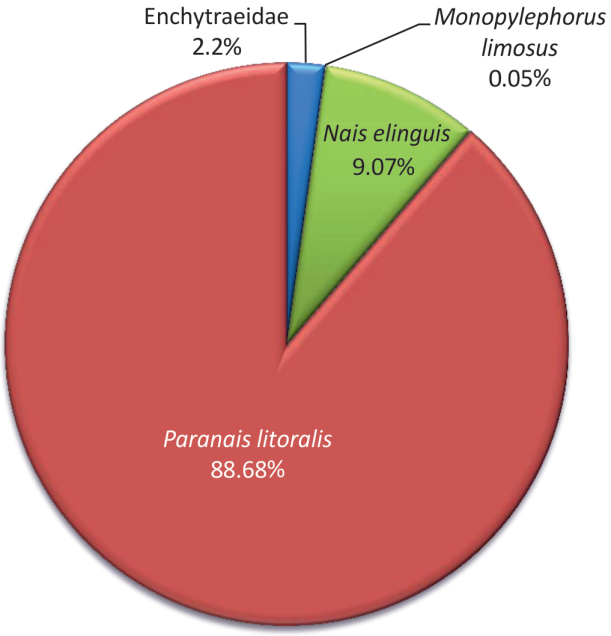

Figure 3

Percentage contribution of taxa to the oligochaete fauna occurring in the lower course of the Bolina River

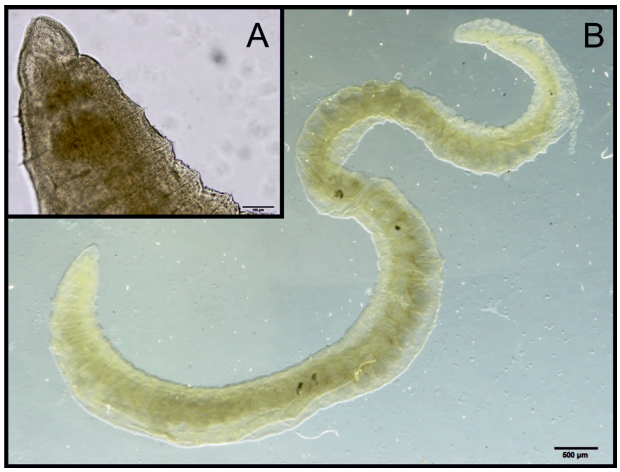

Figure 4

Characteristics of *M. limosus*: A – the anterior part of the body, B – the whole individual

chaetae with a shorter upper tooth in the ventral bundles were present. The number of chaetae was reduced from four and five (in the anterior part) to two and three chaetae per bundle (in the posterior part) in the ventral bundles.

Discussion

To date, *Paranais litoralis*, the dominant species of the oligochaete fauna in the studied stretch of the Bolina River, has been recorded predominantly in naturally saline habitats (e.g. Timm 1999; Moseman et al. 2004). In Poland, it has inhabited coastal waters and the Baltic Sea (Żmudziński 1990; Marszewska et al. 2017). Recent studies of inland waters under the direct influence of saline mine waters have shown that the species may also colonized such habitats. *P. litoralis* has been found in settling ponds and in the Upper Vistula River in Poland (Dumnicka et al. 2018; Sowa et al. 2018).

The habitat characteristics of the Bolina River, where *Monopylephorus limosus* was found, are consistent with previous literature data. This stretch of the river is highly polluted by salty coal mine waters and organic debris, which is similar to the records from China (Chen 1940) and Italy (Erséus 1984; Erséus & Paoletti 1986; Paoletti 1987). Brinkhurst & Marchese (1987) and Rodriguez (1999) pointed out that *M. limosus* is commonly associated with high conductivity due to pollution or salt beds. The laboratory experiments carried out by Erséus & Paoletti (1986) also confirmed the capacity of the species to inhabit sea water (at 35 PSU). In the Bolina River, the species was observed in water with salinity of 29 PSU. The high tolerance to pollutants indicates that it is an opportunistic species (Erséus & Paoletti 1986; Pinder 2003; Chiu et al. 2012).

The presented data on the occurrence of *M. limosus* prove that it is spreading across Europe and it may be expected to occur in other localities. To date, 29 alien species of annelids have been found in Poland, including 19 aquatic oligochaete species (Bobeł 2009; Dumnicka 2016; Pabis et al. 2017). Most of them were found in anthropogenic water bodies (Dumnicka 2016).

