INTRODUCTION

The molluscan fauna of the Odra (Oder River), like those of the other large Polish rivers, has not been sufficiently studied. This is reflected, for instance, by the absence of monographic studies on the whole molluscan fauna inhabiting the largest rivers that would take into account the habitats of the current, the river margin, and water bodies situated in the flood plains. So far, the most extensive data on the occurrence of benthic macrofauna in the upper, middle, and lower courses of the Odra and its tributaries have been provided by the surveys of the International Commission for the Protection of the Odra against Pollution (SCHOLL et al. 2003). That study features 26 snail species and 14 bivalve species detected along the whole river course, but unfortunately the localities of particular species (names of towns or villages) are not mentioned. More or less comprehensive contributions to the knowledge about molluscs of selected stretches of the Odra and its valley have been made by LEHMANN (1873), BOETTGER (1926), JAECKEL (1955), TETENS & ZEISSLER (1964), HASTRICH (1994), BRINKMANN et al. (1997), SCHMID (1999), JANICKI (2002), DOMAGAŁA et al. (2003, 2004), ŁABECKA et al. (2005), MULLER et al. (2007), WAWRZYNIAK-WYDROWSKA (2007), WILKE (2007) and ZETTLER (2012).

In 2009–2011, research was carried out within the project "Groynes as a factor shaping anthropogenic habitats in rivers: an analysis of the complex of benthos, plankton and periphyton in isolated still-water bodies between groynes as exemplified by the middle and lower course of the Odra River". It focused on the specific, anthropogenic river habitat with a slow current, between groynes protecting the river banks. Activities of the research team were coordinated by the second author of this paper. The major aim of the project was to evaluate the areas between groynes, referred to as groyne fields, in this...
large lowland river as habitats contributing to an increase in biological biodiversity. Among benthic organisms, molluscs constituted ca. 25% of the total number of collected specimens (1.7% Bivalvia and 23% Gastropoda). The rich malacological material of 335 snail and bivalve samples provided a reliable basis for publishing the research results. The examined malacofauna of the middle and lower Odra contained a large proportion of alien species, suggesting a crucial role of the water route in their expansion over the territory of Poland. This assumption is supported by the presence of the Odra-Spree Canal and the Odra-Havel Canal, connecting the river system of the Elbe to those of the Odra and Vistula (via the Bydgoszcz Canal).

STUDY AREA

The Odra, the second largest Polish river, constitutes one of the six largest river systems of Europe. It is 854.3 km long (741.9 km situated at least partly within Poland), and its drainage basin encompasses 118,861 km² (106,821 km² in Poland). The average annual flow, according to a water gauge in Hohen-saaten-Finow, amounts to ca. 17 milliard m³, which corresponds to the average flow rate of 540 m³s⁻¹ (DUBICKI & BLACHUTA 1999). The character of the Odra is determined by extensive regulatory works conducted along its course and the fact that it has been connected by canals to the other river systems of Europe. Since the beginning of the 18th century, stone groynes have been constructed in order to move the main current away from the river banks; altogether, ca. 10,000 such groynes have been built (RAST et al. 2000). Between the groynes, especially the longest ones, groyne fields have formed, characterised by slow water flow and in some places even the absence of any flow. In such areas, organic and mineral matter accumulates. In the course of the regulation works, as a result of shortening and straightening of the river course, many former meanders became oxbow lakes. Some of them are still permanently connected to the main course of the river. Groyne fields and oxbow lakes represent lentic environments in the river system of the Odra.

Our research was conducted along a 306-km stretch of the river: from Uraz near Wroclaw (51°14′55.5″N, 16°50′46.57″E) to Ognica near Szczecin (53°3′33.6″N, 14°21′14.3″E) (Fig. 1). In this stretch, the Odra is a large, well-developed lowland river, 120–270 m wide. The depth of the river-bed at average water level is 0.8–1.9 m in the upper section and 3.5–4.3 m in the lower section (MARSZAŁEK 2003). The river-bed is mostly covered by sand and gravel sediment.

