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THE 21ST POLISH MALACOLOGICAL SEMINAR

SEMINAR REPORT

The 2005 Polish Malacological Seminar was held on the 6th and 7th of April, in Ciechocinek, a little spa just south-east of the city of Toruń. The spa is famous for its beneficial effects on some patients, but - being located on a very flat plain and surrounded by completely unmalacological habitats – it is not very beautiful. It is also difficult to get to, at least from some places in Poland and at least for those who are not posh enough to have a car. The Wrocław contingent had to change trains twice, and the last leg of the journey lasted only 5 minutes (though the first lasted about 5 hours). The Warsaw contingent, travelling on a bus, got there a few hours late because of some accident on one of the bridges across the Vistula River (the ONLY bridge in Płock). But even in an unaccessible place of unmalacological topography it is possible to organise a good seminar. The main organisers were the Department of Invertebrate Zoology and the Department of Animal Physiology, both from the Mikołaj Kopernik University in Toruń, plus the Association of Polish Malacologists. The Organising Committee included our colleagues from Toruń: ELŻBIETA ŻBIKOWSKA, ANNA NOWAKOWSKA, JAROSŁAW KOBAK, BARBARA GRYGON-FRANCKIEWICZ and PRZEMYSŁAW NOWACKI, and we thank them all, not only for the perfect organisation, but also for handling the meeting so well in unusual circumstances (see below). We all stayed in one big hotel, which was very good, since such situations favour long evening discussions; most people stayed in the main building and some lucky few in little cottages which were also a part of the hotel. Our cottage was very nice, except that it was impossible to have electricity and cold water in the tap at the same time.

Though it was very good to see all the colleagues again, it was not like the previous twenty seminars, when often a joke and a good bottle were more important than malacology *per se*. This year we were in a rather sad mood. John Paul II had died a few days before the Seminar, and the Organisers at one point were even contemplating the possibility of cancelling the meeting. As a result the participants were much fewer than originally expected – the intial list included about 80 people, and only about 40 actually arrived. The banquet was cancelled and the Seminar lasted only two days instead of the usual three. Another reason for sadness was the departure of our colleague from Słupsk – ZBYSZEK PIESIK – who died of bone cancer a few months before the Seminar.

This year all the participants, except one, were Polish; though some of our Ukrainian and Russian colleagues initially intended to come, they never appeared and only submitted their abstracts. The Seminar volume contains 70 abstracts of oral presentations and posters (though actual presentations were much fewer), with the majority (31, and including papers on trematodes and ciliates in aquatic molluscs, even 38) formed by aquatic ones; terrestrial abstracts (20) discuss ecology, faunistics, physiology and even some pest control aspects; subfossil papers (marine, freshwater and terrestrial) were eight; one paper dealt with methods, one with conservation and two were just stories but very nice. The prevalence (and the choice of the term which is also used by parasitologists is not accidental) of aquatic presentations is a tendency that has been with us for ages (see also Folia Malacologica 7: 275–291 and 12: 83–106), the only difference compared to the past is that now most hydrobiologists seem to be in love with the zebra mussel. Of all things!

Like last year, many presentations were beautifully prepared, either colourful PowerPoint stuff or nice posters. It is also symptomatic that, as a rule, the younger the author is, the more beautiful the presentation.

The weather was good in the beginning, then it started raining, so that we did not regret the fact that there was no collecting trip. Instead, the Seminar excursion went to the city of Toruń which is old, very beautifully situated on the Vistula River, and famous for its gingerbread. Many bought quite a lot of it, but we were warned against going to unauthentic shops where, we were told, we would be sold only false gin-

gerbread. Our age seems to be one of falsity: false jewellery, false teeth, false gingerbread, what next? But we bought only the real gingerbread and it was fine.

It was our 21st Seminar which means that a tradition, when looked after properly, can sometimes become a long one. For those few people who had attended all the previous Seminars, and I am one of such lucky people, it was a good stimulus for some reflections. Have we changed? My answer is no. Some have retired, some are no longer with us, some young malacologists have joined us, our presentation techniques have improved, but we are still basically the same gang of people with the same hobby (well, you don't call malacology a profession, do you?).

If nothing changes, the 22nd Seminar will be in Wólka Milanowska, in the Świętokrzyskie Mts.

As usual, the abstracts included in the Seminar Abstract Book (this time it had a *Lymnaea* on the cover) have been translated behind the authors' back. I thank those few kind people who, considering the amount of work implied in translating a few dozen pages, sent me English versions of their abstracts.

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ABSTRACTS FROM THE 21ST POLISH MALACOLOGICAL SEMINAR

ASSESSING SQUID RESOURCES IN THE WATERS OF SOUTH AFRICA – CRUISE ON F.R.S. ALGOA

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The paper describes my impressions from a cruise (November 2005), the aim of which was testing a new method of assessing squid resources. Because of the considerable increase in exploitation of cephalopod populations within the last 30 years, the Ministry of Natural Environment and Tourism (Republic of South Africa), responsible for the protection and management of the resources, initiates and conducts studies on cephalopods. Funds are largely provided by industry (SASMIA – The South African Squid Management Industrial Association). The studies were carried out in the shelf waters around the Cape of Good Hope (between Cape Point and Port Elizabeth). After locating schools of squid with hydroacoustic methods, squid were caught individually at various times of day with squid hooks ("jigs"); the animals were sexed, weighed, measured; the condition of their gonads was assessed and statoliths were removed for age determination. The studies were supplemented with pelagic and bottom trawling, observations of sea bottom, rearing paralarvae and examining gut contents. The results will provide a basis for devising a method of universal assessment of squid resources with the use of echointegration. The cruise also provided me with an opportunity to accumulate a collection of marine invertebrates for the University of Łódź.

GROWTH OF *ANODONTA CYGNEA* (LINNAEUS, 1758) IN OXBOWS OF THE BACKWATER ZONE OF THE SULEJOWSKI RESERVOIR

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Growth and population structure of *A. cygnea* were studied in 2004 in three sites (A, B, C) in the upper part of the Sulejowski Reservoir. The sites, of an oxbow character, are situated around sandy islands. Hydrochemical analysis of water, most of all oxygen content (0.0–11.8 mg dm^{-3}), pH (7.0–8.7), conductivity (350–417 mS cm^{-1}), indicates slight differences between the sites, the decisive factor being fluctuations of water level. During low water period (April-May) the bottom was uncovered in site A, resulting in a mass mortality of the bivalves. Re-appearance of *A. cygnea* in the site was observed only after three months, with the density of 12 individuals m^{-2}. The highest density, 45 indiv. m^{-2} was found in site B; in site C, located on the border of the pelagic zone, the density was 19 indiv. m^{-2}. Growth of *A. cygnea* in the three sites was studied based on random samples in August 2004, calculating parameters of von Bertalanffy equation. Asymptotic shell lenght (L_{inf}) was found to vary statistically significantly between the sites, the values being: A – L_{inf} = 171 mm (SE=14 mm) compared to B and C, with: L_{inf} = 143±10 mm and 144±5 mm, respectively. The differences indicate more favourable growth conditions in site A. However, the decreased water level resulted in a temporary disappearance of the site and a mass mortality. This drastic habitat change was reflected in the age structure of the analysed populations. In population

A older individuals, aged 5+ and 6+, dominated, while B and C populations were dominated by younger bivalves, of 1+ i 2+ age classes. Comparison of population parameters in site A in 2003 and 2004 shows that the decreased water level caused no change in growth trajectory, but affected the age structure through mortality.

RECENT AND SUBFOSSIL MALACOFAUNA OF THE ŻURAWNICA RANGE (BESKID ŚREDNI MTS)

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The Żurawnica range (729 m a.s.l.), located in the western part of the Beskid Średni Mts, is 6 km long and separates two left-bank tributaries of the Skawa River. Near the top it bears a rocky crest that towers 150–200 m above the surrounding plain. The steep northern slope is crowned by a row of crags built of sandstone. Contrary to most flysh formations in the Beskidy Mts, especially those building crags, the outcrops of Żurawnica have a considerable calcium content ($CaCO_3$ 15–45% and locally even over 60%). Deposits which fill rock niches and crevices are silts and clayey sands, containing 5–15% calcium carbonate. Fairly numerous snail shells, not previously found in similar situations, are present in the deposits. Malacological analysis included 27 samples with recent (15 samples) and subfossil (12 samples) fauna, and used methods described by the author. The rocks form a north-facing threshold ca. 750 m long, and on the slope at its foot, harbour a rather rich malacocoenosis with 35 species (873 specimens). It was subject to analysis including constancy and dominance indices, with their geometric mean (C–D–Q), as well as malacological species spectrum and individual spectrum. The main components of the community were: *Punctum pygmaeum, Vitrina pellucida, Aegopinella pura, Alinda biplicata* and *Laciniaria plicata* (C–D=5–5, 5–4, 5–3; Q>20), accompanied by rather numerous *Acicula polita, Trichia unidentata, Nesovitrea hammonis* and *Perforatella incarnata*. The presence of *Orcula doliolum, Ruthenica filograna, Cochlodina orthostoma* and *Macrogastra tumida* is noteworthy. The subfossil fauna included 40 taxa (642 shells). The most abundantly represented were: *Punctum pygmaeum, Alinda biplicata, Laciniaria plicata,* and *Vitrina pellucida*, shells of *Acicula polita, Nesovitrea hammonis, Aegopinella pura* and *Euconulus fulvus* being also numerous. The recent community and the subfossil assemblage are very similar, with 85% species in common, and the rank correlation coefficient is $r_S = 0.67$. It can be conjectured that the subfossil fauna represents a recent past, probably upper Holocene, especially the historic period. The differences consist in different proportions of shade-loving and open country species. In the recent fauna forest snails constitute 50–70%, meadow and rock-dwelling species not more than 5%, whereas in the subfossil fauna the respective values are 20–50% and 5–35%. The high calcium content in the sandstones of Żurawnica provides favourable conditions for the development of rather rich snail fauna, like in some Carpathian castle ruins. Other organisms that reflect this factor are lichens, with 30 species not recorded from the Beskid Średni and Mały, but known from the Cracow Upland. The specific composition of the mollusc fauna and lichen flora suggests that, compared to the surrounding mountain ranges, the Żurawnica is an ecological island, resulting from the presence of calcium-rich sandstones.

SNAILS AND BIVALVES AS ZONE FOSSILS IN QUATERNARY DEPOSITS

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Snails and bivalves are often found in Quaternary deposits. They are especially common in the deposits of the last glacial period and the Holocene. Individual species and, most of all, their assemblages provide one of the most precise tools of palaeogeographic reconstruction. Mollusc assemblages are good indicators of palaeoenvironment and render it possible to reconstruct its biotic and abiotic conditions, especially climatic changes. Due to this they can be used as indicators of the age of the deposits. Biozones used in stratigraphy must have well-defined borders, time ranges and names, usually derived from the most characteristic species. Another biostratigraphic concept is a zone fossil. It is a specific organism which should meet certain requirements: synchronous appearance and disappearance, common occurrence, short and well-defined stratigraphic range, easy preservation in the deposits, easy identification etc. It is impossible to meet all these conditions for a single species. In reality zone fossils do not exist; there are only their better or worse approximations. Stratigraphic divisions resting on zone fossils should consider only range zones. Each such zone would start with appearance of the species and end when it disappears. It is to a degree possible to distinguish such zones in older systems, since moments of species appearance and disappearance can be then observed. For Quaternary the method is completely useless. The main reason is time. The most precisely defined biozones, based on graptolites (Silurian), ammonites (Triassic, Jurassic) or foraminiferans (Cretaceous, Tertiary), include time intervals of 1.5–2 mln years. They are thus considerably longer than the Quaternary; there the concept of zone fossil does not exist and no stratigraphic divisions based on it are possible. However, it is possible to construct

stratigraphic divisions of the Quaternary, but not based on zone fossils; the stratigraphic units are defined in other ways. The methods and possibilities depend on the knowledge and imagination of scientists.