Table 1

Density and share (%) of oligochaete taxa in samples collected from the lower course of the Bolina River

Taxa	20 Jun. 2017		04 Sep. 2017		10 Oct. 2017		21 Jan. 2018	
	ind. m^{-2}	%	ind. m^{-2}	%	ind. m^{-2}	%	ind. m^{-2}	%
Nais elinguis (Müller, 1773)							808	9.5
Paranais litoralis (Müller, 1780)	28	63.6	132	94.2	132	71.7	7604	89.1
Monopylephorus limosus (Hatai,1898)			4	2.9				
Enchytraeidae juve.	16	36.4	4	2.9	52	28.3	124	1.4
Total density	60		140		184		8536	

Due to the frequent presence of anthropogenically saline aquatic environments in our study area, further detailed research is needed as *M. limosus* may be more widely distributed in similar habitats in the vicinity.

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References

Arhipova, N.R. (2005). *Fauna of Oligochaeta in the reservoirs of the Upper and Middle Volga*. In I.K. Riv'er et al. (Eds.), Biologičeskie resursy presnyh vod: bespozvonočnye (pp. 82–97). Rybinsk: Institut biologii vnutrennih vod. (In Russian).

Bobeł, L. (2009). *Alien species in Poland*. Retrieved June 28, 2018, from http://www.iop.krakow.pl/ias/gatunki/rodzaj-organizmu.

Brinkhurst, R.O. & Marchese, M. (1987). A contribution to the taxonomy of the aquatic Oligochaeta (Haplotaxidae, Phreodrilidae, Tubificidae) of South America. *Can. J. Zool.* 65: 3154–3165. DOI: 10.1139/z87-474.

Brinkhurst, R.O., Qi, S. & Liang, Y.-L. (1990). The aquatic Oligochaeta from the People's Republic of China. *Can. J. Zool.* 68: 901–916. DOI: 10.1139/z90-131.

Chen, Y. (1940). Taxonomy and faunal relations of the limnic Oligochaeta of China. *Contrib. Biol. Lab. Sci. Soc. China, Zool. Ser.* 14: 1–131.

Chiu, K.H., Lin, C.-R, Huang, H.-W., Shiea, J. & Liu, L.L. (2012). Toxic effects of two brominated flame retardants BDE-47 and BDE-183 on the survival and protein expression of the tubificid *Monopylephorus limosus*. *Ecotoxicol. Environ. Saf.* 84: 46–53. DOI: 10.1016/j.ecoenv.2012.06.022.

Dumnicka, E. (2016). Alien Naididae species (Annelida: Clitellata) and their role in aquatic habitats in Poland. *Biologia* 71(1): 16–23. DOI: 10.1515/biolog-2016-0006.

Dumnicka, E., Konopacka, A. & Żurek, R. (2018). Changes in the benthic fauna composition in the Upper Vistula over the last 50 years – the consequences of the water pollution reduction and alien species invasion. *Oceanol. Hydrobiol. St.* 47(3): 303–312. DOI: 10.1515/ohs-2018-0029.

Erséus, C. & Paoletti, A. (1986). An Italian record of the aquatic oligochaete *Monopylephorus limosus* (Tubificidae), previously known only from Japan and China. *Boll. Zool.* 53: 115–118. DOI: 10.1080/11250008609355492.

Erséus, C. & Hsieh, H.-L. (1997). Records of Estuarine Tubificidae (Oligochaeta) from Taiwan. *Species Diversity* 2: 97–104. DOI: 10.12782/specdiv.2.97.

Erséus, C. & Qi, S. (1985). Two aberrant Tubificidae (Oligochaeta) from Pearl River in the People's Republic of China. *Hydrobiologia* 127: 193–196. DOI: 10.1007/BF00024223.

Erséus, C. (1984). The marine Tubificidae (Oligochaeta) of Hong Kong and southern China. *Asian Mar. Biol.* 1: 135–175.

Erséus, C., Daoyuan, S., Yanling, L. & Bin, S. (1990). Marine Oligochaeta of Jiaozhou Bay, Yellow Sea coast of China. *Hydrobiologia* 202: 107–124. DOI: 10.1007/BF02208131.

Hatai, S. (1898). On *Vermiculus limosus*, a new species of aquatic Oligochaeta. *Annot. Zool. Jpn.* 2: 103–111.