MATERIAL AND METHODS

Benthos samples were collected from 31 localities distributed along the middle and lower courses of the Odra (Fig. 1, Table 1). Molluscs were collected from groyne fields (g, 15 sampling sites); from the current at the tips of the groynes (s, 15); control sites (c, 4); and oxbow lakes (o, 12). The control sites were situated in the area of the Odra without groynes, but close to the research sites, so that they reflected the character of the river.
Fig. 1. The studied stretch of the Odra River with research sites
Material was collected in 2009–2010, in the spring, summer, and autumn. In total, 335 mollusc-containing samples were collected, including 242 samples from the area of groynes, i.e. 213 from groyne fields and 29 from the current at the tips of the groynes; 35 samples from control sites and 58 from oxbow lakes. The material was collected with a triangular drag net, side length of 25 cm, maximum handle length
4 m, which allowed penetration of sediments between stone blocks and collection of samples from greater depths. In the field, silt was rinsed off the samples placed on the 50-µm net, and larger debris (e.g. pieces of rock, timber and leaves) was removed on a sieve with mesh size of 5 mm (larger macrobenthic organisms were collected by hand at that stage). Sand and gravel sediments were subjected to sedimentation by stirring the sediment in a water-filled container and decanting from the surface of the sediment the organisms whose specific weight was smaller than the weight of the sediment. The procedure was repeated many times in order to remove mineral fraction. Then the samples were fractioned on a sieve with mesh size of 3.0 mm into macro- and meio-benthos and preserved in 98% ethanol. In the laboratory, molluscs were collected from samples prepared in this way.

RESULTS

Fifty five mollusc species were identified in the studied material (32 Gastropoda and 23 Bivalvia) (Table 1). Species alien to Poland, as well as species protected in Poland, constituted a considerable part of the malacoфаuna. Alien species were represented by the snails Lithogyphus naticoides, Potamopyrgus antipodarum, Physella acuta, Ferrissia fragilis, Menetus dilatatus, and the bivalves Corbicula fluminea, and Dreissena polymorpha. Protected species included Borysthenia naticina (Gastropoda) as well as Anodonta cygnea, Sphaerium rivicola, and S. solidum (Bivalvia). Alien mollusc species constituted 14.5% of all detected species, but in terms of density they accounted for as much as 80% of the total catch.

The most common species in the studied stretch of the Odra, present in the highest percentage of mollusc-containing samples (n = 335) and found in the highest number of sites (out of the total of 31), included:
1. Potamopyrgus antipodarum – 49.1% of samples, 21 sites
2. Viviparus viviparus – 39.8%, 21 sites
Table 1. List of molluscs recorded in groyne fields (g), in the stream at the tips of groynes (s), control sites (c), and oxbow lakes (o) of the middle and lower Odra River

