



THE 15TH POLISH MALACOLOGICAL SEMINAR – WHAT DO WE DO?

SEMINAR REPORT

The 15th Polish Malacological Seminar was held in September 1999 in Łódź, or rather on its outskirts, in the midst of a forest, in a conference centre of the University of Łódź. The main organizer was Professor dr. hab. ANDRZEJ PIECHOCKI (GREAT THANKS!), with assistance of his colleagues from the Department of Invertebrate Zoology and Hydrobiology (here special thanks go to the Department Staff: Ms. ANNA ABRASZEWSKA-KOWALCZYK, Ms. MAŁGORZATA KLUKOWSKA and Mr. GRZEGORZ TOŃCZYK who during the Seminar were everywhere at once to check if everything was absolutely in order).

The number of participants was 52, two of these being guests from the Netherlands and Byelorussia. There were 24 papers and 24 posters; though some participants did not present their results, some others had more than one talk or poster. The topics discussed ranged from *Lymnaea* consuming *Potamopyrgus antipodarum*, through hormonal control in cephalopods or farming *Helix aspersa*, to biostratigraphic significance of Miocene malacofauna (see below). Since this was the 15th anniversary of the first malacological meeting in Poland, one of the talks was about the history of Polish malacology in general and the history of Malacological Seminars in particular. I am one of the very few malacologists who have attended all the Seminars since the very first, and thus can compare my impressions. Now, when listening to all these talks and looking at the posters, it is clear that the quality of work has improved very much since the 1980s: both the quality of ideas and problems solved, and the way of presenting results: slides, transparencies or posters.

During the Seminar Professor dr. hab. STEFAN W. ALEXANDROWICZ, the initiator of the Malacological

Seminars and Organizer of the first seven of them, received a commemorating medal of the Association of Polish Malacologists. Unfortunately, being engaged in a project in Slovenia, he could not appear in person.

The malacological discussions were accompanied by two social events: a rather informal beer-drinking and sausage-grilling, and a formal dinner which was really grand style. One of its numerous highlights was *Helix aspersa maxima*, brought by our “applied” colleagues from Cracow, deliciously spiced and served ad libitum.

One way to advertise the Polish malacology, to find more people interested in our research and perhaps also future co-workers, is to say what we do: for example to publish brief abstracts of posters and talks of our annual meetings. We did just this in 1998 and now are doing it again. Below are abstracts of all the presentations included in the Abstract Book of the XV Polish Malacological Seminar, even though some of the people eventually did not attend for this or that reason. Since the Abstract Book was published in Polish, and the rule of “not more than one standard page” was observed rather liberally, the original texts had to be translated and, whenever necessary, abbreviated. All this has been done – without consulting all the respective authors – by Yours Truly.

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ABSTRACTS OF THE 15th POLISH MALACOLOGICAL SEMINAR, ŁÓDŹ 1999

ZEBRA MUSSEL *DREISSENA POLYMORPHA* IN THE SULEJOWSKI RESERVOIR AND THE LOWER PILICA RIVER

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D. polymorpha was first found in the Sulejowski reservoir, attached to unionids; quantitative samples were taken in 1996–1999, in order to study its distribution, density and population structure. The distribution of the zebra mussel in the reservoir is uneven, depending on the substratum, the highest values being 7,832 indiv./m² on a gravelly-sandy bottom of the reservoir and 8,086 indiv./m² on the bottom of the old Pilica river bed, covered with tree roots. On sandy and muddy bottom *D. polymorpha* is attached to unionid shells; over 50% unionids bear the mussels. The zebra mussel occurs at the depth 0.5–5 m, the maximum density being observed at 3 m; smaller individuals prefer smaller depths, larger individuals are found in deeper water. In the study period the population abundance and the size structure changed: in October 1997 the mean shell length was 12.9 mm, in May 1999 it was 17.8 mm.

SHELL THANATOCENOSES IN THE RACŁAWKA VALLEY NEAR CRACOW

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The mollusc thanatocenosis of the calcareous tufas of the Racławka valley includes 42 species, with only slight differences between the twenty analysed samples. The average proportion of shade-loving snails, species preferring partly shaded habitats, as well as mesophile species is 35–50%; open-country snails constitute 5–10%, while higrophiles and aquatic molluscs are accessory components (1–5%). In all the samples the most abundant species is *Carychium tridentatum*, accompanied by numerous *Vitrea crystallina* and *Aegopinella pura*. The most constant species, with only moderate dominance index values, are *Discus rotundatus*, *Columella edentula*, *Cochlicopa lubrica*, *Vitrea contracta*, *Alinda biplicata* and *Vitrina pellucida*, and of open-country species *Vallonia costata*. *Truncatellina costulata*, not previously recorded from the Cracow Upland, is a part of the thanatocenosis. The thanatocenosis composition reflects the malacofauna of the present nearby habitats.

MALACOFAUNA OF FLOOD DEPOSITS OF THE DUNAJEC RIVER IN THE PIENIŃSKI AND SADECKI RAVINES

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Shell thanatocenoses are often found in flood deposits. Samples of such deposits of the Dunajec river were taken just above the ravine section in Sromowce and somewhat below the ravine in Krościenko. The localities are located in valley sections of different morphology and different shore habitats, which makes it possible to trace the relations between the species composition of the thanatocenosis and the malacocenoses of the recharge area. The Sromowce thanatocenosis includes 40 species, with dominance of terrestrial snails, the most abundant being *Cochlicopa lubrica* and *Vallonia pulchella*, accompanied by numerous species of shady and humid habitats; aquatic molluscs constitute a few per cent. The association characterizes a habitat similar to the present surrounding habitats. The Krościenko thanatocenosis, with its over 50, mainly terrestrial, molluscs, is dominated by shade-loving species, accompanied by mesophiles, higrophiles and open-country species. The presence of epilithic forms, and species typical for the Pieniny Mts. is characteristic. Both thanatocenoses are fairly similar to the malacocenoses that live in the nearest vicinity, which indicates a short-distance transport and a similarity of the thanatocenoses to the malacocenoses that inhabit the place of their accumulation.

SUCCESSION OF MALACOFAUNA IN THE NEOLITHIC FLINTSTONE QUARRY KRZEMIONKI OPATOWSKIE IN THE ŚWIĘTOKRZYSKIE MTS

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The neolithic flintstone quarry Krzemionki Opatowskie is located on a denudation plain built of Jurassic limestones, covered with Pleistocene sandy and sandy-clayey deposits. The originally deforested area was again covered by a forest, the former acidophilous vegetation being replaced by a mesophilous oak-hornbeam forest. Quantitative studies on the malacofauna involved 15 sites. Twenty two snail species were found, the number of species per locality ranging from 5 to 14. The highest number of taxa was found in sparse pine-birch bushes, the only site with species which are rare in natural habitats of the Świętokrzyskie Mts: *Bradybaena fruticum*, *Chondrula*



tridens and *Vertigo pusilla*; the dominant is *Cochlicopa lubrica*. The neolithic flintstone mining contributed to the changes in the surrounding habitats, which involved also their malacocenoses.