LOESS MALACOFAUNA OF WESTERN UKRAINE

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Detailed malacological analysis included seven sites of loess deposits in the Dniester River valley, north of Ivano-Frankivsk: Kolodiiv, Mežygircy, Halyč, Kozyna, Yezupil, Marinopil' and Dovhe. Ten profiles were analysed, and over 100 mollusc-containing samples were taken. Malacological analysis followed standard methods. Characteristic assemblages were distinguished and referred to phases of climatic cycle. Their composition and structure provided a basis for palaeoecological and palaeogeographic conclusions. The analysed loess profiles cover a considerable part of the Quaternary and consist of typical loess series separated by interglacial or/and interstadial fossil soils, as well as levels much disturbed by slope processes, mainly solifluction. The sequence starts with a poor assemblage, with numerous shells of *Pupilla triplicata* and *Vallonia tenuilabris*. It is characteristic of dry, open habitats of an arctic type steppe. It was found in the oldest part of the Halyč profile and its age corresponds to the San 2 glaciation. Deposits of a similar age, but decalcified and devoid of snail shells, were described from Dovhe. On the oldest loess rests a thick complex of solifluction deposits and fossil soils (the soils corresponding to Masovian Interglacial). In younger dusty formations of the Dnieper (Odra) glaciation numerous mollusc shells were found. They indicate predominance of humid habitats of tundra type and the presence of small water bodies. The fossil soils of the Korszov complex and deposits of the Moscow (Warta) glaciation, as well as Horohiv (Eem interglacial) located above, are devoid of molluscs. Loesses of the last glacial contain rich and diverse mollusc assemblages. Their sequence can be well referred to malacological schemes devised for and applied to loesses of S. Poland. The main trends in climatic changes in W. Ukraine are much similar to those observed in S. Poland. The differences include: a relatively small proportion of forms tolerant to being covered with eolic dust (*Pupilla muscorum loessica*) in the Ukrainian assemblages, a clearly higher frequency of typically continental species (*Vallonia tenuilabris*) and the absence of the phase of increased humidity (20–18 Ka BP) which is distinct in many sites in S. Poland.

MOLLUSC ASSEMBLAGES FROM THREE NEW SITES OF LACUSTRINE LATE GLACIAL AND HOLOCENE DEPOSITS IN THE WIELKOPOLSKA

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Mollusc assemblages from the deposits of Imiołki, Rybitwy and Niepruszewo-Cieśle include mainly freshwater species with a slight admixture of higrophile or hydrophile species. Imiołki and Rybitwy are located on the western shore of Lake Lednica (southern part of Gniezno Lakeland). Niepruszewo-Cieśle is situated on the southern shore of Lake Niepruszewskie (central part of Poznań Lakeland). Imiołki: mollusc-containing deposits, grey-blue silts and carbonate gyttja, of a total thickness of ca. 2 m, accumulated in a small water body, separated from Lake Lednica by a narrow, sand-and-clay bank. Fifteen snail species were found there (13 aquatic, 2 terrestrial), as well as seven bivalve species. The most abundant species were *Valvata pulchella* Studer, dominant in the lower part of the profile, *Lymnaea peregra ovata* (Draparnaud), the most abundant species in the upper part of the profile and *Valvata cristata* Müller. The dominant species indicate a shallow and vegetated but permanent water body. Geological studies indicate a late glacial. Rybitwy: mollusc-containing deposits: sandy and carbonate gyttja, of a total thickness of ca. 2.8 m, contained 16 freshwater and two terrestrial snail species, and five bivalve species. The lithology and malacofauna indicate two stages in the water body development during the accumulation of the deposits. The sandy gyttja contains a poor assemblage dominated by the genera *Pisidium* and *Sphaerium*. A high content of mineral material and the poverty of the bivalve-dominated assemblage point to a rather deep accumulation environment and cool climate. In the carbonate gyttja, deposited in a shallower situation, there is a considerable increase in abundance and diversity of molluscs, and snails become dominant. The dominant species, *Valvata pulchella* Studer and *Armiger crista* (Linnaeus), indicate a shallow water with rich vegetation. The deposits were probably formed during late glacial. Niepruszewo-Cieśle: malacofauna-containing grey gyttja and lacustrine chalk are 2.6 m thick. A very rich assemblage includes 16 snail (1 terrestrial) and four bivalve species (over 97,000 shells). The number and abundance of species increase gradually toward the top of the profile. The assemblage is dominated by *Valvata piscinalis* (Müller), *Lymnaea auricularia* (Linnaeus) and *Gyraulus laevis* (Alder). The typical form of *Valvata piscinalis* (Müller) and its lacustrine variety *Valvata piscinalis antiqua* Sowerby form ca. 64% of the assemblage. The dominant species indicate a permanent

stagnant water body. Numerous large thick-walled shells suggest favourable conditions for molluscs. The sequence was probably formed during a major part of the Holocene.

MORPHOLOGY OF OVIDUCAL GLANDS IN *HELIX POMATIA* L.

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Ultrastructure of glandular cells associated with the oviducal part of the spermoviduct was studied. The material was collected in late spring, during the period of high reproductive activity of the snails. In the oviducal part glandular cells form a continuous layer located under ciliated epithelium which lines the lumen of the duct. The cells are bottle-shaped with a widened mid part and strongly narrowed apical part. Each cell opens to the duct lumen, its apical part penetrating between the cells of the ciliated epithelium. In that period the glandular cells are large, and their enlarged apical parts contain a secretion visible as electron light, fine fibrillar material. The large nucleus is located basally and surrounded by a well-developed system of rough endoplasmic reticulum and very numerous electron dense structures of irregular shape, devoid of membranes. Glandular cells of the distal oviducal portion (passing into free oviduct) have their apical parts filled with electron light material. Their cytoplasm contains accumulations of fine fibrillar, electron light material. The results show a high activity of the oviduct wall glands. The fibrillar material secreted by the glandular cells is probably mainly composed of proteins and sugars. Their presence in the oviduct lumen may be associated with formation of secondary egg envelopes.

GASTROPODS OF MT. ŁYSIEC IN THE ŚWIĘTOKRZYSKI NATIONAL PARK, AND THE EFFECT OF ACIDIFICATION

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The parts of the Łysogóry which are the most valuable from the natural history viewpoint are included in the Świętokrzyski National Park. Acid rains and other kinds of industrial pollution, resulting from local or remote emissions, have been affecting the area for over 40 years, consequences being a strong acidification of the soil and changes in malacocoenoses. The ecosystems of the park have been studied since 1993 by the Station of Integrated Monitoring, located on Mt. Łysiec. Gastropod samples were taken with Oekland method in 12 sites on Mt. Łysiec in 1993–1994 and 2002–2003. The analysis included malacocoenoses of various forest habitats and sites located near the monastery (12th c.). Forty four gastropod species were recorded; local populations of six species had probably become extinct (*Carychium minimum, C. tridentatum, Acanthinula aculeata, Deroceras rodnae, Vestia elata* and *Isognomostoma isognomostoma*). Twenty three of the gastropod species found in the Łysogóry in 1963–1979 and 1985–1986 were not found on Mt. Łysiec. No snails were found in three sites: beech forest, fir-beech forest and fir forest. The number of individuals has decreased three times during the last ten years, and ubiquitous species dominate now; montane and hygrophilous species appear to have retreated. The secondary alkalisation of the soils near the monastery was found to contribute to the preservation of the malacocoenoses. It seems that in the Park protection of historical buildings and snails are integrated.

ON MEASURING SNAIL SHELLS

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In snails, the shell size is genetically determined, but it is also affected by the environment; therefore it can indicate both the genetic composition of the population and the conditions in which the snails live. In studies on size variation of snails, the shell diameter is the most commonly used parameter. Because of the specific shape of the shells, measuring them with precision and high repeatability is difficult, even in the comfort of a lab. The task becomes even more difficult in field population studies, where live snails need to be measured, often in adverse weather conditions. In such studies, efficient use of a caliper is very difficult, usually resulting in low repeatability of the measurements. In population studies of the snails with spherical shells (e.g. *Helix*, *Cepaea*, *Arianta*, *Bradybaena*) a standard stencil for drawing circles (diameter 4 to 40 mm at one-millimeter intervals) can be used as a calibrator. To measure a shell one simply needs to find a hole in the stencil of a diameter corresponding to the diameter of the shell measured at the equator of its last whorl. The diameter (number) of this hole is the size of the measured shell. Distribution of the shell sizes measured in this way corresponds to the distribution of the sizes resulting from traditional caliper measurements. Correlation of the results obtained with both these methods is very high ($r>0.90$); it is therefore legitimate to derive a regression formula for estimating the “textbook” diameter on the basis of measurements taken with the calibrator. The

advantages of using a calibrator include: an increased efficiency of the measurements, both in the lab and in the field, due to the simplicity and relative quickness of the process; the ease of measuring the shells of live and active snails; high repeatability of the results (ca. 90%).

REPRODUCTION OF *HELIX POMATIA* IN ARTIFICIAL CONDITIONS

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An experiment aimed at assessing the reproductive potential of *Helix pomatia* in artificial conditions was conducted from April till September 2004. After hibernation, when snails from the wild population resumed their activity, 300 adult individuals were collected and placed in an adequately equipped enclosure of 8 × 3 m size. During consecutive months of the experiment they were kept in optimum environmental conditions. Mating started in May and continued till July. The egg laying period lasted from the end of June till August. Individual snails laid 15–35 eggs; most juveniles hatched about half of July. Out of the original 300 snails, 215 survived till September 2004 (66 were found dead, 19 disappeared). About 4,000 juveniles hatched, and 1,800 survived till September.

REASONS FOR AND RATE OF CHANGES IN GROWTH CURVES IN THE ZEBRA MUSSEL POPULATIONS

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We analysed historical data on the changes in growth curves of *Dreissena polymorpha* within 5–39 years (~1.7–3.3 to 13–26 generations) in 12 populations in Poland. In ten of them the shape of the curve changed significantly which may indicate an altered allocation of resources between growth, reproduction and other vital functions. We used predictions of the model of optimum division of resources between growth and reproduction in the zebra mussel to test if the observed changes could be explained by adaptive reactions to mortality level and rate of biomass production in the populations. According to the theoretical predictions of the model, both the increased mortality and the increase in the rate of biomass production were positively correlated with the changes in the growth rate parameter of Bertalanffy's curve and negatively with the changes in the asymptotic size of the mussels. Assessment of the rate of changes in the growth curves showed that the changes in the growth parameter of Bertalanffy's curve reached a high rate of at least 0.003–0.256 haldanes, and the changes in the asymptotic size took place at a rate of at least 0.038–0.658 haldanes (1,870–86,668 and 17,773–187,353 darwins). The results suggest that the changes in the mortality rate and rate of biomass production in the zebra mussel populations brought about changes in the allocation of resources to growth and reproduction. The changes were compared to such changes in other organisms. Though our data do not permit to decide to which degree the observed changes had a genetic background and to which degree phenotypic plasticity was responsible, they indicate adaptive processes which, during the last 200 years in Europe (~67–133 generations), contributed to the diversification of the zebra mussel on our continent.