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Odra Sites</th>
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<tbody>
<tr>
<td><strong>Gastropoda</strong></td>
<td></td>
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<tr>
<td><strong>Neritidae</strong></td>
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<tr>
<td>1. <em>Theodoxus fluviatilis</em> (Linnaeus, 1758)</td>
<td>g</td>
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<tr>
<td><strong>Vitriporidae</strong></td>
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<tr>
<td>2. <em>Viviparus contectus</em> (Millet, 1813)</td>
<td>g</td>
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<tr>
<td>3. <em>Viviparus viviparus</em> (Linnaeus, 1758)</td>
<td>c</td>
</tr>
<tr>
<td><strong>Bithyniidae</strong></td>
<td></td>
</tr>
<tr>
<td>4. <em>Bithynia leachi</em> (Sheppard, 1823)</td>
<td>g</td>
</tr>
<tr>
<td>5. <em>Bithynia tentaculata</em> (Linnaeus, 1758)</td>
<td>c</td>
</tr>
<tr>
<td>5a. <em>Bithynia tentaculata f. producta</em> Menke, 1828</td>
<td>g</td>
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<tr>
<td><strong>Hydrobiidae</strong></td>
<td></td>
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<tr>
<td>6. <em>Lithoglyphus naticoides</em> (C. Pfeiffer, 1828)</td>
<td>g</td>
</tr>
<tr>
<td>7. <em>Potamopyrgus antipodarum</em> (Gray, 1843)</td>
<td>c</td>
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<tr>
<td><strong>Valvatidae</strong></td>
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<tr>
<td>8. <em>Borytheina naticoides</em> (Menke, 1845)</td>
<td>c</td>
</tr>
<tr>
<td>9. <em>Valvata cristata</em> O. F. Müller, 1774</td>
<td>g</td>
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<tr>
<td>10. <em>Valvata piscinalis</em> O. F. Müller, 1774</td>
<td>g</td>
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<tr>
<td><strong>Acroloxidae</strong></td>
<td></td>
</tr>
<tr>
<td>11. <em>Acroloxus lacustris</em> (Linnaeus, 1758)</td>
<td>g</td>
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<tr>
<td><strong>Lymnaeidae</strong></td>
<td></td>
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<tr>
<td>12. <em>Gastropus truncatus</em> (O. F. Müller, 1774)</td>
<td>g</td>
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<tr>
<td>13. <em>Lymnaea stagnalis</em> (Linnaeus, 1758)</td>
<td>g</td>
</tr>
<tr>
<td>14. <em>Radix auricularia</em> (Linnaeus, 1758)</td>
<td>g</td>
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<tr>
<td>15. <em>Radix balthica</em> (Linnaeus, 1758)</td>
<td>g</td>
</tr>
<tr>
<td>16. <em>Stagnicola palustris</em> (O. F. Müller, 1774)</td>
<td>g</td>
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<tr>
<td><strong>Physidae</strong></td>
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<tr>
<td>17. <em>Physa fontinalis</em> (Linnaeus, 1758)</td>
<td>g</td>
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<tr>
<td>18. <em>Physella acuta</em> Say, 1817</td>
<td>g</td>
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<tr>
<td><strong>Planorbidae</strong></td>
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<tr>
<td>19. <em>Ancylus fluviatilis</em> O. F. Müller, 1774</td>
<td>g</td>
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<tr>
<td>20. <em>Antiochus leucostoma</em> (Millet, 1813)</td>
<td>g</td>
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<tr>
<td>21. <em>Antiochus spinulosus</em> (Linnaeus, 1758)</td>
<td>g</td>
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<tr>
<td>22. <em>Antiochus vorticula</em> (Linnaeus, 1758)</td>
<td>g</td>
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<tr>
<td>23. <em>Bathyomphalus complanatus</em> (Linnaeus, 1758)</td>
<td>g</td>
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<tr>
<td>24. <em>Ferrissa fragilis</em> (Tryon, 1863)</td>
<td>g</td>
</tr>
<tr>
<td>25. <em>Gyraulus albus</em> (O. F. Müller, 1774)</td>
<td>g</td>
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<tr>
<td>Molluscs of the Odra River: expansion of alien species</td>
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<td>-----------------------------------------------------</td>
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<tr>
<td>28. <em>Gyrinochilus crista</em> (Linnaeus, 1758)</td>
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<tr>
<td>27. <em>Hippopus sphondylius</em> (Linnaeus, 1758)</td>
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<tr>
<td>28. <em>Menetus dilatatus</em> (Gould, 1841)</td>
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<tr>
<td>29. <em>Planorbites corneus</em> (Linnaeus, 1758)</td>
<td></td>
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<tr>
<td>30. <em>Planorbis carinatus</em> O. F. Müller, 1774</td>
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<tr>
<td>31. <em>Planorbis planorbioides</em> (Linnaeus, 1758)</td>
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<tr>
<td>32. <em>Seguenzia vitrea</em> (O. F. Müller, 1774)</td>
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</tbody>
</table>

**Bivalvia**

**Unionidae**
1. *Anodonta anatina* (Linnaeus, 1758)
2. *Anodonta cygnea* (Linnaeus, 1758)
3. *Unio pictorum* (Linnaeus, 1758)
4. *Unio trunculus* Philipson, 1788