EXPANSION OF *POTAMOPYRGUS ANTIPODARUM* (GRAY) IN THE WATERS OF THE WIGRY NATIONAL PARK

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For extended version of the paper see *Folia Malacologica* 7(2): 103–108.

BIOSTRATIGRAPHY OF QUATERNARY LACUSTRINE DEPOSITS IN CHOJNA (NW POLAND)

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The profile Chojna 2/85 includes a 12.2 m series of deposits, lacustrine sediments being 7 m thick. Thirty two mollusc taxa (over 3,900 shells) were found there, including 6 terrestrial and 18 aquatic snail species, and 8 bivalves. The following associations have been distinguished: A – the oldest, where *Armiger crista* and *Valvata piscinalis* form 60–77%; B – a monotonous assemblage with *V. piscinalis* forming 80–95%; C – with *A. crista*, *V. piscinalis* and *V. pulchella* together constituting 70–95%; D – with *A. crista*, *V. piscinalis* and *Hippeutis complanatus* constituting 35–75%; E – a rich association with *A. crista*, *Gyraulus albus*, *V. cristata* and *H. complanatus* forming 35–75%; F – an assemblage with a higher proportion of mesophiles and marsh-dwelling species of seasonally flooded habitats, which testifies to the lake being overgrown with vegetation; *V. cristata*, *Anisus vorticulus* and *Vertigo antivertigo* form 25–40%. Associations A are characteristic of the Boreal period; in the Atlantic period B associations occur. Associations C, D and E represent Subboreal period, while the border Subboreal/Subatlantic period is reflected by the change from malacofauna E to F.

HISTOLOGICAL ANALYSIS OF OVARIES OF *DREISSENA POLYMORPHA* FROM VARIOUS HABITATS

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The objective of the study was to compare the ovary cycle of *Dreissena polymorpha* in natural and arti-

ficial conditions. Samples were taken every 1–4 weeks from June till October from the lakes of the Mazurian Lakeland and the Gulf of Szczecin; the aquarium material was collected in the lake Miedwie. In June and July the gonads of the lake and aquarium individuals were filled with oocytes at all growth stages. In August the percentage of f_4 oocytes per unit area in natural habitats was 10.5 and in aquaria 14.3. At the beginning of September in the individuals from natural habitats there were no f_4 , but only f_1 and few f_2 oocytes; in aquarium females there were still some few f_4 oocytes. At the end of September the gonads of aquarium mussels were devoid of oocytes, while in females from natural habitats f_1 oocytes were found.

INDUSTRIALIZATION AND FLUORINE CONTENT IN SHELLS OF *HELIX POMATIA*

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Snail shells provide a convenient material for monitoring environment pollution (easy access, possibility to use empty shells instead of killing animals). Shells of *Helix pomatia* from various localities constituted the material, shells from laboratory culture being treated as control. Fluorine content was determined in 131 shells; it was found to vary in a statistically significant way, depending on the degree of pollution of the locality.

PURINES IN EGGS AND TISSUES OF *HELIX ASPERSA MAXIMA*

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Content of 15 purines (chemical energy carriers in cells of living organisms) (GTP, GDP, GMP, ATP, AMP, NAD, NADP, IMP, Hyp – hypoxanthine, Xan – xanthine, UA – uric acid, Ino – inosine, Guo – guanosine, Ado – adenosine) and a pyrimidine (Urd – uridine) was determined in eggs and foot muscle tissue of young (feeding) and adult (just after hibernation) *Helix aspersa maxima*. The following purines were found (listed according to their decreasing concentration): in eggs AMP, Urd, ADP, IMP, ATP, Ino, Guo, Hyp, NAD, GMP; in young AMP, IMP, ADP, GMP, ATP, UA, NAD, Urd, Ino, Xan, Hyp, Ado, Guo; in adults AMP, UA, ADP, NAD, Xan, GMP, Ado, ATP, Ino, Urd, Guo, Hyp, IMP. No detectable quantities of GTP, GDP or NADP were found in any sample. Quantitatively AMP prevailed, constituting over 90% all purines in the eggs. The mean EC [energy charge] values were: 0.016 (eggs), 0.16 (juveniles) and 0.17

(adults). Differences were found in the content of particular purines between juvenile and adult snails, IMP content being ca. 20x higher in juveniles. This indicates considerable age-dependent differences in purine metabolism.

BIOMETRICAL ANALYSIS OF SELECTED CHARACTERS OF *VIVIPARUS VIVIPARUS* FROM THE LOWER NAREW RIVER

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The following parameters were analysed in *Viviparus viviparus* from 15 localities in the lower section of the Narew river: population size structure, fresh and dry body mass, dry shell mass, shell height/breadth ratio, shell height/dry mass ratio, ratio shell height/dry body mass, dry/fresh body mass ratio. The size structure varied between the sites, classes III and IV being the most numerous. Dry and fresh body mass, dry shell mass, shell height/breadth ratio and shell height/dry mass ratio changed with size classes, while dry/fresh body mass ratio varied little with size. The mean dry body mass ranged from 0.2 to over 0.5 g, depending on shell size. The ratios shell height/dry shell mass and shell height/dry body mass decreased with shell height. The mean fresh body mass varied between localities and size classes and ranged from 1.5 to 4.8 g. The ratio dry/fresh body mass was little variable.

GONAD OF *HELIX POMATIA* IN ANNUAL CYCLE

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Helix pomatia were collected in the vicinity of Olsztyn, twice a month from April till October, and during hibernation. Standard-fixed gonads were stained with MAYER hematoxylin/eosin and with MALLORY'S method. In April and May the gonad was filled with spermatogonia, spermatocytes and oocytes at all development stages; stages at which the gametocyte is still connected to the acinus wall predominated. One acinus contained most often 1, 2 or sometimes 3 mature oocytes surrounded by follicular cells. Spermatocytes were aggregated in clusters of 4–6 with one follicular cell. Most snails laid eggs in July; later the gonad was emptied of gametes and became filled again in autumn, when initial gametogenesis stages appeared. Likewise, after hibernation the gonad was empty or contained only initial stages of gametogenesis; in some snails the acini were filled, especially in February and March.