PLANT INFUSIONS AS MEANS OF SLUG CONTROL

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Chemicals used nowadays to protect plants against damage from slugs are not always effective, and new means to limit slug feeding are constantly sought, e.g. plant extracts which are studied with respect to their deterrent or contact effect on slugs. The experiment conducted in the Chair of Plant Protection Methods, Agricultural University in Poznań, was to test the deterrent and contact effect of coffee, tea, onion and garlic on *Deroceras laeve* (Müll.). The concentrations used were: coffee 0.5; 1.0; 2.0; 25.0; 33.0 and 100%; tea 0.5; 1.0; 2.0%; onion 0.5; 1.0; 2.0%, garlic 0.5; 1.0; 2.0%. The experiment, in 10 cm Petri dishes with three layers of humid filter paper, was run in four trials, five slugs in each. To study the deterrent effect, fragments of cabbage leaves of known surface and weight, soaked in the respective extract for 5 minutes, were offered to the slugs; control leaves were soaked in water. The leaves were weighed after 3 and 7 days, the absolute deterrent index was calculated and dead slugs counted. The best deterrents were 25% coffee (adi 29.5) and 1% tea (adi 29.3). For both combinations 15% mortality was observed after 7 days. When 0.5% onion extract was used, after 7 days the mortality was 30%, and adi 19.8. To study the contact effect, each dish was filled with 12 ml of the respective plant extract; dead slugs were counted after 3 and 7 days. The highest mortality (100%) was caused by 25 and 33% coffee; 100% coffee caused a mortality of 85%.

CHARACTERISTICS OF THE POPULATION OF *HELIX POMATIA* FROM THE NATURE RESERVE SKARPA URSYNOWSKA

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Because of its culinary and nutritional value, *Helix pomatia* Linnaeus, 1758 is very popular in French, Italian and Spanish cuisine. In Poland, a well-known exporter, mass collecting has caused a decrease in the abundance of the species, and now it is partly protected (only individuals with shell diameter of over 30 mm can be collected from May 1st till May 31st). Numerous studies conducted at present are aimed at assessing its abundance in various regions, e.g. Małopolska, but there are no data on Masovian populations. The 2003/2004 and 2004/2005 studies (end of May – half of September) in the nature reserve Skarpa Ursynowska in Warsaw consisted in collecting *H. pomatia* along transects; the snails were then weighed (to the nearest 0.01 g) and their shell height was measured (accuracy 0.1 mm). The snails were then marked with a dermatograph (summer 2003/2004) and nail varnish (2004/2005) and released. Their behaviour was observed in the field. The number of individuals caught in 2003/2004 and 2004/2005 was 410 and 474, respectively. Mating was observed in May/June in 2003/2004; next year additional mating took place in August (low temperatures in June). The mean shell height in the first season was 37.45 mm, the mean biomass 17.83 g. In the second season the respective values were 38.81 mm and 19.75 g. The snails were most abundant in partly shaded places with little grass and dominance of stinging nettles (food), raspberries and brambles (shelter). The highest activity was observed when the air humidity was high and insolation moderate or low; the activity increased towards evening.

DIVERSITY OF THE MALACOCOENOSES OF THE CYBINA RIVER

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In 2004 we made an inventory of aquatic snails and bivalves of the Cybina River, a right-bank tributary to the Warta River. Sampling sites were located at 1 km intervals from the river source to its mouth. At least five samples were taken in each site, in all microhabitats available, with a drag net. Shells were also collected from flood debris. The total number of species recorded from the Cybina River is 58, which is 82% freshwater malacofauna of the Wielkopolska region. Aquatic snails are represented by 36 species, bivalves – 22 species. Three bivalve species: *Unio crassus*, *Anodonta cygnea* and *Sphaerium rivicola*, are legally protected. One of the factors contributing to the richness of the malacofauna is the presence of diverse water bodies in the river valley.

ECOLOGICAL ASPECTS OF THE OCCURRENCE OF *SEGMENTINA NITIDA* IN FIELD PONDS

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Segmentina nitida O.F. Müll. is most frequent and abundant in shallow (temporary) water bodies of variable water level. It often occurs in masses among *Lemna* sp. and filamentous algae. It is among the most drought-resistant freshwater snails and can survive a year outside water. The aim of the studies was to trace the effect of selected habitat factors on the occurrence and density of *S. nitida* in midfield ponds, and to identify behavioral adaptations to survive dry periods. The density of *S. nitida* was studied in 30 small ponds in W. Wielkopolska. They differed in their geomorphological characters, microhabitats, periodicity (from highly ephemereal to permanent). Quantitative samples were taken with a scraper of 20 cm cutting area, driven along 0.5 m bottom (basic sample = 0.1 m^2). In May and October 2002 and in May 2003, 50 microhabitats were selected in the ponds, and 5 basic samples were taken from each (0.5 m^2 per microhabitat). Physico-chemical parameters of water were also measured. Adaptation of *S. nitida* to surviving dry periods was studied in three temporary water bodies which are its typical habitats. Samples were taken in July 2003 and 2004 from dry bottom, along transects, with a metal cylinder, base area 78.5, stuck 5 cm into the bottom. In 2003 from each pond 30 samples were taken, and 60 in 2004. The depth in the sampling point and its distance from the shore were noted. Statistical analysis of the effect of habitat factors on the density was performed with ordination and CANOCO programme, considering the periodicity of the pond, physico-chemical parameters of water, microhabitat type, connection with other water bodies, surface of the catchment area, organic matter content and concentration of heavy metals in bottom deposits. *S. nitida* was found to be most abundant in small periodical ponds, drying out for 4–6 months per year, in habitats overgrown with *Sparganium erectum* and sedges (*Carex acutiformis, C. riparia*), and on mats of filamentous algae. Spring water temperature, organic matter content in the bottom deposits and de-

gree of vegetation coverage were found to affect the snail density. Studies on habitat selection by *S. nitida* during dry periods indicate that for aestivation it chooses places covered by macrophytes but remote from the margins, where humidity is higher.

PRELIMINARY STUDIES ON NATURAL INFECTION OF LYMNAEID SNAILS BY LARVAE OF *FASCIOLA HEPATICA*

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Fasciola hepatica is a dangerous parasite of domestic and wild ruminants; in various regions of the world fasciolosis affects humans. Mammals get infected as a result of consuming metacercariae which have encysted on aquatic plants or grass of temporarily flooded meadows. Drying grass does not prevent infection. Crucial intermediate hosts of the liver fluke are lymnaeids; cercariae originating in their digestive gland leave the snails to encyst on vegetation and change into invasine metacercariae. The main natural intermediate host in Poland is believed to be *Galba truncatula*, and in areas of cattle fasciolosis the presence of the snail should be expected. The aim of our study (2003–2004) was to check cattle farms near Brodnica, Toruń and Wąbrzeźno for the occurrence of fasciolosis, and then to examine the composition of the malacofauna of marshy meadows where the cattle grazed. The cattle were examined coproscopically, and the snails were diagnosed for the parasite. Cattle from nine farms were found to be infected, and five areas with the most numerous cases of fasciolosis were malacologically studied. *G. truncatula* was not found in any of the areas. Examination of other snail species revealed cercariae of various species of digenetic trematodes. In one of the areas three individuals of *L. stagnalis* were found to emit small numbers of cercariae corresponding to *F. hepatica*. Further studies are required to decide if species other than *G. truncatula* may play a role of natural intermediate hosts of the liver fluke.

TREMATODES IN DOMINANT SPECIES OF FRESH-WATER GASTROPODS

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Populations of dominant species of benthic molluscs *Viviparus viviparus* L., *Lymnaea stagnalis* L., *Bithynia tentaculata* L. in biocenosis of the mouth of the Desna River and Lake Babje (Kiev) were investigated in the autumn of 2004. The snails were parasitologically examined. The number of larvae and parthenites was assessed in the Bogorov camera. Lake Babje: the population density of *V. viviparus* was 155 indiv. m^{-2}. The general prevalence of infection (PI) was 28%, cercariae of *Leucochloridiomorpha constantiae* Müller (PI – 20%, average intensity of infection 1.5 cercariae/mollusc), *Cercaria bolschewensis* Cotowa (PI – 2%, average intensity of infection 17 cercariae/mollusc) and rediae of Echinostomatidae (PI – 16%, average intensity of infection 105.3 cercariae/mollusc) were found. *L. stagnalis* (density 10 indiv. m^{-2}) contained in a single case cercariae of *Cotylurus sp.* (intensity of infection 464 cercariae/mollusc). Desna River: population density of *V. viviparus* – 13 indiv. m^{-2}, PI – 46.2%; cercariae of *L. constantiae* (PI – 30.7%, average intensity of infection – 3.4 cercariae/mollusc) and *C. pugnax* (PI – 30.7%, average intensity of infection – 5,403 cercariae/mollusc, 2,129 rediae/mollusc) were found. A few cases of co-occurrence of two trematode species in one host were observed. Population density of *B. tentaculata* – 14 indiv. m^{-2}; cercariae of *Pleurogenoides medians* Olsson (PI – 7.14%, average intensity of infection – 1,786 cercariae/mollusc) were found. With the above parameters of infection and mollusc population density it was possible to calculate the average number of trematode parthenites and larvae per unit area of substratum. In the benthos of the Desna River mouth the density per 1 m^2 of the bottom was 15 cercariae of *L. constantiae*, 21,363 cercariae and 8,497 rediae of *C. pugnax*, 1,786 cercariae of *P. medians*, the total parasite density was 23,163 cercariae and 8,497 rediae. In the benthos of Lake Babje the values were: 47 cercariae of *L. constantiae*, 53 cercariae of *C. bolschewiensis*, 2,611 rediae of Echinostomatidae spp., 464 cercariae of *Cotylurus* sp.; the total density was 564 cercariae and 2,611 rediae. Further investigations will include parameters of cercariae emission. Most trematode larvae are unable to find the next host in the life cycle and constitute an energy-rich food basis for a variety of hydrobionts. Similar investigations will allow to specify the role of dominant mollusc species and their parasites in the ecosystem.

MALACOFAUNA OF THE BUG RIVER OXBOWS IN THE NADBUŻAŃSKI LANDSCAPE PARK

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The Nadbużański Landscape Park includes the mid section of the Bug River valley, located south of the river. It is one of the largest landscape parks in Poland, protecting almost 120 km of the river. The landscape is much varied, and the wide valley, with its meandering river and numerous oxbows, is close to natural. In 2002 the staff of the Chair of Ecology and Environment Protection started detailed hydrobiological studies of the oxbows. The malacofauna was studied in six of them, located between the mouths of two tributaries: Liwiec and Nurzec. The oxbows are to a varied degree connected with the Bug – from oxbows with a considerable flow, through intermediate, to completely cut off. They harbour from nine to 13 mollusc species. Oxbows Szumin and Wywłoka are especially rich in unionids, *Dreissena polymorpha* and viviparid snails. In places their density reached several hundred individuals per 1 m^2. Among unionids the most common species was *Unio pictorum*; *U. crassus* was also found, though very rare. In the most isolated Lake Białe molluscs were the least abundant, and unionids were absent.

GROWTH RATE OF *VIVIPARUS VIVIPARUS* (LINNAEUS, 1758) UNDER LABORATORY CONDITIONS

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Viviparus viviparus (Linnaeus, 1758) shows clear sexual dimorphism; its life span ranges from five to ten years, and it is common in lowlands of N. and C. Poland. We made an attempt at verifying the age of these snails based on field studies and laboratory experiments. The experiments were aimed at assessing growth rate of individuals in various shell size (height and width) classes. The laboratory individuals originated from a population of *V. viviparus* from an oxbow of the Bug River. Fifty individuals were caught at random in the field. They were sexed, and the sex ratio was 1:1. They were divided into four size classes; each class was placed in an aquarium (23–25°C, aerated), and regularly fed with detritus partly supplied with aquarium fish feed. New-born snails were found on the next day, and then the aquaria were searched for young individuals once a week during one month. These young snails were counted, measured and placed in a separate aquarium in the same conditions for 12 months. Their shells were measured monthly. During the first month of life the shell increment was 0.56 mm, in the second 0.85, in the third 0.97, in the fourth, fifth and sixth 0.78, and in the following six months – 0.90. During the year the snails reached or even slightly exceeded the literature-reported size for class I. The growing snails did not reproduce during the experiment.