**Corbiculidae**
5. *Corbicula fluminea* (O. F. Müller, 1774)
6. *Corbicula fluminea* (O. F. Müller, 1774)

**Sphaeriidae**
7. *Musculium lacustre* (O. F. Müller, 1774)
8. *Pisidium amnicum* (O. F. Müller, 1774)
9. *Pisidium caucasicum* (Polli, 1791)
10. *Pisidium crassum* Stelfox, 1918
11. *Pisidium hemisphaericum* (Sheppard, 1825)
12. *Pisidium limatulum* Held, 1856
13. *Pisidium montagui* (Paladilhe, 1866)
14. *Pisidium nitidum* Jenyns, 1832
15. *Pisidium personatum* Malm, 1855
16. *Pisidium pudoruncula* (Steffox, 1918)
17. *Pisidium pulchellum* Jenyns, 1832
18. *Pisidium subtruncatum* Malm, 1855
19. *Pisidium supinum* A. Schmidt, 1851
20. *Sphaerium cornutum* (Linnaeus, 1758)
21. *Sphaerium rivulorum* (Lamarck, 1818)
22. *Sphaerium solidum* (Normand, 1844)

**Dreissenidae**
23. *Dreissena polymorpha* (Buller, 1771)
3. *Bithynia tentaculata* – 32.9%, 25
4. *Valvata piscinalis* - 25.7%, 23
5. *Lymnaea stagnalis* – 24.2%, 22
6. *Physella acuta* – 23.3%, 17
7. *Corbicula* spp. (*C. fluminalis* + *C. fluminea*) – 17.7%, 12
8. *Dreissena polymorpha* – 15.3%, 16
9. *Planorbis planorbis* – 12.9%, 21
10. *Galba truncatula* – 11.4%, 15

Most of these species occurred along the whole studied part of the river. *Bithynia tentaculata f. producta* and *Menetus dilatatus* had never been reported from the Odra before.

The richest malacofauna inhabited the groyne fields (g), where 51 mollusc species were recorded (29 Gastropoda, 22 Bivalvia) (Table 1). The following species were found solely in such fields: *B. tentaculata f. producta*, *B. naticina*, *M. dilatatus*, *F. fragilis*, and *A. cygnea*. The most abundant snail species included: *P. antipodarum* (80%!), *V. piscinalis* (2.7%), *G. truncatula* (2.4%), and *B. tentaculata* (2.3%). Furthermore, a high representation of the Sphaeriidae (15 species) was significant, including such orb mussels as *S. rivicola* and *S. solidum*.

Samples from the current at the tips of the groynes (s) yielded the poorest fauna: 20 species (11 Gastropoda, 9 Bivalvia) (Table 1). The most abundant snail species were *P. antipodarum* (45%) and *B. tentaculata* (8%), whereas the most abundant bivalve was *Pisidium henslowanum* (6%).

Almost equal numbers of mollusc species were detected in the oxbow lakes (o) and control sites (c) situated outside the area with groynes: 36 and 35, respectively (Table 1). Stagnophilous snails, such as *P. acuta*, *P. planorbis*, and *V. piscinalis*, dominated in the oxbows; each of these species constituted ca. 10% of the total number of collected snails. Interestingly, *P. antipodarum* constituted merely 4% of the total. In the control zone, *P. antipodarum* and *V. viviparus* dominated, each of them accounting for 17% of the total number of detected snails. Both reophilous (*L. naticoides*, *Ancylus fluviatilis*, *S. rivicola*) and stagnophilous species (e.g. *P. planorbis*) were found in the control zone.

The presence of *Lithoglyphus naticoides* (Fig. 5) among alien species is worth mentioning, as it represents the Ponto-Caspian element in the Polish fauna. It was found in six localities along the stretches of the river between Nowa Sól and Urad. The distance from the Odra-Spree Canal (marked by the earlier presence of that snail species) was 13 km downriver and 123 km upriver (Table 1). The species was most frequent in groyne fields, where its density ranged from 1 to over 500 indiv.m⁻².

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1 Considered jointly due to the fact that reliable identification of young individuals was impossible.
Potamopyrgus antipodarum (Fig. 6), an invasive species originating from New Zealand, is presently the most common and most abundant snail species in the Odra. Its mass occurrence was recorded along the whole river course, where it inhabited groyne fields as well as oxbow lakes and the river current near the tips of groynes. However, in the groyne fields its relative abundance was the highest, namely 80%, and in the oxbow lakes it was the lowest, amounting to only 4%. In many locations the abundance of *P. antipodarum* was considerable, reaching up to 6,800 indiv.m\(^{-2}\), while the average density amounted to 260 indiv.m\(^{-2}\). The highest density of that snail species was found in the material collected in the upper part of the studied stretch of the river, between Ścinawa and Połęcko. *P. antipodarum* was found on sandy bottom, bottom composed of sand and silt, on pieces of rock, and on aquatic plants.