ROLE OF MOLLUSCS IN ACCUMULATION OF HEAVY METALS IN SELECTED HABITATS OF THE ZEGRZYŃSKI RESERVOIR

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Content of Cu, Zn, Mn, Fe, Cd, Pb was studied in molluscs which occur abundantly in the Zegrzyński reservoir: *Viviparus viviparus*, *Lymnaea stagnalis*, *L. peregra*, *Dreissena polymorpha*, *Anodonta anatina*, *A. cygnea*, *Unio pictorum* and *U. tumidus*. The molluscs were collected in May, July and September 1997 and 1998 at 8 sites; samples of water and bottom deposits were also taken. Concentration of heavy metals in shells and bodies was determined with AAS method. The load of heavy metals in littoral molluscs was similar to (Zn and Fe) or ca. 10 times lower (Cu, Mn, Cd, Pb) than that in the water; on an average it constituted hundredth or decimal parts of the content in the bottom deposits, but locally the values exceeded 1%. Metals accumulated in molluscs are removed from circulation for the lifetime of these animals, and those accumulated in shells become biologically inaccessible.

MOLLUSCS OF THE LAKE WARNIAK

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Samples were taken from depths of 0.3, 0.5, 1, 2, 2.5 and 3 m at 5 sites spread evenly around the lake, with the use of BERNATOWICZ rake of 0.16 m² sampling area and a semi-quantitative method, with a net of working side of 20 cm. Twenty one mollusc species were recorded: 3 prosobranchs, 8 pulmonates and 10 bivalves; further 10 species were represented by empty shells. The unionids were present at almost all sites. Of the remaining molluscs the most frequent were: *Valvata piscinalis*, *Bithynia tentaculata*, *Physa fontinalis*, *Gyraulus albus*, *Lymnaea peregra*, *L. auricularia*, *Sphaerium corneum*, *Pisidium henslowanum* and *P. nitidum*. The unionids dominated in the lake malacocenoses. Snail densities ranged from a few to ca. dozen individuals per m², the unionid densities being 6–25/m², *S. corneum* – a few to 170, and *Pisidium* spp. from a few to ca. dozen. The biomass consisted mainly of the unionids (up to 442 g/m²), the biomass of other molluscs ranging from a fraction of gram to over 66 g/m².



FRESHWATER MOLLUSCS OF THE WIGRY NATIONAL PARK

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The so called complex of Wigry lakes includes 56 lakes of varied trophy, depth and size. The malacofauna of the Wigry lake and 20 other selected lakes was studied in 1997 and 1998. Seventeen snail and 5 bivalve taxa were found in the Wigry lake. The dominant species was an expansive *Potamopyrgus antipodarum*, followed by *Dreissena polymorpha*, the abundance of other species being very low. The vertical range did not exceed 4–5 m, the maximum abundance being reached at 0.5–2.0 m. The malacofauna of the remaining lakes was clearly poorer. *P. antipodarum* and *D. polymorpha* occurred only in some of them, their vertical range not exceeding 4 m. It is noteworthy that the malacofauna of the lake Białe Wigierskie (9 snail and 4 bivalve taxa), recently isolated, and that of eutrophic lakes Leszczewek and Omulówek, connected with the Wigry, is poor. The significance of connection between the lakes for mollusc dispersal is unclear: malacofauna of some small, forest, mesotrophic lakes was more diverse than that of lakes directly connected with the Wigry. It seems that the most important factor is trophy.

REPRODUCTION SITES AND RATE IN *ARION LUSITANICUS*

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Mating and egg-laying were observed in the area where *Arion lusitanicus* occurs in masses (Łańcut, Albigowa, Wysoka in SE Poland) from July till December. Fertility and egg incubation were studied in outdoors and laboratory culture. In the field *A. lusitanicus* mated in the third decade of July and started egg-laying at the beginning of August, in gardens, cultivated fields, orchards and other anthropogenic habitats, on soil surface and 2–10 cm deep. The density of egg batches ranged from 1 to 9 per m², 12–124 eggs per batch. First juveniles hatched at the end of October. In the outdoors culture the slugs laid eggs during over 3 months, ca. 450 eggs per individual, in batches of 5 to 193. The laboratory individuals laid eggs during 18–57 days, 5–190 per batch. The number of eggs produced per individual was lower than in the outdoors culture (122–382). Later batches contained fewer eggs than earlier ones, both

in the field and in the laboratory. Incubation and hatching depended on temperature (temperatures studied: 10, 15 and 20°C), the percentage of hatching juveniles being closely correlated with the duration of incubation period. The mean percentage of hatching eggs was the highest at 15°C and amounted to 85.5%.

HEAVY METALS AND PHOSPHORUS IN SNAILS OF THE RIVER LIWIEC AND ITS TRIBUTARIES

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Concentration of Cu, Zn, Cd and Pb, and phosphorus in soft parts and shells of *Lymnaea stagnalis* and *Planorbarius corneus* from the river Liwiec and its five tributaries was examined. The concentration in soft parts [ug/g] was: Cu 9.7–31.9, Zn 35.1–223.0, Pb 0.85–8.23, Cd 0.11–1.62, P 145.0–406.7; in shells: Cu 2.0–7.3, Zn 9.4–44.6, Pb 0.38–6.70, Cd 0.017–0.095, P 25.0–95.8. Metabolically active elements (Cu, Zn, P) accumulated in soft parts at a concentration higher than toxic Pb and Cd. Concentration of Cu, Zn and Cd was 2–3 times higher in the mid course of Liwiec, below the outlet of municipal sewage plant in Siedlce. *L. stagnalis* accumulated heavy metals in higher quantities than *P. corneus*, and thus seems to be a better bioindicator. Pb concentration was higher in sites located close to busy roads. Phosphorus concentration in soft parts of *L. stagnalis* was higher than in *P. corneus*, and it was slightly higher in the mid course of Liwiec.

MALACOFAUNA OF QUATERNARY DEPOSITS OF THE EASTERN PART OF THE GULF ZATOKA POMORSKA

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Development of the eastern part of the gulf Zatoka Pomorska was traced based on quantitative composition of malacofauna in the profiles of its sediments. Freshwater and marine malacocenoses made it possible to draw a border between land and marine deposits. Freshwater fauna confirms the presence of lakes in the shoal Ławica Odrzana, from the Late Glacial till the Littorina Transgression.

ABNORMAL SHELLS IN *LYMNAEA (RADIX) PEREGRINA*

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Shells of *Lymnaea peregrina* are characterized by a rather quick increment. The body whorl is usually dis-

tended, though its variation resulted in describing several forms (e.g. *ovata*, *lagotis*, *ampla*). Individuals with abnormal shells are fairly frequent in the subgenus *Radix*. Five juveniles of *L. peregra* were kept in the laboratory; after 5 months 4 of them had shells with the outer margin of aperture widened and reflexed above the whorl surface. Two individuals died, the remaining ones formed further 1/4–1/3 whorl. These specimens had a large transverse “pocket” on the body whorl. In another experiment 80% progeny of two normal individuals had the above-mentioned reflexed aperture margin when sexually mature. The trait persisted in 50–60% adults of the next two generations, and some continued building further whorls. It appears that in the laboratory relatively young individuals reach sexual maturity; during reproduction their body stops growing but the mantle collar continues building the shell, forming a wide, often reflexed lip on the external margin of the aperture. If such an individual continues growing, an abnormal body whorl will result.