THE EFFECT OF GONADOTROPIC STIMULATION OF *HELIX POMATIA* L. FROM NATURAL HABITATS AND HELICULTURE ON THE HISTOLOGICAL PICTURE OF ITS GONADS AND BODY MASS INCREMENT

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The material included *Helix pomatia* from a heliculture of the Animal Husbandry Institute in Balice nr. Cracow and from a natural population in the nearby park. One experiment (March-May 2002, with only heliculture snails) used injections (thrice, at fortnight intervals) of serogonadotropin (PMSG) with Biogonadyl (HCG), applied three days later as an oogenesis-stimulating factor, and hypothalamic hormone stimulating vitellogenesis and ovulation (GnRH). The control group was divided in two parts: one received injections of physiological fluid at corresponding intervals, the other was not injected. The snails showed advanced somatic maturity but they did not have reflexed and hardened lip. In the second experiment, in May 2003, snails from natural and farmed populations were divided in three age groups: 1. 1+, after first hibernation; 2. 2+ and 3+, maturing, after two or three hibernations, with not reflexed lip; 3. >3+, fully mature, after at least three hibernations, with hard, reflexed lip. The farmed snails were fed standard snail fodder. A clear acceleration of gamete maturation was observed in the gonads of snails treated with gonadotropic hormones. All stages of gametogenesis were seen on histological slides, including spermatozoa and vitellogenic oocytes, while gonads of control snails contained mainly early stages of gametogenesis. Body mass increments in farmed snails after hormonal injections ranged from 17 to 43%, and from 6.6 to 99.1% in control groups. The survival rate of snails in all groups was comparable and ranged from 34.6 to 57.7%. Likewise, in gonads of farmed snails (experiment II) an accelerated maturation of gametes was observed, especially in individuals aged 3+ and 1+. Appearance of spermatozoa and vitellogenic oocytes in snails aged 1+, suggests acceleration of their sexual maturation, even by one season.

Farmed and wild snails aged 2+ showed no differences in the histological picture of their gonads.

MOLLUSCS OF SELECTED WATER BODIES OF THE LOWER BUG RIVER VALLEY

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The lower Bug River valley holds numerous water bodies of different degree of connection with the main river bed. Most are oxbows at various succession stages; besides, some are side branches with a permanent connection with the main river bed, or oxbows that have lost connection in their upper part or on both sides. Depressions in the valley hold small water bodies fed by underground waters. The malacofauna was studied in 25 water bodies of different size, position relative to the river and connection with the main river bed. Samples were taken in late spring and summer in 2002–2004, to determine the species composition and structure of the malacocoenoses, and to relate their diversity to habitat diversity. About 30 mollusc species were recorded – 20 snails (5 prosobranchs) and ca. 10 bivalves. From one to 20 species were recorded from individual water bodies, most often the number did not exceed 10. The species-richest site was one of the sections of the former bed of the Bug, connected to the river by a canal. A qualitatively poor malacofauna was found in small, stagnant water bodies which remain after overgrowing oxbows, and in a side branch of the Bug, with its bottom intensely washed during high water level. The species diversity was usually rather low, the Shannon-Weaver index never exceeding 2, and in most cases 1. The most widespread species in the studied habitats (F>50%) were *Lymnaea stagnalis*, *Bithynia tentaculata* and *Viviparus contectus*, and, considering empty shells, *Planorbarius corneus*. *Anodonta cygnea* and *Sphaerium corneum* were also rather frequent. *L. stagnalis*, *B. tentaculata* and *V. contectus* formed the highest proportion in most malacocoenoses. In large water bodies directly connected to the river, and in some large water bodies without such connection, a significant component of the malacocoenoses was *Viviparus viviparus*. The malacocoenoses showed a slight similarity in their species composition and dominance structure. The mollusc densities estimated based on semi-quantitative samples ranged from a few to over 200 individuals per 1 m^2 bottom, most often not exceeding 20 indiv. m^{-2}. The richest and most diverse malacoenoses were those of larger water bodies with no direct connection to the river and with moderately advanced succession. A high diversity of the water bodies (size, succession stage, connection to the river) ensures a considerable species richness of the studied fragments of the Bug valley in spite of the low diversity in most analysed water bodies.

DAMAGE TO SEEDS AND SEEDLINGS OF WINTER WHEAT AND WINTER RAPE BY *DEROCERAS RETICULATUM* (MÜLLER) AND *ARION LUSITANICUS* MABILLE

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Winter wheat and winter rape are cultivated plants the most often damaged by slugs. The greatest damage is done by *Deroceras reticulatum* (Müller) and *Arion lusitanicus* Mabille at early stages of plant development. Wheat is the most susceptible to damage at seed stage, less so at seedling stage; older plants are also damaged but this does not prevent their further growth. The rape is the most strongly damaged as seedlings, which may even lead to complete destruction of large cultivation areas. The experiments were aimed at determining the rate, way and extent of damage to the wheat and rape by the two slug species. *A. lusitanicus* damaged rape seedlings on an average by 39.2% in the first day of feeding, and by 99.1% after seven days. Rape seeds on the first day of feeding by the slug were damaged in 3%, and after four days in 38%. *D. reticulatum* damaged rape seedlings on an average by 29.7% on the first day of feeding and by 99.5% after eight days. The mean proportion of wheat seeds damaged by *A. lusitanicus* ranged from 8.9% to 42.9%; average damage to wheat seedlings by the slug ranged from 10.2% to 42.6%. *D. reticulatum* caused much less damage to wheat seeds compared to seedlings. The proportion of damage caused by that slug ranged from 6.6% on the first day of feeding to 21.2% after four days, and the proportion of damage to seedlings was 13.4% and 46.6%, respectively.

THE EFFECT OF SUBSTRATUM, TEMPERATURE AND CONSPECIFICS ON THE ATTACHMENT STRENGTH OF *DREISSENA POLYMORPHA*

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The zebra mussel attaches to the substratum with byssus. Its attachment strength depends on many external factors and affects various life parameters of the mussel (e.g. resistance to toxins, anti-predator protection, or resistance to water current). The effect of various factors (kind of substratum, temperature, conspecifics) on the attachment strength of adult zebra

mussels was studied. Measurements were taken with digital dynamometer, after 2, 4 or 6 days of the mussel exposure under laboratory conditions. It had been shown earlier that the mussels attached stronger to resocart (a plastic of phenoplast group), alluminium and PCV, compared to rubber, and weaker still to zinc and resocart covered with Penaten cream. Limited attachment strength on zinc substratum resulted from its toxicity, the mussels being affected by substances released to the water, while Penaten affected only those mussels that were in direct contact with it. Biofilm developing on various substrata had a favorable effect on the attachment strength only for resocart. The attachment strength depended also on water temperature: it was the greatest at 20 and 25°C (0.75 N). At 10, 15 and 30°C it was much smaller (0.20, 0.31 and 0.16 N, respectively), and at 5°C the mussels did not attach to the substratum. At 30°C, 38% individuals died. The presence of conspecifics stimulated attachment; the effect was significant after 2 and 6 days of the experiment, and slightly weaker after a longer exposure.

POTAMOPYRGUS ANTIPODARUM (GRAY, 1843) IN THE GREAT MAZURIAN LAKES (PRELIMINARY RESULTS)

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Potamopyrgus antipodarum is an invasive snail originating from New Zealand; since 1930s it has been invading inland waters of Poland, and is suspected of having a negative effect on the native freshwater snails. In 1979 I found it for the first time in the Great Mazurian Lakes, in Lake Mikołajskie, and since then it was observed there regularly but not abundant. In 2004 I found *P. antipodarum*, also at low abundance (max. 45 indiv. m^{-2} bottom) in a shallow (up to 2.0 m) littoral of Lake Roś, in both its mid part and near connection to other water bodies. The low abundance of live animals and empty shells indicate that there probably never was any mass appearance in the lake, which is often the case with invasive species in the initial stages of invasion. The low and similar abundance of *P. antipodarum* in various parts of Lake Roś does not allow for a guess about the direction of its migration. Preliminary studies (1–2 sites in each lake), in the same year in lakes Bełdany, Mikołajskie, Tałty, Niegocin and Kisajno, showed that the snail occurred in each at low densities. It was not observed in small lakes Majcz Wielki and Jorzec, which are located nearby and connected with the Great Lakes through the Jorka River. At the same time I found that in the earlier studied (1997 and 1998) lakes Wigry and Białe Wigierskie *P. antipodarum* showed the same occurrence pattern – mass occurrence (up to a few dozen thousand individuals per m^2) in the former and sporadic in the latter lake. The results indicate an atypical – for an invasive species – character of distribution of *P. antipodarum* in the Great Mazurian Lakes: at a constant, very low density. It does not seem to be associated with the lake trophy, since the phenomenon was observed in both eutrophic and mesotrophic lakes, and in the oligotrophic lake Białe Wigierskie. The limiting factor may be competition from native snail species. It is not excluded, however, that, considering its parthenogenic reproduction, the Great Mazurian Lakes and Lake Białe Wigierskie were invaded by genetic lineage[s] of low fertility or low viability of progeny, much lower than in e.g. Lake Wigry. This view is supported by the age structure of the population from Lake Roś where the biggest individuals form a majority. Testing the hypothesis may be easier than searching for possible abiotic and external biotic factors responsible for the low density of *P. antipodarum* in the Great Mazurian Lakes.

PRELIMINARY STUDIES ON THE DIVERSITY OF TERRESTRIAL MALACOCOENOSES IN THE CYBINA RIVER VALLEY

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In 2004, an inventory of terrestrial gastropods was made in the Cybina River valley, located east of Poznań. Visual search and litter sampling were employed at 43 sites distributed evenly in the studied area. The total of 4,028 specimens represented 51 species (over half – 57% – of all snails recorded from the Wielkopolska region). Such a high number of species recorded in the preliminary stage of the studies and during only one season suggests a considerable richness of the malacofauna. The results provided a basis for the estimate of spatial distribution of malacocoenoses in the Cybina valley, and for a map of natural evaluation of the area.

CONTRIBUTION TO THE STUDIES ON DAMAGE TO HERBAL PLANTS BY *ARION LUSITANICUS* MABILLE (GASTROPODA, STYLOMMATOPHORA)

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Arion lusitanicus Mabille was introduced in Poland in the early 1990s; it originates from the Iberian Peninsula and for a few dozen years has been spreading in many European countries. In Poland it occurs insu-

larly in the Carpathian foothills, and near Cracow and Brzeg. It is an omnivore; it occurs synanthropically in masses in gardens and fields where it does great damage to cultivated plants. Besides vegetables, industrial and orchard crops, it consumes many herbal plants, both wild and cultivated. The aim of the studies was to assess its preferences to various herbal plants and the susceptibility of different species to the slug feeding. The studies were conducted in 2002–2003 near Łańcut and Wysoka (SE. Poland), where *A. lusitanicus* occurs in masses. The density of slugs and the degree of damage were examined in localities of various plant species. A total of 80 species of herbal plants were examined; of these 65% were not eaten by the slug at all, in spite of its presence in the site. The most damaged species were *Rudbeckia laciniata*, *Lilium candidum*, *Archangelica officinalis*, *Urtica dioica* and *Aegopodium podagraria*. Among the remaining food plants, 16 species were damaged to a moderate degree, and seven species were only slightly damaged.

A TEMPERATURE-MEDIATED EFFECT OF TREMATODE INFECTION ON THE ACTIVITY OF SELECTED ENZYMES IN FRESHWATER SNAILS

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The dynamics of some biochemical parameters (activity of succinate dehydrogenase, ATP/ADP ratio) of *Viviparus viviparus* L., infected with cercariae of *Leucochloridiomorpha constantiae* Müller, rediae and cercariae of Echinostomatidae spp. and uninfected snails were investigated. Experiments were carried out at 20°C (normal conditions) and increased temperature (25°C). The preliminary results indicate a decrease in the activity of succinate dehydrogenase and ATP/ADP ratio in infected compared to uninfected snails. A less pronounced increase in the enzyme activity was observed with increasing temperature for infected compared to uninfected snails. The greatest decrease in the enzyme activity was observed in the variant with a multiple invasion (snails infected with two trematode species). In the variant with low intensity of invasion by *Leucochloridiomorpha constantiae* (1–2 cercariae), no significant decrease in the enzyme activity was observed.