Marszewska, L., Dumnicka, E. & Normant-Saremba, M. (2017). New data on benthic Naididae (Annelida, Clitellata) in Polish brackish waters. *Oceanologia* 59: 81–84. DOI: 10.1016/j.oceano.2016.06.003.

Moseman, S.M., Levin, L.A., Currin, C. & Forder, C. (2004). Colonization, succession, and nutrition of macrobenthic assemblages in a restored wetland at Tijuana Estuary, California. *Estuar. Coast. Shelf Sci.* 60: 755–770. DOI: 10.1016/j.ecss.2004.03.013.

Myślińska, E. (2001). *Organic and laboratory land testing methods*. Warszawa: PWN. (In Polish).

Naidu, K.V. (2005). *Fauna of India and the adjacent countries. Aquatic Oligochaeta*. Kolkata: Zoological Survey of India.

Nomura, E. (1915). On the aquatic oligochaete *Monopylephorus limosus* (Hatai). *J. Coll. Sci. Imp. Univ. Tokyo* 35: 1–46.

Pabis, K., Krodkiewska, M. & Cebulska, K. (2017). Alien freshwater polychaetes *Hypania invalida* (Grube 1860) and *Laonome calida* Capa 2007 in the Upper Odra River (Baltic Sea catchment area). *Knowl. Manag. Aquat. Ecosyst.* 418(46): 1–3. DOI: 10.1051/kmae/2017033.

Paoletti, A. (1987). Some notes on the biology of the Asiatic species *Monopylephorus limosus* found in Italy. *Hydrobiologia* 155: 307–307. DOI: 10.1007/978-94-009-3091-9_39.

Pinder, A.M. (2003). First Australian Records of Three Species and Two Genera of Aquatic Oligochaetes (Clitellata: Annelida). *Proc. Linn. Soc. N.S.W.* 124: 109–114.

Rodriguez, P. (1999). *Monopylephorus camachoi* nov. sp., a new rhyacodriline worm (Tubificidae: Clitellata) from the Coiba Island, on the east Pacific Coast of Panama. *Hydrobiologia* 406: 49–55. DOI: 10.1023/A:1003728015659.

Soors, J., van Haaren, T., Timm, T. & Speybroeck, J. (2013). *Bratislavia dadayi* (Michaelsen, 1905) (Annelida: Clitellata: Naididae): a new non-indigenous species for Europe, and other non-native annelids in the Schelde estuary. *Aquat. Invasions* 8(1): 37–44. DOI: 10.3391/ai.2013.8.1.04.

Sowa, A., Krodkiewska, M. & Halabowski, D. (2018). Shaping of the aquatic oligochaete assemblages in inland saline anthropogenic habitats: a case study of coal mine settling ponds in southern Poland. *Fundam. Appl. Limnol.* 92(2): 173–179. DOI: 10.1127/fal/2018/1181.

Takashima, Y. & Mawatari, S.F. (1996). Marine Tubificidae (Oligochaeta) from Hokkaido, northern Japan, with descriptions of two new species. *Species Diversity* 1: 55–70.

DOI: 10.12782/specdiv.1.55.

Timm, T. (1999). Distribution of freshwater oligochaetes in the west and east coastal regions of the North Pacific Ocean. *Hydrobiologia* 406: 67–81. DOI: 10.1023/A:1003749519662.

Timm, T. (2009). A guide to the freshwater Oligochaeta and Polychaeta of the Northern and Central Europe. *Lauterbornia* 66: 1–235.

van Haaren, T. & Soors, J. (2013). *Aquatic Oligochaeta of The Netherlands and Belgium*. Ultecht: KNNV publisher. DOI: 10.1163/9789004278097.

Wang, H. & Cui, Y.-D. (2007). On the studies of Microdrile Oligochaeta and Aeolosomatidae (Annelida) in China: brief history and species checklist. *Acta Hydrobiologica Sinica* 31: 87–98.

Yamaguchi, H. (1953). Studies on the aquatic Oligochaeta of Japan. *J. Fac. Sci. Hokkaido Univ., Ser. 6* 11: 277–342.

Yanling, L. (1987). Preliminary study of the aquatic Oligochaeta of the Changjiang (Yangtze) River. *Hydrobiologia* 155: 195–198. DOI: 10.1007/BF00025651.

Żmudziński, L. (1990). *Animal world of the Balic Sea*. Warszawa: WSiP. (In Polish).