APPLICATION OF MOLECULAR TECHNIQUES TO TAXONOMIC STUDIES

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The base for the use of molecular techniques in taxonomic studies is the knowledge of genome organisation. In the case of eukaryotic nuclear genomes, tandem sequences are used in taxonomic and phylogenetic studies because the loci containing them have diverse nucleotide sequences. Depending on the type of repetitive sequence, the differences may involve the level of order, family, genus, species, population or individual. Genes of histone family are useful for ordinal level analyses, rRNA genes – for family and generic level analyses. Analysis of specific and individual differences pertains for example to VNTR loci or microsatellite DNA. Analysis of animal mitochondrial genomes is also applied, since they evolve quicker than nuclear genomes. Techniques of analyzing relationships between taxa are: PCR, DNA sequencing, DNA hybridization, RFLP, RAPD and others. Mitochondrial DNA organization is already known in some molluscs e. g. in some members of the genera *Pecten*, *Mytilus* and *Cepaea*, and some chitons. mtDNA sequencing provided data on evolution of *Partula*. The phylogeny of the genus *Albinaria* was also reconstructed based on mtDNA. Sequences coding for a subunit of mitochondrial cytochrome oxidase make it possible to distinguish between some species of *Bulinus*. Variations in the nucleotide sequence of the small rRNA subunit gene were a basis for phylo-

genetic analysis of Pleuroceridae and *Littorina*. Studies on rRNA genes of large and small ribosome subunits confirmed monophyly of Apogastropoda, Coenogastropoda, Neogastropoda and Heterobranchia. Analysis of RAPD DNA markers contributed to the studies on taxonomy of *Cochlicopa*, *Bulinus* and *Donax*. The use of such techniques is increasingly common; it may confirm or disprove some of our views on phylogeny and solve problems for which morphological-anatomical characters are not sufficient.

AQUATIC SNAILS OF TRIBUTARIES TO THE NAREW RIVER

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Species composition and diversity of malacofauna were examined in the rivers Sona, Pelta, Łydynia and Wkra. Quantitative samples were taken within one month, aquatic plant communities were identified, and physico-chemical properties of water analysed with routine methods; bottom deposits were analysed with respect to organic matter content. Twenty seven snail species were found, the dominant being *Bithynia tentaculata*. A characteristic malacocenosis of the Narew tributaries is composed of five species of various degree of co-occurrence: *B. tentaculata*, *Lymnaea peregra*, *L. stagnalis*, *Physa fontinalis* and *Viviparus viviparus*.

HELIX ASPERSA MAXIMA IN CULTURE CONDITIONS – GROWTH AND SOME SHELL CHARACTERS

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The growth rate and shell quality of farmed snails determine the ultimate quality of the product; this creates a necessity of studies on the dependence between the growth and farming conditions. The material originated from snail farms where various methods of culture were used. Growth rate was studied in snails fed with various kind of feed and kept in various conditions. Depending on the feed quality, the percentage of snails that reached commercial size (over 14 g weight) ranged from 0 to 42.0%, at the variability index of body weight of 58.1–72.7%. The coefficient among siblings amounted to 54.5–115.4%. The snails kept in hothouses, under the most favourable thermal conditions, showed the highest growth rate. The shell quality proved to be the best in snails kept under natural conditions (sunlight).



SUCCINEA OBLONGA AND *S. OBLONGA* *ELONGATA* – A BIOMETRICAL ANALYSIS

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Succinea oblonga is abundant in most snail associations. It includes two forms: *S. oblonga* and *S. oblonga elongata*. *S. oblonga elongata* from five loess localities was analysed biometrically (shell height and width, aperture height and width, number of whorls). There is a close correlation between the following shell parameters: shell height and its width, shell height and aperture width, shell width and aperture width, aperture width and aperture height, which indicates an equalized ontogenetic growth. The ratio aperture height/shell height decreases with increasing shell size; for this reason small shells fit the description of *S. oblonga elongata* better than larger shells.

SIGNIFICANCE OF *HELIX* FARMING FOR PROTECTION OF *HELIX POMATIA*

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Helix pomatia, regarded as a national delicacy in France, has a long hibernation period, a slow growth and takes a long time to reach sexual maturity. The high demand and high price have resulted in a decrease in its abundance in natural habitats within the last ten years; in many European countries it is now a protected species, and in some, among others Poland, its farming has been attempted. Though commercial availability of farmed snails would ease the collectors' pressure on natural populations, farming of *H. pomatia* is still at an experimental stage. An alternative edible species, yielding better farming results, is *H. aspersa* (Mediterranean Algerian *H. aspersa maxima* and W European *H. aspersa aspersa*). Compared to *H. pomatia*, which reaches sexual maturity at the age of 3 years at the earliest, *H. aspersa* becomes mature and attains commercial size in 4–8 months. The full system of snail farming includes all life cycle stages. At the Institute of Animal Husbandry, Balice, the yield of *H. pomatia* was 6.4 kg/m². In spite of the efficiency of heliciculture, its participation in meeting the demand for *Helix* is still low.

REPRODUCTION BIOLOGY OF *HELIX ASPERSA* UNDER FARM CONDITIONS

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In the wild *Helix aspersa maxima* and *H. aspersa aspersa* reach sexual maturity at the age of 2 years, the

maximum of reproduction falling on August–November (*aspersa maxima*) or May–September (*aspersa aspersa*). Under optimum farming conditions (20°C temperature, 65–85% air humidity, 18 hrs daylight) the snails reproduce throughout the year, reaching maturity at the age of 16 (*aspersa maxima*) or 20 (*aspersa aspersa*) weeks. The mean egg production per snail is 130 (*aspersa maxima*) or 100 (*aspersa aspersa*); the incubation period under optimum conditions (25°C, 85–90% air humidity) is ca. 10%, and ca. 90% eggs hatch.

LIFE CYCLE OF *HELICODONTA OBVOLUTA*

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The life cycle of *Helicodonta obvoluta*, a Central European species with northern distribution border in Poland, was studied in the field and in the laboratory. The spring reproductive period falls on the beginning of April, May and June, the autumn period lasts from half of August till October. Eggs (13–27 per clutch) are laid in crevices in rotting wood; one to two clutches are produced yearly, the maximum per lifetime being six clutches. The eggs are laid in clusters, elongate (length/width ratio 1.0–1.21), 2.1–2.85 mm long and 2.0–2.6 mm wide, calcified. The incubation period is 14–21 days, the hatching being asynchronous. The hatchlings consume the remnants of the egg shell; egg cannibalism has been observed. Having attained the final shell size (5.75–6.6 whorls, aperture surrounded by lip) which lasts ca. 10 months, the snails reach sexual maturity. The mean shell increment is 0.4 whorl/month. The maximum life span in the laboratory is 3 years, and in the wild the average is 2 years.