Physella acuta (Fig. 7), a snail species introduced in Europe probably from North America, was found along the whole course of the Odra and inhabited all the studied parts of the river (Table 1). However, its relative abundance was the highest in the oxbow lakes (11%) and control sites (4%). Adult specimens were characterised by significant shell sizes (up to 15.5 mm high), and the spire/aperture height ratio was, on average, 1:2.05 (from 1:1.63 to 2:2.4). Such proportions are typical of the bladder snail identified as *P. heterostropha* (GLOER 2002). However, since the specific rank of this taxon has recently been questioned (see Discussion), it is here classified as *P. acuta*.

Ferrissia fragilis, the species most often referred to under synonymous names *F. clessiniana* (Jickeli, 1882) and *F. wautieri* (Mirolli, 1960), also represents the North American element in the Polish fauna. A single specimen found in groyne fields in Rapice, near the mouth of the Odra-Spree Canal, represented the so-called septal form, with a horizontal septum which is believed to develop under adverse conditions, e.g. low water level, oxygen deficit, etc. (RICHARDOT 1976). *F. fragilis* is known from a number of locations scattered over Greater Poland, Mazovian Lowland and Upper Silesia (STRZELEC 2011), where it occurs as an ancylid form devoid of septum. The only other record of the septal form in Poland is a flooded subsidence basin surrounded by forest, situated near Zabrze (SPYRA 2008).

Menetus dilatatus (Fig. 8A–C) is another North American introduction. In North America it occurs along the Atlantic coast, from Nova Scotia to Florida, ranging west to the Mexican Plateau, Texas, Oklahoma, and central and northern California (JOKINEN 1992). Previously, in Poland it had been found only in the Konin Lakes, fed by heated effluent water discharged by a power plant (BERGER & DZIĘCZKOWSKI 1977). A single specimen of this rare freshwater snail was found in the groyne fields in Rapice, where it occurred together with *F. fragilis*.

Borysthenia naticina (Fig. 9), a protected species, one of the rarest in the Polish malacofauna, was observed only in Głogów, where six adult specimens were found in two samples collected from the groyne fields. The find confirmed the results of a recent research conducted by ZETTLER (2012), who recorded *B. naticina* near the town of Stützkow, in the lower course of the river. The coincident observations indicate that the Odra is still a refugium of this interesting and poorly studied species.

Another noteworthy mollusc is the rare form of Bithynia tentaculata f. producta, found near the groynes in Głogów, Cigacice and Krosno Odrzańskie. The form is characterised by larger shell dimensions than the typical *B. tentaculata* and a narrowing of the body whorl. The largest specimen was 13.2 mm high and 7.4 mm wide. As for smaller bivalves, the pill-clam *Pisidium crassum* is worth mentioning; encountered mainly in Polish lakes (PIECHOCKI 1989), it was found in the groyne fields in Połęcko and Słubice.
Bivalves of the genus *Corbicula* (Figs 10 and 11) occurred frequently and in large numbers along almost the whole middle stretch of the Odra, from Uraz to Ślubice. In most locations they were represented by *C. fluminea*, but in Głogów, Rapice, and Urad, *C. fluminalis* was also recorded (Table 1). Most of the collected specimens were juvenile; due to insufficiently developed taxonomic features they could not be reliably identified and thus it was impossible to trace possible differences in distribution of the two species along the river course. The considerable number of young specimens is a proof of *Corbicula*’s expansion over the drainage basin of the Odra. According to Kołodziejczyk & Łabecka (2011), *C. fluminalis* is an Asian species, whose native range encompasses northern Iran, Afghanistan, a considerable part of Mesopotamia (Iraq, Syria, Kuwait, Turkey), South Caucasus, India, and Kashmir, whereas *C. fluminea* originates from the drainage basin of the Ussuri River, the south-eastern part of China and Korea (Stańczykowska & Kołodziejczyk 2011).
Dreissena polymorpha, an invasive species native to the Ponto-Caspian area, is presently widespread across Poland and Europe, and since 1985 also in North America (STAŃCZYKOWSKA & LEWANDOWSKI 2011). In the middle and lower Odra it was one of the most frequent molluscs, but in the collected samples it was not abundant. This could be associated with the sampling method, which focused on loose sediments (sand, silt) and not on hard surfaces to which the mussel attaches itself with byssus threads. D. polymorpha was recorded in the groyne fields, oxbow lakes, and at the tips of groynes. Its records from the environs of Wrocław (Uraz, Prężyc, Ścinawa) extended the range of the species southward in comparison to recently published data (STAŃCZYKOWSKA & LEWANDOWSKI 2011).