UNIONIDS OF THE KONIN HEATED LAKE SYSTEM

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Four of the six unionids known from Poland occur in the Konin system of heated lakes: *Unio tumidus* Philipsson, 1788, *Unio pictorum* (Linnaeus, 1758), *Anodonta anatina* (Linnaeus, 1758) and *Anodonta cygnea* (Linnaeus, 1758), as well as introduced *Anodonta woodiana* (Lea, 1834). *A. woodiana* differs in its shape from the native unionids and is decidedly the largest; it is the most similar to *A. cygnea*. Its mean shell length is 120 mm. The native *Unio* – *U. tumidus* and *U. pictorum* – reached an average length of 60 mm, *Anodonta* – *A. anatina* and *A. cygnea* – 80 mm. The native unionids occur in cooler lotic and lenitic parts of the system; in lakes they occupy littoral zone 0.8–2.5 m deep, in canals – the shore zone starting with 0.5 m. *A. woodiana* occurred in the shore zone from 1.5 to 2.5 m, clearly preferring heated habitats of moderate flow. The highest density (up to 60 indiv. m^{-2}) and biomass (up to 20 kg m^{-2}) of *A. woodiana* were observed in the most heated zones: the intial cooling reservoir and discharge canals of the power plant. The native unionids occurred in the greatest abundance in the cooler part of the initial cooling reservoir, lakes Ślesińskie and Mikorzyńskie, canal between these two lakes, intake canals of the power plant and the canal of the fish ponds, but did not reach such high densities. In cooler lakes the densitites were rather similar and amounted to ca. 3 indiv. m^{-2}, in cool canals, as a result of clustered distribution, locally the density reached 30 indiv. m^{-2}. The most abundant was *U. tumidus*, followed by *U. pictorum* and *A. anatina*. *A. cygnea* was found in single sites only. The highest proportion in terms of abundance and biomass was formed by *A. woodiana* (77.3 and 95.7%, respectively).

MALACOCOENOSES OF THE DEPOSITS OF THE VISTULA RIVER DELTA CONE AND ITS FOREGROUND

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The study area included the active part of the Vistula delta – the delta cone and the prodelta. Nineteen samples were taken: 11 on land, eight on the sea bottom; 64 species of freshwater and marine molluscs were identified. Freshwater species included: *Valvata piscinalis* f. *antiqua*, *Gyraulus rossmaessleri*, *Lithoglyphus naticoides*, *Theodoxus fluviatilis*, *Viviparus viviparus*, *Pisi-*

dium amnicum, P. casertanum f. *ponderosa, P. conventus, P. lilljeborgii, P. supinum, Unio pictorum, U. crassus, Dreissena polymorpha, Sphaerium solidum, S. rivicola*. The marine assemblage included: *Hydrobia ulvae, H. ventrosa, Cerastoderma glaucum, Macoma balthica, Mytilus edulis, Mya arenaria*, which are also components of the recent fauna of the S. Baltic. Besides them occurred species of different ecological requirements: *Bittium reticulatum, Eulimella nitidissima, Rissoa interrupta, Nassarius reticulatus, Littorina littorea, Cerastoderma edule, Corbula gibba, Mya truncata, Mysella bidentata* and *Thracia papyracea*. The species live in waters of higher salinity (10–35 PSU) than the S. Baltic. Co-occurrence of the mentioned species was the basis for distinguishing malacocoenoses: freshwater, marine and mixed.

COMPARATIVE CHARACTERISTICS OF SHELLS OF *CORBICULA FLUMINEA* (O. F. MÜLLER, 1774) AND *C. FLUMINALIS* (O. F. MÜLLER, 1774) (BIVALVIA: CORBICULIDAE)

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The aim of the paper was to discuss diagnostic shell characters in two similar species that are new to the fauna of Poland. The material was collected in the lower section of the Odra River (discharge canal of the power plant Dolna Odra). *C. fluminea* was collected in autumn 2003 and in 2004, *C. fluminalis* from May to December 2004. Qualitative samples were taken manually from the depth of 0.2–2 m, 2–20 m from shore. Live specimens came from sandy bottom, in most cases being a component of the infauna; very few were found on the surface of the sand. Empty shells were found on sandy and muddy bottom. *C. fluminea* is a medium-sized bivalve of a triangular, rather thick shell, with rounded anterior and slightly angular posterior part. Its surface sculpture consists of distinct, concentric ribs. The umbones are located more or less centrally; a short external ligament is just behind the umbo. Specimens from sandy bottom had brown-olive periostracum, with yellow concentric stripes best visible in the ventral part of the shell. Specimens from muddy bottom were dark brown; few olive-green shells were also found, and usually belonged to younger individuals. The inside of the shell is whitish with a violet hue, and alternating light violet stripes. In *C. fluminalis* the periostracum is olive, and the sculpture consists of thin ridges spaced closer than in *C. fluminea*. The shell is triangular, slightly asymmetrical, with the umbo distinctly twisted anteriorly. The inside is intensely violet in the ventral part and on sides, and white-violetish with an orange coating near the umbo. Lateral teeth, both anterior and posterior, are arcuately bent, the pallial line clearly marked. In live specimens the external surface of the shell is shiny, in dead shells – matt, in most cases with eroded umbones. Morphometric analysis of the shells included length, width, height and their ratios.

PRELIMINARY STUDIES ON THE EFFECT OF MAGNETIC FIELD ON THE VIABILITY AND REPRODUCTION OF *HELIX*

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The studies are in their initial stage. Our previous results showed considerable differences in the number of eggs laid during a season by *Helix aspersa maxima* (180), *Helix aspersa aspersa* (150) and *Helix pomatia* (40–50). The results of studies on sea urchins, fish, crayfish and poultry suggest that magnetic field of certain parameters may accelerate maturation of the reproductive system. Hibernating reproducers of the three taxa were subject to low-energy magnetic field; 150 individuals of each taxon were exposed to magnetic field of 5, 10 and 15 microtesla. Control snails were also hibernating but not exposed to magnetic field. *H. aspersa maxima* and *H. aspersa aspersa* ceased hibernating at the end of February; their survival rate did not differ from such rates in control snails. *H. pomatia*, which hibernates longer, will be subject to the same observations in April. The reproducers will be monitored till the end of the egg-laying period. The number of copulations, egg batches, number of eggs per batch will be recorded; the percentage of hatched eggs will be calculated, as well as the proportion of juveniles which survive till the age of 4 weeks.

SHELL VARIATION IN *HELICODONTA OBVOLUTA* (O. F. MÜLLER, 1774) (GASTROPODA: PULMONATA: HELICIDAE)

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Helicodonta obvoluta is a C. European species, with range extending from the Pyrennees and the southern part of Atlantic coast of France to S. Slovakia and N. Hungary; it occurs also in Great Britain, Moravia, Albania, Bosnia, N. Serbia and the Appenninic Peninsula; in Poland it has few localities in the Central Sudetes. A total of 649 adult shells from Great Britain, Germany (Bavaria [1], Baden-Württemberg [2], Saxony [3]), Poland, Czech Republic, Slovakia, Switzerland and Italy (Lombardian and Venetian Alps [1], Central Appenines [2]) were analysed with respect to their minor (*d*) and major (*D*) shell diameter, shell

Table. Shell variation in *Helicodonta obvoluta*

	D	d	H	UD	ud	h	W	N	W_1	W_2	W_3	W_4	W_5	W_6
All shells	12.12	10.67	5.62	3.72	3.32	5.18	5.22	5.76	1.14	2.16	0.31	1.12	0.99	2.10
Poland	12.58	11.26	5.80	4.03	3.51	5.37	5.55	5.88	1.12	2.17	0.32	1.15	0.97	2.14
Germany [1]	11.78	10.35	5.42	3.63	3.23	5.09	5.09	5.71	1.14	2.18	0.31	1.13	1.00	2.06
Germany [2]	11.45	10.08	5.32	3.47	3.11	4.87	4.86	5.66	1.14	2.16	0.30	1.12	1.00	2.02
Germany [3]	12.03	10.56	5.67	3.66	3.35	5.03	5.01	5.80	1.14	2.12	0.30	1.09	1.01	2.07
Italy [1]	12.84	11.13	5.95	3.86	3.48	5.72	5.52	5.97	1.15	2.16	0.30	1.11	1.04	2.15
Italy [2]	10.75	9.38	5.21	3.57	3.10	4.66	4.77	5.50	1.15	2.06	0.33	1.16	0.98	1.96
England	12.68	11.01	5.93	3.76	3.42	5.42	5.43	5.68	1.15	2.14	0.30	1.10	1.00	2.23
Czech R.	12.83	11.24	5.90	3.87	3.51	5.40	5.38	5.80	1.14	2.18	0.30	1.10	1.00	2.21
Slovakia	12.55	11.11	5.95	3.76	3.42	5.28	5.18	5.82	1.13	2.12	0.30	1.10	1.02	2.16
Switzerland	11.47	9.97	5.31	3.32	2.96	4.83	4.91	5.74	1.15	2.16	0.29	1.12	0.99	2.00

height (*H*), minor (*ud*) and major (*UD*) umbilicus diameter, aperture height (*h*) and width (*w*), number of whorls (*N*) and ratios: W_1 (*D/d*), W_2 (*D/H*), W_3 (*UD/D*), W_4 (*UD/ud*), W_5 (*h/w*) i W_6 (*D/N*). The table shows the mean values of shell parameters (metric characters in mm).

Shells from populations in the central part of the range (Switzerland, Germany – Bavaria, and Baden Württemberg) are clearly smaller than those from marginal populations on the NW., NE. and E. distribution border (England, Poland, Czech Republic and Slovakia) and from the Lombardian and Venetian Alps, as indicated by simialr values of *D*, *d*, *H*, *UD*, *ud*, *h* and *w* in the two groups of shells. Snails from the Abruzzi (Central Appennines) have shells of a similar size to those from the centre of the range, though the area is on the southern border of the range.

A NEW RECORD OF *CHILOSTOMA FAUSTINUM*

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On the 22nd October 2004 a single individual of *Chilostoma faustinum* (Rossmässler, 1835) was found in the Romincka Forest (NE Poland). In Poland *Ch. faustinum* was previously reported only from the mountains and foothills. The closest locality is in Lithuania near Kaunas (ca. 100 away), where the snail is probably introduced. For details see Folia Malacologica 13: 95–96.