SNAILS OF THE POGÓRZE AND KOTLINA WAŁBRZYSKA (SW POLAND)

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For extended version of the paper see Folia Malacologica 7(1): 53–72.

HOW DID *BYTHINELLA* REACH ITS PRESENT DISTRIBUTION IN CENTRAL EUROPE?

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Twenty isolated populations of a spring-dwelling genus *Bythinella* from Poland, Slovakia and Hungary were analysed with respect to their morphological (40 characters in males, 42 in females) and allozymic (9

loci) variation. The intra-population variation was much wider than inter-population, the variability ranges of populations overlapping. Euclidean and genetic distances between the populations were correlated with the geographic distance. A high polymorphism (11.1–55.6%) and a high mean number of alleles per locus (1.1–2.1) exclude founding a population by a single female. Eighteen populations deviate from the HARDY-WEINBERG rule, but not because of inbred. The results do not fit the archipelago model, but suggest an originally continuous population, the diversity being an effect of a later division (drift, local selection, mutation). When *Bythinella* appeared in the studied area (ca. 7,700 years ago), the hydrological-geomorphological situation resembled the present, but the air humidity was higher and the ground mostly marshy. The snail lives in springs, but may crawl outside water and is rather drought-resistant; originally it may have been more amphibiotic, and found refuge in springs when the climate got more arid.

MALACOCENOSES OF RIVERS OF AN INDUSTRIAL REGION IN POLAND (UPPER SILESIA)

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Rivers of four geographic mesoregions of Upper Silesia (Płaskowyż Rybnicki: 5 rivers, 12 sites; Kotlina Pszczyńska: 5 rivers, 10 sites; Wyżyna Katowicka: 19 rivers, 37 sites and Garb Tarnogórski: 7 rivers, 16 sites) were studied with respect to their mollusc fauna and selected chemical properties of water. Out of 38 aquatic snails known from Upper Silesia 28 were found, and out of 19 bivalves, only 6 were present. The scarcity of bivalves results from pollution of all the bottom sediments with heavy metals and communal and industrial wastes. The number of species ranged from 0 in six rivers to 18 in the northern section of Brynica, 17 in Pszczyńska and 15 in Trzebyczka. Species found in rivers of all the mesoregions are: *Lymnaea peregra*, *L. stagnalis*, *Planorbium corneum* and *Pisidium subtruncatum*. In three rivers only *L. peregra* was found, and in one only *L. stagnalis*. Eight species were found only in single rivers: *Bithynia leachi*, *Viviparus viviparus*, *Valvata cristata*, *V. pulchella*, *V. naticina*, *Marstoniopsis scholtzi*, *Unio tumidus* and *Dreissena polymorpha*. The SIMPSON coefficient for the malacofauna ranged from 0.75 in Kotlina Pszczyńska to 0.88 in Garb Tarnogórski. *Potamopyrgus antipodarum* and *Physella acuta* are immigrants in the studied area. The species richness was negatively cor-

related with the content of chlorides and sulphates and decreased with water quality.

NEW DATA ON THE HOLOCENE MALACOFAUNA OF THE SUDETES

MAREK PAKIET

[presented by IWONA CZEPIEC]

Rich and characteristic malacocenoses were found in the Kaczawskie Mts, in Polanica (foothills of Stołowe Mts) and in Kletno (Śnieżnik Massif). Eoholocene and Mesoholocene faunas have been found in five profiles of deposits filling small caves, rock shelters, niches and crevices in Cambrian limestone of the Kaczawskie Mts. The Eoholocene fauna of the rock shelter Panna includes *Discus ruderatus*, *Vertigo geyeri*, *Vallonia costata* and *Cochlodina orthostoma*, higher up passing into an assemblage of *Discus rotundatus*, *Orcula doliolum*, *Cochlodina costata* and *Clausilia parvula*. The Mesoholocene fauna, found in all the profiles, is composed of numerous shade-loving species: *Acicula polita*, *Orcula doliolum*, *Discus rotundatus*, *Aegopinella pura*, *Ae. minor*, *Ruthenica filigrana*, *Macrogastra plicatula*, *Perforatella incarnata*, *Helicodonta obvolvata* and *Isognomostoma isognomostoma*, accompanied by mesophile forms: *Carychium tridentatum*, *Cochlodina costata*, *Clausilia parvula*, *Laciniaria plicata* and *Helicigona lapicida*, and an open-country snail *Vallonia costata*. Slug shells are abundant. The assemblage is characteristic of Atlanticum and younger phases. The profile of Holocene deposits in Polanica contains a total of 39 mollusc taxa. Grey silts contain mainly *Succinea putris*, *Vallonia enniensis*, *Vertigo antivertigo*, *V. angustior* and *Carychium*, the association being typical of very humid and marshy habitats, corresponding to the Subboreal/Subatlantic transition. In the fen soils there are mainly *Vallonia costata*, *V. enniensis*, *Pupilla muscorum*, *Discus rotundatus*, *Vertigo angustior*, *Carychium minimum*, *C. tridentatum* and *Cochlicopa lubrica*; the fauna is historical, corresponding to Oława valley associations. In Chocieszów near Polanica the fauna is composed of *Vertigo pusilla*, *V. alpestris*, *Vallonia costata*, *Discus rotundatus*, *Punctum pygmaeum* and *Cochlodina laminata*, and later replaced by an assemblage with *Vallonia pulchella* and *V. costata* which corresponds to deforestation phase associated with Neolithic cultures. The fauna with *Isognomostoma isognomosoma*, *Oxychilus depressus*, *Ena montana*, *Vitrea subrimata*, *Aegopinella pura*, *Cochlodina laminata*, *Discus rotundatus* and *Arianta arbustorum* in deposits of karst



forms in Kletno, described by the author earlier, corresponds to Atlantic and Subboreal phases.

VARIATION OF THE SHELL, GENITALIA AND COLORATION OF *PERFORATELLA INCARNATA* AND *P. VICINA*

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Variability and diagnostic value of shell, genital and coloration characters in *Perforatella incarnata* and *P. vicina* was analysed, based on over 300 specimens from various populations in Poland (Carpathians, Sudetes, Lower Silesia). The shell size and shape, number of whorls and umbilicus size are variable in both species. Three forms can be distinguished in each species with respect to the structure of male genitalia. The number and way of branching of mucous glands and shape of the lumen of penial papilla vary widely. The colour pattern on mantle varies, but the species differ in the area/circumference ratio of the mantle spots. Variability ranges of the shell colour do not overlap. The shell surface sculpture is little variable and differs between species. The variation of shell, genitalia and mantle is of intra-population nature. The only univocal diagnostic characters to distinguish between *P. incarnata* and *P. vicina* are shell colour and sculpture, and the mantle colour pattern.