Bivalves of the genus Sphaerium, S. rivicola (Fig. 12) and S. solidum (Fig. 13), believed to be endangered with extinction in Poland (VU and EN categories; DIDUCH-FALNIOWSKA & ZAJĄC 2002), were relatively abundant and frequent in the studied stretch of the Odra. S. rivicola was recorded in 14 sites along almost the whole river course, whereas S. solidum was encountered in nine localities (Table 1). Both species inhabited the groyne fields and control sites. A single occurrence of S. rivicola was recorded in an oxbow lake. However, both species were most frequent in the groyne fields.

The swan mussel (Anodonta cygnea) was found only in the sand and silt sediment in the groyne field in Nowa Sól. Habitats of that type, distributed along the river course, are characteristic of the occurrence of A. cygnea, and the species is likely to be found in a greater number of localities. Other protected mussels – Pseudanodonta complanata and Unio crassus – undetected in our research, still occur in the Odra. This is suggested by the data published by GLOER & MEIER-BROOK (2003: distribution map, p. 74), SCHOLL et al. (2003), ZAJĄC (2004), and ZETTLER (1997: distribution map, p. 215).
DISCUSSION

In spite of the common opinion that pollution and regulation of the river-bed have an adverse effect on benthic organisms, the malacoфаuna of the Odra – a heavily degraded river – is still rich and diversified. The total number of species recorded in the Odra (including those recorded by other authors and undetected in this study) is 67 (40 Gastropoda, 27 Bivalvia), which constitutes 76.1% of the total freshwater malacoфаuna of Poland (Piechocki & Sulikowska-Drozd 2008). Species complementing the list of 55 taxa in Table 1 include Bithynia troglodyta, Marniopsis scholtzi, Valvata macrostoma, Sacta corvus, Myxus glutinosus, Aplexa hydronormus, Anisus vorticulus, Gyraulus riparius, Unio crassus, Pseudanodonta complanata, Sinanodonta woodiana and Pissidium obtusale. It ought to be remembered, however, that the research carried out in 2009–2011 did not encompass the whole course of the Odra.

We did not take into account three species occurring in the Odra according to Jeckel (1955) and Scholl et al. (2003): Radix ovata, R. peregra and Physella heterostropha. According to Gloor (2002) R. ovata is a junior synonym of R. balthica, while R. peregra – a synonym of R. labiata – does not occur in the river, and P. heterostropha is a synonym of Physella acuta (see below). The occurrence in the Odra of such species as Stagnicola fuscus and S. turricula, listed by Boettger (1926) as forms of S. palustris, and Omphiscola glabra recorded by Scholl et al. (2003), is dubious. According to Bargues et al. (2006), S. turricula is identical with S. palustris, whereas the remaining two species do not occur in Poland. (Jackiewicz 1998).

Our research has shown that groynes fields provide an exceedingly favourable habitat for molluscs. This is probably associated with the presence of various kinds of bottom (silty, sandy, rocky, and vegetated) in a small area, so that species of various ecological requirements can exist in close proximity. An additional favourable factor is probably that of diversified water flow velocity, making it possible for reophilous species to exist alongside stagniphilous ones.

The strikingly high proportion of alien species (13.4%, including Sinanodonta woodiana, not recorded in this study) indicates that the Odra River system is of crucial significance in the expansion of these species over the territory of Poland. A major role in the process of dispersal of new arrivals is certainly played by the canals: the Odra-Spree Canal and the Odra-Havel Canal, connecting the drainage basins of the Odra and the Elbe. The highest number of alien species was detected in places where these canals entered the Odra, including, among other species, M. dilatatus (the second record in Poland), F. fragilis, P. acuta, C. fluminea, and C. fluminalis. The above-mentioned species were also recorded in the drainage basin of the Elbe (Falkner et al. 2001, Arlt 2005, Muller et al. 2005). They represent the North American element in the European fauna.