CERCARIAE FOUND IN AQUATIC SNAILS IN THE ZŁOTÓW DISTRICT

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Abstract not submitted

ON THE BIOLOGY OF *VERTIGO MOULINSIANA* (DUPUY, 1849) (GASTROPODA: PULMONATA: VERTIGINIDAE)

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Biological observations on *Vertigo moulinsiana* were conducted in a recently discovered locality in the central part of Pomerania. For comparative purposes also other species of *Vertigo* were observed: *angustior* Jeffreys, 1830, *antivertigo* (Draparnaud, 1801), *pusilla* O. F. Müller, 1774, *pygmaea* (Draparnaud, 1801), *ronnebyensis* (Westerlund, 1871) and *substriata* (Jeffreys, 1833). In the studied site *V. moulinsiana* inhabits the reed zone on a margin of a small lake surrounded by agricultural fields. In summer the snails were most often found on live reeds, sedges, *Glyceria* etc. Very often the lower parts of the plants were submerged. When the plants dried out, most snails were still sitting on them, even throughout winter; adaptations are very sticky mucus ensuring good attachment to the plants and a large amount of air in the mantle cavity preventing snails from drowning. According to the literature the species feeds on fungi – parasites of plants. In the lab tree leaves (birch, oak, apple tree) were used as food. In closed containers the snails would often stay just under the lid, but they would

make trips to the bottom, to feed and lay eggs. On a dry substratum they moved at ca. 0.5 mm/s (= 3 cm/min). Adult snails, collected in April and placed in the containers, laid eggs from half of April till the end of July (some longer), 14–36 eggs per individual (mean 26). Most eggs were laid in June (38.6%) and April (20.9%) and July (20.5%). Observations on the age structure in the wild indicate that juvenile snails (less than 2.5 whorl), appear in June and their proportion in the population increases till September or October. Some of them become mature in autumn. Wintering juveniles become mature in June or the beginning of July next year. Some of the individuals that have laid eggs probably die, but the remaining ones winter over and, after egg-laying, die in spring next year. The eggs are translucent and almost colourless, slightly flattened, of a 0.60–0.87 mm diameter. Embryonic development at 20°C lasts 15–17 days (sometimes slightly longer), and at 22°C – 12–13 days. Embryonic shells have a diameter of 0.53–0.70 mm, and 1.1–1.5 whorl (mostly 1.2–1.3 whorl). Juvenile snails in the lab rarely matured – only 3 out of 17 (inadequate food?). The time to maturity (formation of apertural barriers) was 79, 90 and 105 days from hatching. The snails were kept singly all the time, and two of them laid their first eggs 15-16 days after reaching maturity. Analysis of egg structure in the genus *Vertigo* makes it possible to distinguish three kinds of eggs. Eggs of *V. moulinsiana* are similar to those of *V. pygmaea*, but they differ from both *V. angustior* and the remaining studied species.

INDIVIDUAL VARIATION IN BEHAVIORAL THERMOREGULATING REACTIONS OF *HELIX POMATIA* L.

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Results of our previous studies showed that snails differed individually in their reactions to the same habitat stimuli. In snails studied in spring, just after hibernation, and during hibernation, two individual patterns of reaction could be distinguished. It should be asked why individuals from natural populations are so different in their behavioral reactions. *Helix pomatia* in temperate climate must be able to survive sudden changes in habitat conditions (spring frost, winter warming). The reason for the observed differences in thermal preferences may be genetic differentiation of the population, which in turn may be of significance for the population plasticity. Plus temperatures in winter might cause cessation of hibernation. Laboratory exposure to plus temperatures in winter causes cessation of hibernation but only when during many days the temperature exceeds ~10°C. Climatological studies in the area of Toruń indicate that the mean winter temperature never approaches this threshold for a period longer than a few days. It suggests that the probability of spontaneous winter awakenings in the snail population from this area is very low, which testifies to the adaptation to climatic conditions. It can be supposed that there exists a seasonal "time dispenser", and the system of receptors controls long-term temperature changes, not reacting to its sudden and short-lasting fluctuations.

DISTRIBUTION AND ROLE OF *HYDROBIA* IN THE THREE-MILE POLISH COASTAL ZONE OF THE BALTIC ON THE SECTION DARŁOWO–WŁADYSŁAWOWO

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Macrozoobenthos studies in a three-mile coastal Polish zone of the Baltic on the section Darłowo–Władysławowo started in 1996; the main object being mouth sections of the main rivers of Pomerania. Populations of the genus *Hydrobia* were analysed quantitatively and qualitatively. The material was collected from transverse profiles located 1 mile E and 1 mile W of the river mouth, each profile 3 miles long, and at the level of Czołpino and in Władysławowo. A total of 48 localities were sampled. Hydrobiids in the studied material were represented by *Hydrobia ulvae* Pennant and *H. ventrosa* Montagu. In the studied zone they were abundant only in the mouth zone of Słupia (frequency 50%). In the region of the Wieprza mouth the frequency was 10%, Łeba 29% and Łupawa 12%; the snails were not observed in Czołpino and Władysławowo. Quantitative analysis showed that the densities of *Hydrobia* were: in the mouth of Wieprza 0–64 indiv. m^{-2} ($\bar{x}$=8 indiv. m^{-2}), Słupia 0–318 indiv. m^{-2} ($\bar{x}$=57.6 indiv. m^{-2}), Łupawa 0–130 indiv. m^{-2} ($\bar{x}$=16.3 indiv. m^{-2}), Łeba 0–398 indiv. m^{-2} ($\bar{x}$=50.5 indiv. m^{-2}). Fresh mass ranged within: in the Wieprza mouth 0–12 gm^{-2} ($\bar{x}$=3.0 gm^{-2}), Słupia 0–8.1 gm^{-2} ($\bar{x}$=1.89 g m^{-2}), Łupawa 0–5.2 g m^{-2} ($\bar{x}$=0.65 gm^{-2}), Łeba 0–9.99 g m^{-2} ($\bar{x}$=1.36 g m^{-2}). The shell height was, in the mouth of Wieprza 2.0–2.9 mm, Słupia 2.1–3.9 mm, Łeba 1.0–3.9 mm, Łupawa 1.0–3.9 mm. Analysing the distribution depending on the distance from shore, it was found that the highest abundance of the two species was noted 0.5 mile from the shore in the Wieprza mouth region; Słupia – 3.0 miles from shore, Łeba – 2.0 miles and Łupawa 1.0 mile. *Hydrobia* were the most abundant at the depth of 16–20 m. Compared to other molluscs of the studied estuary, *Hydrobia* because of its low abundance does not play a greater ecological role

and does not provide a significant food basis for other hydrobionts. Because of their low densities, *H. ulvae* and *H. ventrosa* might be used as bioindicators of deterioration of conditions in the shore zone.

HUMIDITY AND THE EFFECT OF SHELL COLOUR ON ACTIVITY OF *CEPAEA NEMORALIS*

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Activity of brown and yellow unbanded shelled *Cepaea nemoralis* was observed in 23 outdoor cage experiments carried out in various weather conditions in Słupsk, northern Poland. The experiments were carried out at noon local time and lasted one hour; the activity of each snail was scored at 5 minute intervals. In the range of temperatures examined in this study, air humidity was the significant factor associated with differences in the activity of the morphs. At air humidity of approximately 90%, all snails remained active throughout the experiment, irrespective of the colour of the shell. At air humidity of over 70% brown snails remained active significantly longer than yellow ones. When humidity was below 70%, yellow snails remained active significantly longer than brown ones, and the onset of inactivity was earlier with decreasing air humidity. No consistent effect of the level of solar radiation, air temperature, or air humidity/temperature ratio was observed. Even though the differences in the time of remaining active were not large, they indicate that yellow and brown *C. nemoralis* are adapted to different climatic conditions. For details see Folia Malacologica 13: 109–114.

TERRESTRIAL GASTROPODS OF CEMETERIES IN CENTRAL POMERANIA IN 1993–2003

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The studies were conducted in 1993–2003 in 25 cemeteries (six town cemeteries, intensely used and exceeding 1.5 ha, and 19 village graveyards, mostly old and devastated, less than 1.5 ha). Gastropods were collected in spring and summer, most often during or after rain, employing visual search and ground cover sieving. A total of 38 species of 13 families were recorded. The malacofauna of town cemeteries was poorer (25 species) compared to village sites (33 species). The highest number of species was found in Lębork (14), the lowest in Barwice (3.). The most frequent species were: *Cepaea nemoralis* and *C. hortensis* (17 sites each), *Discus rotundatus* (14), *Limax maximus* (12) and *Cochlicopa lubrica*, *Arion subfuscus* and *Trichia hispida* (11 sites each). Species with single records were: *Succinea oblonga*, *Vertigo pusilla*, *Punctum pygmaeum*, *Nesovitrea hammonis*, *Deroceras laeve*, *Perforatella bidentata* and *P. incarnata*. The similarity analysis revealed no very similar communities. Some similarity (Jaccard index) was observed only for 16 cemeteries, and only one case pertained to two town cemeteries (Lębork). In other cases there were no clear similarities in the composition of the malacofauna. The higher density and species diversity in village cemeteries can be explained by richer and more diverse vegetation and much weaker anthropopressure.

THE EFFECT OF HEAVY METAL IONS ON THE REPRODUCTION AND DEVELOPMENT OF *LYMNAEA STAGNALIS*

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Under the conditions of increasing environmental pollution heavy metals are among the most important pollutants; at present the anthropogenic load of many of them in the hydrosphere several times exceeds that from natural sources; hence the need for studies on their effects on hydrobionts with a view of employing the results to devise ecological monitoring systems. *Lymnaea stagnalis* (Linné, 1758), a common freshwater pulmonate, seems to be a suitable object for toxicological investigations. The effect of different concentrations of six heavy metal ions (copper, manganese, zinc, cadmium, cobalt, nickel) on its reproduction and development was investigated; the snails were exposed to the ions for 70 days. The range of concentrations from lethal to threshold for *L. stagnalis* was found to be rather wide. Based on the reaction of the snail's reproductive system to various levels of intoxication, it was found that high concentrations stimulated and low concentrations inhibited reproduction.

GEOGRAPHICAL VARIATION IN THE COMPOSITION AND RICHNESS OF FOREST SNAIL FAUNAS IN NORTHERN EUROPE

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The forest snail fauna of northern Europe originated from post-glacial colonisation from the south. While it is regionally poor (c. 150 species, excluding

slugs), individual localities can be rich by global standards (up to 57 species). Distance decay in faunal similarity is very gradual in lowland regions, but Carpathian faunas are sharply differentiated, and hold the most endemics. British faunas are remarkably uniform. Very little of this differentiation is due to congeneric replacement; it results mostly from shifts in the richness of whole families. Clausiliids in particular predominate in the Carpathians and adjacent areas, but this is not reflected in the apparent density of individuals: as species richness increases, average abundance of each declines. In general, small species are more widely distributed than large ones. Although the richest localities are found in the Carpathians, regional variation in local richness is slight. Substrate has significant effects: oligotrophic areas have poorer and more locally variable faunas. When slugs are included, areas of less than 100 km^2 holding more than 60 species can be found in many parts of the region; the richest such patches hold about half the whole regional forest fauna. Comparison with regions further south shows that although they have much richer regional faunas, local communities are no richer than those of the north. Distance decay is much more rapid. These results are discussed, with global comparisons, in terms of the ways in which molluscan communities are assembled and structured. For details see Records of the Western Australian Museum, Supplement 68: 115–132 (2005).

UNEXPECTED SNAILS – SUPPLEMENTS TO THE DISTRIBUTION OF TERRESTRIAL SNAILS OF POLAND

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In 2001–2004 we gathered new data on the distribution of two species: *Cepaea vindobonensis* (Férussac, 1821) which is rare in Poland, and *Cochlodina costata* (C. Pfeiffer, 1828) which was regarded as extinct in the area. *C. vindobonensis*, a Pontic species, was previously known from two areas in Poland: central-western and south-eastern. Many authors emphasised that the species did not occur in the mountains, though it was known from the Slovak part of the Carpathians. In 2002 we found a population of C. *vindobonensis* in the Biała Woda Valley in Małe Pieniny. The snails live there on a partly open, south-facing limestone rock face and at its base. Another visit in 2004 indicates that the population is prosperous. The new site may be an isolated fragment of the natural range or result from introduction by the Walachians who in the 15th c. established a village there. *C. costata*, an E. Alpine-Dinaric species, was recorded by the 19th c. authors from Mt. Ślęża and several sites in the Kaczawskie Mts; subspecies *C. costata silesiaca* was described from Mt. Połom in the latter mountains; it was supposed to differ from the typical form in the length ratio of lower and spiral lamellae. The last specimens were collected on Mt. Miłek in the Kaczawskie Mts in 1950s, later only subfossil shells were found. Other sites could not be confirmed, despite repeated searches, and the species was regarded as extinct in Poland. In 2003 on Mt. Miłek (mixed forest with dominant beech and limestone crags) we found several live specimens and fresh shells of *C. costata*. All represented the typical form. The only specimen of *C. costata silesiaca* in our collection comes from Płonina (Kaczawskie Mts), where it occurred with the typical form (remaining shells from the same site); hence *C. costata silesiaca* should not be regarded as a subspecies. For details see Folia Malacologica 12: 153–156, 189–192.