STUDIES ON MIOCENE AQUATIC MOLLUSCS FROM THE BĘLCHATÓW BROWN COAL BEDS

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Twenty six aquatic mollusc species (22 snails and 4 bivalves) have been found in the Miocene deposits of Bělchatów. In the oldest horizon (Beł-C; late Burdigalian) 17 taxa were present, the most common being *Microprosothenia belchatovens*, *Gyraulus applanatus* and *Gyraulus* sp. In horizon Beł-B (late Burdigalian or early Langhian) 18 taxa were present, with *Stadtiellopsis schlickumi*, *Gyraulus applanatus* and *Pisidium annadalei* as the most frequent and abundant species. In the youngest horizon, Beł-A (probably early Thorntonian), aquatic molluscs were represented by 9 taxa, *Belchatovia hydrobiopsis* being the dominant. Based on the malacofauna, habitat conditions could be reconstructed. In the Lower Miocene (Beł-C) there was a shallow, freshwater lake with lymnaeids, planorbids and sphaeriids, besides abundant *B. belchatovens*. In the Mid Miocene (Beł-B) the lake was extensive and slightly brackish, as evidenced e. g. by mass occurrence of *S. schlickumi* and the presence of neritids. In the littoral *Theodoxus cyrtocelis* and

Clithon pictus lived. Affluents brought shells of rheophile *Pisidium annadalei*. In the late phase of Mid Miocene (Beł-A) the salinity probably increased; this is supported by the absence of lymnaeids and decreasing number of planorbids. *Belchatovia hydrobiopsis*, occurring in masses, was probably a brackish-water species.

THE ROLE OF LYMNAEIDS IN THE DISPERSAL OF *POTAMOPYRGUS ANTIPODARUM*

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APPLICATION OF THERMAL ANALYSIS (DTA, TG, DTG) IN STUDIES ON RECENT SHELLS OF FRESHWATER MOLLUSCS

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The studies were aimed at quantitative determination of organic matter and calcium carbonate in mollusc shells, indicating a possibility of species identification based on thermal analysis of shell fragments and providing a basis for explaining the origin of fossil carbonate deposits. The proportion of organic matter/calcium carbonate was found to vary between species and to depend on shell size. Thermal effects registered on DTA and DTG curves were found to differ as well.

HEAVY METALS IN SHELLS OF FRESHWATER MOLLUSCS FROM ROZTOKA ODRZAŃSKA (NW POLAND)

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Among ten analysed mollusc species from Roztoka Odrzańska, the lowest concentrations found were Cu in *Lithoglyphus naticoides*, and Zn, Cd, Pb and Co in *Anodonta anatina*. The highest concentrations of heavy metals were found in *Unio pictorum* (Cu), *Theodoxus fluviatilis* (Zn, Cd, Co) and *Sphaerium rivicola* (Pb). The differences in heavy metal concentrations were the smallest in the case of Cu and Zn, the largest for Cd, Co and Pb and may be associated with different feeding modes of the molluscs.

HEAVY METALS IN SHELLS OF FRESHWATER MOLLUSCS FROM THE Odra ESTUARY

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Heavy metal concentrations in shells vary between species from the same habitat, and between conspecific individuals originating from different habitats. The phenomenon was observed in *Dreissena polymorpha* and *Viviparus viviparus* from the estuary of Odra, Miedwie lake and Mazurian Lakes. In shells of *D. polymorpha* from various habitats the ratio of maximum to minimum metal concentration was: Cu – 38, Zn – 45, Pb – 11, Cd – 72, Co – 3, Hg – 440. A similar phenomenon was observed in *V. viviparus*, the extreme values being 247 for Cu and 4 for Co and Hg. The results indicate that mollusc species in the same water body accumulate different quantities of heavy metals, molluscs of the same species but different habitats differ in their heavy metal concentration in shells and soft parts, and the heavy metal concentration is correlated with the shell size.

HORMONAL REGULATION OF CEPHALOPOD REPRODUCTION IN THE LIGHT OF COMPARATIVE ENDOCRINOLOGY OF INVERTEBRATES

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In dibranchiate cephalopods nearly all aspects of reproductive activity in both sexes are controlled by a single hormone produced by optic glands; it also affects gametogenesis. An exception is control of synthesis of nidamental gland secretion in cuttlefish; it is regulated by neurohormones produced in the cerebral ganglia and optic lobes, and by gonadal steroids. The secretory activity of optic glands is inhibited by nerve fibres of lobus subpedunculus; the control may be modified by external factors. In cephalopods there is probably no central (neuro)endocrinal control of gonadotropic centre; likewise, there is no negative hormonal feedback optic gland-gonad, which is probably associated with a short life following reproduction. The specificity of hormonal regulation of cephalopod reproduction is discussed in the light of comparative endocrinology.

REPRODUCTIVE INTERACTIONS BETWEEN THE BITTERN *RHODEUS SERICEUS* AND THE UNIONID CLAMS

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The bittern is the only fish of ostracophile reproductive guild in Poland. Its reproduction and distribution depend on *Unio* and *Anodonta*. The bittern increases its reproductive success (protection of eggs against predators) investing energy in eggs and avoiding costs of brood protection. This requires a specific mating behaviour (courtship dance, male territorialism). Development of eggs and larvae in the pallial cavity is slowed down because of low oxygenation and poor light conditions. The fry leaving the clam are developmentally advanced. Questions arise: which clam species is preferred, are habitat preferences of the bittern and clams similar, does the fish reproductive success depend on clam size, does the clam cover costs of bittern egg incubation, does the bittern-clam association favour dispersal of glochidia? The Authors' observations and literature review are presented.

POLISH MALACOLOGY – PAST, PRESENT AND FUTURE

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For extended version of the paper see this volume, pp. 275–291.

RAPD TECHNIQUES IN THE STUDIES ON A LYMNAEID SUBGENUS *STAGNICOLA*

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Lymnaeids are variable, the only identification base till present being the structure of genitalia. Nine of eleven lymnaeid species found in Europe are present in Poland. Most are common, but the occurrence

of *Omphiscola glabra* has not been confirmed, and doubts arise as to the distinction of some species, e. g. *L. turricula*, *L. occulta*, *L. corvus*, *L. vulnerata*. RAPD technique might help to solve the problem. Combinations of 5 pairs of 10-nucleotide starters were used; PCR conditions being 50 cycles, each consisting of the following steps: denaturation 92°C, 1 min, annealing 56°C, 1 min, elongation 72°C, 1 min. The present studies are aimed at ascertaining if it is justified to place *L. corvus* in a separate subgenus, and how many species should be distinguished in the subgenus *Stagnicola*.