The catchment area of the Odra and the canals connecting it with the Elbe and Vistula river systems were also of great importance for the westward spread of Ponto-Caspian species. This is shown by the recent distribution of D. polymorpha and L. naticoides in Poland and Germany (Gloor & Meier-Brook 2003: distribution maps, Piechocki 2004, Kołodziejczyk 2011, Stańczykowska & Lewandowski 2011). The numerous localities of L. naticoides situated between Nowa Sól and Urad suggest that the middle Odra constitutes a refugium of this species, once invasive and presently receding, which confirms the tentative view of Kołodziejczyk (2011) on the current status of this Ponto-Caspian mollusc in the Polish waters.

For many years, P. acuta was regarded as Mediterranean, but recent research has shown that the species, presently cosmopolitan, started its expansion from North America and continued spreading during the 19th and 20th centuries. In Europe it first appeared in Mediterranean countries and then colonised other areas. The analyses of alloenzymes and mitochondrial DNA have shown that bladder snails, earlier classified as P. acuta, P. heterostropha and P. integra, are conspecific (Wethington & Lydeard 2007).

Potamopyrgus antipodarum, at present one of the most common freshwater snails in Poland, probably colonised our country through the drainage basin of the Odra and the canals connecting the Odra to the Elbe. This is confirmed by the presence of this species in the system of Elbe-Havel-Spree water connections already at the time of World War I (Jeckel 1955), its pioneer locations in Lake Trląg (catchment area of the Noteć River, 1933) (Urbański 1938), the Odra and its tributaries (Jeckel 1955), and its expansion to the Upper Silesia (through the Glwice Canal) (Strzelec 2011) as well as its present mass occurrence along the whole course of the Odra.

The recent invasion of the Asian bivalves of the genus Corbicula has a similar and equally drastic character. Research conducted in 1998-2001 did not reveal the presence of Corbicula species in the Odra (Scholl et al. 2003). They were first recorded in 2003 (Corbicula fluminea) and 2004 (Corbicula fluminalis) in heated waters of the Lower Odra Canal near Czarnów and Gryfino (Domagała et al. 2004, Łabecka et al. 2005). In 2006 and 2007, a number of localities of Corbicula fluminea were discovered in the upper, middle, and lower course of the river, where the species was represented both by live specimens and by empty shells (Muller et al. 2007, Wawrzynek-Wydrowska 2007, Wilke 2007). However, the cited authors did not encounter Corbicula fluminalis in the course of field research. Studies of
the fauna of groyne-associated habitats indicate that both bivalve species quickly expand their range along the Odra, and at the same time highlight the importance of the Havel-Odra and Spree-Odra canals as immigration routes of invasive species into Poland. It is worth mentioning that *C. fluminea* has recently been recorded in the Vistula in Cracow (MACKIEWICZ 2013).

The presence of alien molluscs and mass occurrence of invasive species do not seem to have an unequivocally negative effect on the native malaco fauna. This fact is reflected by both high species diversity of snails and bivalves and high abundance of such native molluscs as *V. viviparum*, *B. tentaculata* or *V. piscinalis*. The out-competing of *Physella fontinalis* by *P. acuta* may be an exception. Both species have similar ecological requirements and inhabit eutrophic waters with luxuriant vegetation, in locations where the bottom is covered with sand and silt. *P. acuta* was recorded in 16 locations, mainly in groyne fields, and *P. fontinalis* in 13; the latter species was more frequent in oxbow lakes. The two species co-occurred in only eight sites.

The river-bed of the Odra, diversified habitats of the areas between groynes, and numerous oxbow lakes provide favourable conditions for the occurrence of molluscs with various ecological requirements. This is confirmed, among other things, by the presence in the Odra of protected reophilous species, e.g. *B. naticina*, *S. rivola*, and *S. solidum*, which have become extinct in many other Polish rivers.

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