COMPARATIVE STUDIES ON *DREISSENA* POPULATION IN COOLING POND OF CHERNOBYL NPP AND KIEV RESERVOIR (DNIEPER RIVER)

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Populations of *Dreissena* were studied in a cooling pond of the Chernobyl nuclear power plant and the middle part of the Kiev reservoir, the uppermost in the Dnieper River reservoir cascade. The pond is no longer used as a cooling pond, but its zones, in conformity with the earlier thermal regime, are called: old cold (OC), new cold (NC), new warm (NW), old warm (OW) and old hot (OH) zones. In the cooling pond the mussels were collected from stones, in the reservoir from sandy bottom and unionid shells in the littoral. Two species of *Dreissena* were found to occur in the studied water bodies: *D. polymorpha* Pallas and *D. bugensis* Andr. In the cooling pond the biomass of Dreissenidae in the benthos reached 4,900 gm^{-2}, and *D. bugensis* dominated. In the periphyton the biomass of *D. bugensis* was 10,100 gm^{-2}, and of *D. polymorpha* – 200 gm^{-2}. The biomass of *D. polymorpha* varied more compared to the other *Dreissena*, the respective values of variability coefficient being 71.8–125.9%, and 32.1–47.8%. In the cooling pond the population of *D. polymorpha* was not only less abundant, but also less evenly distributed than *D. bugensis*. In the benthos of the Kiev reservoir the biomass of *D. bugensis* was 6,600 g/m^{-2}, and of *D. polymorpha* – 190 gm^{-2}. On unionid shells the respective values were 200 and 50 gm^{-2}. Shells of *D. bugensis* from the two water bodies differed morphometrically. The external shell volume in the 11–15 mm size class in the cooling pond ranged from 508.8±34.5 to 697.3±31.1 mm, and was 1.67 times higher than in the reservoir. This volume for the size class of 21–25 mm was 1.42 times higher in

the pond. The form coefficient (K_v) was higher for the mussels from the reservoir: for the 21–25 mm size class it was 1.15±0,009–1.18±0.009 in the pond, and 1.27±0.021–1.33±0.016 in the reservoir. The shell length/height ratio in the pond was below 2, in the reservoir over 2. The phenotype structure of *D. bugensis* population was investigated in the cooling pond. The colour pattern and sculpture of the shells varied among the zones of the pond. An increase in shell melanization (coefficient K_m) was observed from from OC-zone (K_m=0.55) to OH-zone (K_m=0.67). Compared to the reservoirs of the Dnieper the melanization was slightly lower, but it was much higher than for *D. polymorpha* in the Prypat river. The frequencies of seven shell pattern phenes varied between the zones. The frequency of phene G (arched components of the pattern) was 0.565–0.737 (summer period), that of phene F (zigzag pattern) was 0.007–0.018 and the phene occurred only in OC-zone. Phene J (wavy components of the pattern) had its maximum frequency in OH-zone. The phenotypic diversity (Shannon index and Zhivotovski r-coefficient) was low in zones NW and OW.

SHELL BIOMETRICS AND BODY MASS OF *SPHAERIUM CORNEUM* L. (SPHAERIIDAE) IN THE CENTRAL PART OF THE WŁOCŁAWEK RESERVOIR

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Biometrical studies on sphaeriid bivalves were most often aimed at solving taxonomic problems. Little is known on the use of biometrics for determining body mass of the bivalves, and thus it is not comparable to the mass of other benthic groups, e.g. Chironomidae and Oligochaeta. Studies on the sphaeriid fauna were conducted in the central part of the Włocławek reservoir in the flow and flood zone. The dominants were *Sphaerium corneum* and *Pisidium henslowanum*; the rare *Sphaerium solidum* was also recorded. Dependence between the length, height and convexity ("thickness") of the shell was analysed for *S. corneum*, and an attempt was made at finding an easily measurable parameter that would allow to determine the dry body mass. For most "slim" specimens the results of measurmenets of the fresh body mass conformed to Alimov's formula. For "slightly stouter" and "stout" individuals new formulas were introduced. Based on the calculations, formulas describing the dependence between the shell length and the dry mass of the body were introduced. Changes in interrelationships between the shell parameters in different seasons and habitats were noted.

MORPHOMETRIC DIFFERENCES BETWEEN SOME UNIONIDS IN THE EUROPEAN PART OF RUSSIA AND THEIR TAXONOMIC POSITION

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The aim of the study was to recognise the degree of morphometric differentiation between and within *Unio crassus, U. pictorum, U. tumidus* groups from some localities in European Russia (St. Petersburg Region, Valday, Karelia). Most malacologists treat these groups as polymorphic species in the genus *Unio*; sometimes *U. crassus* is placed in a distinct genus – *Crassiana*. However, some recent Russian malacologists (e.g. STAROBOGATOV) consider these groups as distinct genera (*Crassiana, Unio, Tumidiana*). Standard ratios were calculated based on three standard dimensions of the shell (length – L, height – h, convexity – C) – h/L, C/h, C/L. Qualititative features, such as the character of anterior teeth interposition, umbonal sculpture, periostracum colour were also considered. The matrices of ratio values (one general matrix, including all three groups, and three partial, each for one group) were analysed with factor analysis and canonical analysis. Moreover, we calculated squared Mahalonobis distances between the samples on the basis of canonical scores. Recently, we have successfully used this morphometric distance to confirm taxonomic relationships of some forms within the genus *Dreissena*. As a result of the factor analysis of the general matrix, h/L and C/L ratios have maximum loadings on principal component (PC) I. In canonical structure the h/L ratio has a maximum weight in canonical root (CR) I. On both scatterplots (of factor and canonical scores) in the spaces of PC I and II (I and II CR) there are three distinct clusters of points, each corresponding to one of the three groups (*U. crassus, U. pictorum, U. tumidus*). However, eight representatives of *U. pictorum* (from 26) occur within the cluster of *U. tumidus* samples. Then we analysed partial matrices using factor and canonical analyses. No taxonomically significant morphometric differentiation was found within groups. On the dendrogram, obtained from Mahalonobis distance matrix, the sample of *U. crassus* makes up a distinct cluster, while the samples of *U. pictorum* and *U. tumidus* mix in one cluster. Furthermore, anterior teeth of *U. pictorum* and *U. tumidus* have a very similar interposition. However, the anterior teeth structure in *U. crassus* is clearly different. *U. pictorum* and *U. tumidus* are very close morphologically; there is a within-group morphometric homogeneity. Consequently, these forms are very close species within the genus *Unio* and should not be regarded as two genera or two subgenera. *U. crassus* may be considered as a subgenus *Crassiana* in the genus *Unio* or a distinct ge-

nus *Crassiana*. Although our results agree with the traditional view on the systematics of this bivalve group, an ultimate decision should be based on a whole set of methods, including genetical techniques.

SHELL THANATOCOENOSES AND MOLLUSC COMMUNITIES IN QUATERNARY DEPOSITS OF POGÓRZE PRZEMYSKIE

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The study area is located in the eastern part of Pogórze Przemyskie, in the San River catchment area. Flood debris was collected in the valleys of Krzeczkowski Potok and Olszanka. The thanatocoenosis included 78 species (over 15,000 specimens). It was dominated by forest and scrub-dwelling species; with a high proportion of euryoecious species. Besides, it included open country, higrophile and aquatic species. A small admixture was formed by snails from older deposits, including characteristic loess species. Subfossil assemblages have been described from the same valley; they occur in Pleistocene and Holocene deposits of the river terrace. The Pleistocene deposits contained two assemblages. One occurred in the floor of the terrace; euryoecious species dominated, with a significant proportion of open country, aquatic and shade-loving taxa, and few higrophile components. The other assemblage was found in slope deposits and loess; it was poor, with mostly euryoecious species, accompanied by meadow species. In the Holocene assemblage the most significant components were forest and scrub-dwelling species, followed by mesophile taxa; open-country, higrophile and aquatic species played a marginal part. The assemblages reflect habitat changes in the deposition environment. The Pleistocene assemblages of fluviatile deposits are characterised by dominance of mesophile, open-country and aquatic species, shade-loving molluscs being also numerous. Loess species are an important component of the assemblage. It indicates a mosaic-like character of the habitats, with open valleys and wooded areas. The assemblage of slope deposits and loess is dominated by mesophiles and species of unshaded habitats. It indicates prevalence of non-forest areas of dry substratum, with herbaceous vegetation. Cooling of the climate in that period brought about disappearance of forest habitats. The Holocene thanatocoenosis contains a considerable proportion of shade-loving species, with admixture of mesophiles and open country species; the assemblage is associated with a mosaic of habitats. The expansion of forest habitats was associated with warming of the climate and increasing humidity. This process was accompanied by reduction of open, xerothermic and steppe habitats. The composition and structure of thanatocoenoses of recent flood debris are close to those found in the Holocene fluvial deposits and indicate a mosaic-like distribution of habitats. Most of the area is shaded, with forest habitats. There are also deforested and cultivated areas, as indicated by the presence of *Cecilioides acicula*.

NEW LOCALITIES OF *STAGNICOLA PALUSTRIS* AND *S. TURRICULA* IN POLAND AND THEIR TAXONOMIC STATUS

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Stagnicola palustris (O.F. Müller, 1774) and *S. turricula* (Held, 1836) are regarded as distinct species, mostly based on their genital structure. Analysis of molecular characters indicated a high similarity, much greater than that between them and other members of *Stagnicola* and *Lymnaea*. Based on this it was proposed to regard them as subspecies of different ranges: *S. palustris palustris* in N. Europe (Sweden, Denmark, The Netherlands, N. Germany, NW. Poland), and *S. palustris turricula* in SE. Europe (S. Germany, Austria, Czech Republic, Hungary, Bulgaria). In Poland, *S. palustris* was recorded from the north-western part of the country, while *S. turricula* would be limited to south-eastern fringes, especially the Bieszczady Mts. Search for specimens for molecular studies confirmed this distribution pattern, but populations were also found outside the mentioned areas. Populations of *S. palustris* were found far to the south (floods of the Nida R. near Kielce, in Busko Zdrój, ponds near Iwonicz Zdrój) and *S. turricula* was found further to the west and north than originally supposed (Odrzykoń, Nysa, Niebieskie Źródła near Tomaszów Mazowiecki). In some sites (Odrzykoń, Niebieskie Źródła) the two taxa occur sympatrically which excludes their subspecific status; it can be suggested that molecular differences, though small, but involving also the newly-found distant populations, combined with anatomical differences, confirm the species status of *S. palustris* and *S. turricula*.