GENETIC IDENTIFICATION OF MORPHOLOGICALLY DIVERSE BIVALVES OF THE GENUS *ANODONTA*

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Bivalves of the genus *Anodonta* from the cooling water system of the power plant Konin are difficult to identify. The bivalves from Licheńskie lake near Konin were identified as *A. woodiana*, but those from canals and initial cooling reservoirs differed from them in shell morphology. Twenty nine specimens of *A. woodiana* from the Licheńskie lake (group 1), 27 from the warmest canal (group 2) and 23 from the initial cooling reservoir (group 3) were analysed electrophoretically for 7 enzymes. The groups differed in their shell morphology. The same alleles, except single rare alleles, were found in the three groups. Their genetic similarity calculated with NEI'S method ranged from 0.982 to 0.991. The largest genetic distance was that between groups 1 and 3 (0.018) and 1 and 2 (0.016), the smallest between 2 and 3 (0.009). In spite of the observed shell differences, all the *Anodonta* from the cooling system of the power plant Konin are conspecific.

ANALYSIS OF METRIC SHELL CHARACTERS IN *ANODONTA* SP. FROM HEATED KONIN LAKES (C POLAND)

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Anodonta clams from heated reservoirs of the Konin power plant were analysed with respect to their shell weight, length, height, convexity, elongation index and convexity index, basic statistic being calculated for each parameter, mean values being compared with t-Student test, and distribution of values

using KOLMOGOROV-SMIRNOV test. Three groups of clams: from the Licheńskie lake, from the warmest canal and from the initial cooling reservoir, were found to differ in most of their shell parameters.

HELICOPSIS STRIATA IN THE LOWER ODRA VALLEY

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In order to update and supplement distributional data on *Helicopsis striata* in the Odra river valley, the area was repeatedly surveyed in 1989–1997. A total of 21 sites were found, 13 of them being new, and 10 subfossil. Sites with only subfossil shells were the most destroyed, with sparse vegetation and bare substratum in places. In such sites *Helicella obvia* occurred. Sites with small populations of *H. striata* were less affected and only rarely shared with *H. obvia*. Larger populations of *H. striata* occurred in the least affected habitats, with dense xerothermic vegetation shading the substratum. In such sites the species was not accompanied by *H. obvia*. At midday hours *H. striata* is buried in the soil, contrary to *H. obvia*. The former species seems to be less catholic regarding insolation, humidity and temperature. Extinction of *H. striata* results from habitat devastation rather than from competition with *H. obvia*.

BIOSTRATIGRAPHIC, PALAEOZOOGEOGRAPHIC AND PALAEOECOLOGICAL SIGNIFICANCE OF THE MIOCENE MALACOFAUNA FROM BĘŁCHATÓW

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Studies on the Miocene malacofauna of the open-cast brown coal mine Bělchatów have continued since the 80s. Land snails were found in lacustrine chalk representing shores of the erstwhile lake, in three horizons: Běl-A, Běl-B and Běl-C, of age corresponding to biozones MN4 (Běl-C), MN5-6 (Běl B) and MN9 (Běl-A). Forty one land snail species have been studied to date (published or in press; 6 new to science): 3 cyclophorids, 2 pomatiasids, 5 aciculids, 10 ellobiids, 1 endodontid, 1 pupillid, 7 vertiginids, 4 valloniids, 3 strobilopsids and 5 gastrocoptines. The remaining land snails are cochlicopids, endodontids, clausiliids, zonitids, vitrinids, subulinids and helicids. Horizon Běl-C, stratigraphically the most significant, contains remnants of Oligocene elements (*Carychiopsis*) or species characteristic of Lower Miocene (*Pomatias bisulcatum*, *Constricta tenuisculpta*). Somewhat younger horizon Běl-B is the richest, with

many species whose occurrence continues since Lower Miocene (*Renea pretiosa*, *Planogyra nana*) and others that appear first in this horizon (*Carychium pachytilus*, *Vertigo angulifera*). Horizon Beł-A is the poorest; it is almost devoid of Lower Miocene components; species first found in this horizon are e. g. *Palaina martensi* and *Vertigo oecsenis*. Zoogeographically, four groups can be distinguished in the Bełchatów fauna: 1. completely extinct genera; 2. genera extinct in Europe, but found at present in remote regions of the world: Far East, Africa, Americas; 3. genera extinct in Poland but found at present in the Mediterranean or Caucasus; 4. genera found at present in Poland. Palaeomalacological and palaeobotanical data make it possible to describe the Miocene climate as humid, subtropical and the vegetation as dominated by evergreen mesophytic forests.

FOREST MALACOCENOSES OF THE BIESZCZADY NATIONAL PARK (PRELIMINARY RESULTS)

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Samples of 1 m² of leaf litter and upper layer of soil were taken twice (May and August) with OEKLAND'S method (modified by DZIĘCZKOWSKI) from three forest habitats in the Bieszczady National Park. A total of 47 land snail species were recorded. In *Alnetum incanae* 40 species were found, at a mean density of 672 individuals per m². Dominants were *Aegopinella epipedostoma* and *Discus perspectivus*, the former species being constant. In *Dentario glandulosae-Fagetum typicum* 28 snail species were found, at a mean density of 157 per m². Eudominant was *Punctum pygmaeum*, dominant *Vitrea crystallina*. All species were not very frequent or sporadic. In *Pulmonario-Alnetum* 23 species were found, mean density being 270/m². *Vitrea crystallina* and *Carychium tridentatum* were eudominants, *Ae. pura* dominant, the only constant species was *V. crystallina*. More than half of the recorded species have their distribution centres in the mountains of Central Europe. *Acicula parcelineata*, not previously recorded from the Bieszczady Mts, was found in two sites.

THE EFFECT OF CRAYFISH ON THE UNIONIDS OF THE LAKE BYLICE MAŁE (NW POLAND)

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Till 1996 the lake Bylice Małe was inhabited by an abundant population of a crayfish *Astacus leptodactylus*, whose mean wet biomass was 35.2 g/m². Since 1997 it has started receding, in favour of *Orconectes limosus*. In the spring 1999 it was found that

the American invader had practically evicted the native species. The change was accompanied by many alterations in the fauna and flora of the lake. At present unionid clams are present abundant or very abundant in all the lake zones; a population of the zebra mussel has appeared, the species which had been completely exterminated by the crayfish. The changes in the density of bivalves – filtrators – are probably the main reason for the fourfold increase in the water transparency. Till 1996 the unionids (*Anodonta cygnea*, *A. anatina*) were the most abundant at depths over 3 m, where the crayfish occurrence was limited by oxygen conditions. Since 1997 they have started to migrate to the littoral and at present are the most numerous there. Another two unionid species have appeared: *Unio tumidus* and *U. pictorum*. Most probably the main reason for these changes in the unionid fauna was the extinction of the native crayfish.

ROLE OF AQUATIC PULMONATES IN ESTIMATION OF WATER QUALITY

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Using test organisms to estimate water quality is usually cheaper and easier than chemical analyses. Pulmonates as test organisms have both virtues and drawbacks. The most common species, *Lymnaea stagnalis* and *Planorbarius corneus*, as adults are not very sensitive to pollutants. They are more sensitive as embryos. The aim of the study was to trace viability and development rate of eggs of freshwater pulmonates under the effect of non-specific pollutants contained in communal and industrial wastes. The wastes were obtained from the wastewater treatment plant Kraków-Płaszów, where they were mechanically or mechanically and biologically purified, and from the wastewater plant in Nowa Huta. In *Lymnaea stagnalis* freshly laid eggs proved to be the most sensitive; they were tested for viability and development rate in pure (control) and wastewater. Płaszów wastes, purified mechanically, were strongly toxic; biologically purified wastes were weakly toxic or not toxic, depending on the lot. A comparison of snail tests with the results of the tests with MicrotoxR bacteria indicate that snails are more pollution-sensitive than bacteria.

THE EFFECT OF SAMPLING METHODS ON THE RESULTS OF QUANTITATIVE STUDIES ON MOLLUSCS OF S BALTIC

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Various quantitative sampling methods were and still are used in the studies on the Baltic molluscs,



hence comparability between results of various authors and periods is problematic. The studies during the last 70 years varied in the type of dredge used and in the way of calculating biomass indices. A comparison of various kinds of dredge revealed statistically significant, method-dependent differences in the mean density and biomass on sandy and clayey bottom. The way of calculating biomass index also affected the results significantly. Other factors that may affect the results are also discussed. The use of underwater TV to estimate the sampling localities and whether or not the samples are representative, has proved to be a useful aid in interpretation of the results.

MALACOFAUNA OF THE COASTAL LAKE WICKO (GULF OF SZCZECIN)

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The lake Wicko is a part of the Gulf of Szczecin; it is eutrophic (communal sewage from Międzyzdroje), resulting in a poverty of bottom fauna. Its macrobenthos was studied in 1997 at 14 localities, 3 years after the wastewater plant in Międzyzdroje came into existence. Both the macrofauna and the water quality (temperature, pH, salinity, oxygen content, visibility of Secchi disc) have improved within the last 3 years. Species, mainly snails, not noted since the 80s, have returned. The following molluscs have been recorded: *Bithynia tentaculata*, *Valvata piscinalis*, *Potamopyrgus antipodarum*, *Theodoxus fluviatilis*, *Hydrobia ulvae*, *H. ventrosa*, *Dreissena polymorpha* and the genera *Anodonta* and *Unio*.

WHAT DO WE KNOW ABOUT THE ANADENIDS?

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The slug family Anadenidae includes three genera. Two, better known, live in North America, the third, *Anadenus*, inhabits high altitudes (over 4,000 m a.s.l.) of the Himalaya. The latter genus is known from some 19th c. species descriptions based on single specimens, and the literature includes about a dozen references. The author has revised *Anadenus* based on museum collections and new materials from southern China, is preparing descriptions of new species and re-considering the status of the family and genera. The revision includes detailed anatomical drawings and descriptions. Grouping the three genera in one family is questionable.

DEVELOPMENT OF MOLLUSC FAUNA OF THE LAKE MALTAŃSKIE IN POZNAŃ

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In 1980–1990 the lake Maltańskie – an artificial lake in Poznań – was thoroughly renovated. Since re-filling it with water in 1990 its malacofauna has started to develop again. Material was collected in 1994–1998, and in autumn 1992 and 1996, after the lake had been drained twice. The number of live molluscs varied from year to year (9–140). Thirty nine taxa were found (27 snails and 12 bivalves), 17 of them (15 snails and 2 bivalves) being represented by live individuals. Five species were present in all the study years, two of them (*Lymnaea peregra* and *Bithynia tentaculata*) being found alive in 1994–1998, one (*Valvata piscinalis*) was found alive during three years, and two (*Gyraulus albus* and *Armiger crista*) were found alive twice. Eleven species were found in only one of the study years. The most abundantly represented live molluscs were: *Lymnaea peregra* (1994, 1996) and *Bithynia tentaculata* (1995, 1997, 1998).

SCROBICULARIA PLANA IN HOLOCENE DEPOSITS OF THE S BALTIC COAST

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The lowland Nizina Gardzieńsko-Łebska is the only area of the Polish Baltic Coast where *Scrobicularia plana* was found in Holocene deposits. The shells occur only in brown-black sandy-silty (lagoon) deposits of older Atlantic period (ca. 7,500–6,800 years BP). The occurrence of *S. plana* in these deposits results from a somewhat different morphological and geological situation of this part of the coast: transgression at the end of the Boreal period and the beginning of Atlanticum flooded bottoms of river valleys, creating lagoons, where molluscs preferring muddy bottom and rather stagnant water could live. The other parts of the Polish coast underwent transgression only later (7,000–6,700 years BP) and formed a fragment of open sea shore, or were separated from open sea by discontinuous barriers. Such habitats are characterized by intense water movements and by malacocenoses with dominance of *Cardium glaucum*. *S. plana* inhabited calm zones of the S Baltic coast till 6,800 years BP. Its absence in younger deposits may evidence conditions unfavourable for accumulation of fine-grained deposits, decreasing salinity of lagoons or strong wave action. Deposits with *S. plana* are indicative of the oldest, Holocene transgression phase (beginning of Atlanticum) and of the presence of shallow, calm waters, where accumulation of



fine-grained deposits and existence of species associated with them were possible.

HABITAT-DEPENDENT SHELL VARIATION IN *HELICELLA OBVIA* (MENKE)

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Specimens of *Helicella obvia* from three different habitats (a xerothermic hill slope, a densely vegetated fallow field and a cultivated field; ca. 150 shells from each locality) have been examined with respect to shell biometrics. The shell parameters reached their highest values in snails from the cultivated field, and their shell growth was the quickest. In snails from the xerothermic slope the parameters, including growth rate, were the lowest. Morphological data indicate that snails of each habitat form a separate population.

HABITAT SELECTION BY *ANODONTA CYGNEA* L. IN THE NIDA VALLEY

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Habitats of *Anodonta cygnea* are eutrophic, shallow water bodies or shallow parts of large oxbows, old

river beds and fragments of slow flowing rivers. Such habitats are getting increasingly rare (canalisation, hydrotechnical devices). Studies in the Nida river valley were aimed at finding adequate means of protecting *A. cygnea*. The results indicate that the species prefers not very densely vegetated oxbows, or old river beds of slowed flow. The density of all age classes decreases as the reservoir overgrows with vegetation. Waters inhabited by *A. cygnea* and devoid of it differ in their physico-chemical properties for both natural (inflow of mineralized water) and anthropogenic reasons (pollution). Analysis of preferences within a reservoir indicates optimum microhabitats. The clams concentrate on the slope, 2–10 m from the shore, their number decreasing with increasing depth. Larger individuals live in deeper water. The number of individuals is also correlated with the thickness of mud layer. The preferred habitats are formed and maintained due to hydrological processes in river valleys, which also favour migration and colonisation of new habitats. Canalisation and melioration stop these processes. The best way to protect *A. cygnea* is thus to conserve a natural, hydrological activity of rivers on long sections of river valleys.