SHELL AS A SYMBOL

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Shells as symbols have a long history. They were symbols of fertility, health, holiness, proof of having accomplished a pilgrimage, and even company logos. The traditions go back to the Palaeolithic. Shells, es-

pecially of cypraeids, because of the likeness of their apertures to female genital organs, symbolised fertility, and probably also permanence of life; perhaps they were also associated with afterlife. This is indicated by numerous finds of cypraeid necklaces in women's graves of that period. Later, during the Halstadt period, cypraeid shells were found in entire Europe, including Poland. They were most often imports from the Red Sea and Indian Ocean. In ancient times, in Greece and Rome, *Cypraea pantherina* was associated with the worship of Aphrodite. It was a charm protecting women against diseases and ensuring successful childbirth. In Egypt in the 1st c. BC, not only shells but also their clay imitations were worn as amulets. The meaning of cypraeid as a health symbol is interwoven with early medieval legends (for example "St. Anthony's pig" (*C. pyrum*), where the legend of curing a pig by the saint was associated with the cypraeid whose aperture resembles pig's head). In India the shell of *Xancus pyrum*, especially sinistral, is till now a symbol of god Vishnu, and reaches exorbitant prices. Shells are also associated with the cult of the goddess of happiness and beauty, Lakshmi. They are among the luck emblems of Buddha, Man-La. An important role was played by shells in the beliefs of Indians. God Quetzalcoatl was born from a snail shell, and his palace was also made of shells. Through ages pectinids were of the greatest significance as symbols. At the decline of ancient Rome, *Pecten* became an immortality symbol. Christianity associated it with the worship of Virgin Mary. The shell was compared to the body, and pearls (which are not produced by pectinids) to immortal soul. In Middle Ages it was a badge of pilgrims and attribute of St. James. Miraculous finding of his grave in Compostella caused the place to become one of the greatest worship centres in Middle Ages, and the destination of pilgrimages from whole Europe. The legend of miraculous recovery of the knight Ampulia, who touched a *Pecten* shell, caused the shell to become the symbol of the saint, but most of all was the proof of accomlished pilgrimage. It was also the emblem of St. Roch, the pilgrims' patron. The *Pecten* shape was very appropriate for an aureole, because of its rounded margin and ray-like ribs. Since Renaissance it appears in painting and statues of saints. It is found in nearly all churches, as an infinite number of varieties, sometimes bearing little resemblance to the original form. *Pecten* appears also as a component of the coats of arms of countries, cities and knights. During rococo, shells lost most of their significance as symbols, but became a popular motif for interiors. Today *Pecten* is the Shell concern logo. The founder of the company, Marcus Samuel, in Victorian times initially dealt in shells brought to London by sailors. When the shell got replaced by petrol, his successors called the first tanker "Murex", and the *Pecten* shell became the company's logo. Shells as symbols have played a significant part in human culture.

REPRODUCTIVE BIOLOGY OF *OPISTHORCHOPHORUS TROSCHELI* (PAASCH, 1842) (GASTROPODA: PROSOBRANCHIA: BITHYNIIDAE) IN THE SOUTH OF THE WESTERN SIBERIA

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In the south of the Western Siberia, in the Novosibirsk region, Bithyniidae are hosts to 38 trematode species, representing 14 families. Observations on the reproductive biology of a bithyniid *Opisthorchophorus troscheli* (Paasch, 1842) were conducted in the Kargat River (basin of Lake Chany, the biggest in the Western Siberia), from May to September, in 1995–2002, and in the laboratory. The reproductive period of *O. troscheli* started in the second decade of June (1995, 1997, 1998, 2002) or at the end of May (1996, 1999, 2000), depending on water temperature which varied between years. It ended in the second decade of July in all years. *O. troscheli* collected in the Kargat R. (n=228) laid on an average 11.9±0.42 egg capsules. Observations of egg-laying were carried out in four control sites every day in 1996. Each day in the third decade of May the number of cocoons laid by *O. troscheli* increased by a factor of 14.3, in the first decade of June – 12.1, in the second decade – 6.3, in the third decade 10.1, in the first decade of July – 9.7, in the second decade – 3.0. In the third decade of July no new cocoons were observed. During one reproductive season a total of 455 cocoons were found, which contained 5,414 egg capsules. In the laboratory 1,215 snails (shell length 5.0–10.4 mm) were kept in 53 aquaria, 3–38 individuals per aquarium. Those that reproduced in the laboratory (n=420) laid on an average 11.2±6.2 egg capsules; the egg-laying started in the first half of June, reached its maximum at the end of June, and ceased in the second decade of July. The number of egg capsules produced per individual was found to decrease from the begining to the end of the reproductive season (maximum: from 55 to 15; mean: from 15.1±10.1 to 8.3±3.9). The duration of the reproductive period of *O. troscheli* in the south of the Western Siberia varied from 40 to 60 days in different years; its end in the second decade of July was probably determined by the photoperiod.

COMPARATIVE MORPHOMETRIC CHARACTERISTICS OF SHELLS OF *DREISSENA POLYMORPHA* (PALL.) IN VARIOUS PERIODS OF THE FUNCTIONING OF THE COOLING SYSTEM OF THE KONIN POWER PLANT

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Dreissena polymorpha was collected in five lakes (since 1970 a part of the power plant's cooling system) of varying hydrodynamic, thermal and trophic conditions, which affected reproduction of the mussels, time spent by larvae in the water column, distribution in the system and growth of settled animals. Morphological changes were estimated based on linear measurements of shells in 1973 and 2004. Distinction between morphotypes was based on ratios (L/H and L/W), considering also age-size structure. In 1973 the mussels from the lakes were similar in their shell height (L/H) in all age-size classes, especially in lakes included in the "long" water circulation (Licheńskie, Ślesińskie, Mikorzyńskie). Rather low shells prevailed there (82.7%). In lakes Pątnowskie and Gosławskie, with age the mussels were found to grow in height more intensely. The L/W ratio in all lakes increased with the age of the mussels. The morphometric structure of the shells in lakes, despite considerable thermal differences (22.5–30.5°C), was similar, with predominance of morphotype hwW (56.7±15.2%) among young and hw (54.5±12.9%) among older individuals. Decrease in size and absence of age-associated shell shape variation were observed in the mussels from lake Ślesińskie, of considerable water turbulence (waterfall discharge). Mussels of hw morphotype constituted 81.5±22.4% in all age classes. In canal Wąsoski (34°C) the mussels were higher, but also wider than in the lakes. The age-related changes in shell shape were similar in the lakes and in the canal. In the canal the mean height coefficient did not change with age (73.4±18.4%). In 2004 the shell shape diversity in all size classes was nearly 2.5 times higher than in 1973. Among individuals 5.5–10.5 mm long, from habitats of different thermal and hydrodynamic conditions, hHw morphotype dominated in 2004 (71.0±7.8% in lakes and 67.0±9.5% in canals). Among older shells dominant morphotypes varied depending on thermal conditions. In the least heated habitats hwW morphotype dominated (38.5–40.5%), followed by hw (33.3%, lake) and hHwW (29.7%, canal). In moderately heated lakes morphometric structure compared to 1973 did not change, though the proportion of the dominant morphotype hw decreased nearly twice (41.7±1.7%). Subdominants were also hwW shells (25.9±9.2%). At higher summer temperatures, irrespective from hydrodynamic conditions, hHwW morphotype (44.0–63.0%) dominated. The situation was similar in lakes of natural thermal conditions – strong summer heating of superficial water layer (to 1.5 m depth) – in lakes Dargin (65.8%) or Inulec (65.9%) and in the Mazurian Lakeland. The results suggest that the growth of shell height and width constitutes a morphological adaptation of the zebra mussel to increased temperatures.

AQUATIC SNAIL FAUNA OF LOCALITIES INCLUDED IN THE AMPHIBIAN BREEDING SITES PROTECTION PROGRAMME IN SILESIAN VOIVODESHIP

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The programme "Protection of amphibian breeding sites in Silesian voivodeship" was launched in 2002 by the "Pro Natura" society and the Natural History Department of the Upper Silesian Museum in Bytom. Its aim is preservation of diverse aquatic habitats; it includes also herpetological, ornithological and floristic studies in 438 sites in Silesian voivodeship. Malacological studies were conducted from June to August 2004 in selected sites. Molluscs were collected from 0.25 m^2 area, in most cases vegetated by emerged plants. Common macrophytes were *Typha latifolia*, *Phragmites australis* and *Glyceria maxima*, they provided substratum to snails. Snail communities were found in 76 sites; the total of 3,372 specimens represented 22 species: *Viviparus contectus, Potamopyrgus antipodarum, Bithynia tentaculata, Acroloxus lacustris, Lymnaea truncatula, L. peregra, L. auricularia, L. corvus, L. stagnalis, Planorbis planorbis, Anisus spirorbis, A. vortex, Bathyomphalus contortus, Gyraulus albus, G. crista, Hippeutis complanatus, Segmentina nitida, Planorbarius corneus, Ferrisia clessiniana, Physa fontinalis, Physella acuta* and *Aplexa hypnorum.* In Silesian Upland 20, and in Silesian Lowland 14 species were found; the number of species in common being 12. The number of species per site was 1–9, and most often 3, and, depending on the substratum: 1–3 species on most of muddy substrata, 2–7 (most often 2) on sandy bottom and 1–6 (most often 4–5) on clay bottom. *P. planorbis* was the most abundant, *B. tentaculata*, *L. corvus*, and *P. fontinalis*, were found only in single sites. *R. auricularia* and *L. stagnalis* were found in numerous sites. The highest constancy (C=30–50%) was that for *R. auricularia*, *L. stagnalis*, *G. albus*, *G. crista* and *P. corneus*. Because of their low relative abundance these species were most often recedents (D=5.1–20.0%) and subrecedents (D<5.0). Dominants (D>40.0%) in most sites were: *P. planorbis*,

P. acuta, *A. vortex* and *F. clessiniana*. The group of most frequently co-occurring species included *R. auricularia*, *L. stagnalis*, *G. albus* and *G. crista* (Ag=15.1–25.0%). Introduced species were found in the following numbers of sites: *P. acuta* – 15, *F. clessiniana* – 11, *P. antipodarum* – 7. Co-occurrence index for *P. acuta* with *P. antipodarum* and *F. clessiniana* was 8% and 7%, respectively. Species diversity index for half of the sites was within 0.51–0.75. Only one site showed a higher diversity (0.84), the remaining ones - lower.

DOUBLE UNIPARENTAL INHERITANCE OF MITOCHONDRIAL DNA IN UNIONIDS

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The quantity of mtDNA in animal cells is ca. 1–2% total DNA. The size of mitochondrial genomes ranges from 13,800 base pairs in nematodes to 2,500,000 in musk melon (16.1 kb in freshwater bivalve *Lampsilis ornata,* 17.1 kb in marine *Mytilus edulis*). As a rule, mtDNA does not contain introns, repetitive DNA, pseudogenes and mobile components. Because of its usually small size, haploid character, diversified sequence of some genes and accumulating neutral mutations, mtDNA is more adequate for evolutionary studies compared to DNA. Besides, it does not undergo recombination and is inherited from the mother in unchanged form, except accidental mutations (SMI – Standard Maternal Inheritance). A different way of inheriting mtDNA is found in marine and freshwater bivalves and is termed double uniparental inheritance (DUI). Two types of mtDNA occur then: F type inherited from the mother, and M type, inherited from the father. Males have both types. A male gets mitochondrial genome of M type, located in the gonads, from his father and transfers it to his sons. His somatic tissues contain F type which he has received from the mother. Though DUI occurs mainly in marine and freshwater bivalves, these groups differ considerably in the details of the process. Differences between F and M types in members of *Mytilus* range from 2% to 21% and evidence for recombination exists. In freshwater species (unionids) the differences are greater (28–34%), at a lower variation compared to *Mytilus*. Contrary to marine bivalves, F and M types in unionids form distinct clades in phylogenetic analyses. It is conjectured that the F and M types in bivalves have been evolving separately for 100 mln years, and DUI in unionids has been in operation for at least 200 mln years.

FOREST ANTHROPOGENIC RESERVOIRS AS HABITATS FOR FRESHWATER SNAILS

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The studies, conducted in 2003–2004, included eight reservoirs near three coal mines: Szczygłowice, Knurów and Makoszowy in Zabrze. The reservoirs are a result of deep-mining of coal, and all are surrounded by a forest. The area is much transformed by industry and mining, with its relief much affected by coal exploitation. Sinkhole ponds are a typical component of the landscape of Silesian Upland. In summer their water level changes considerably, in the warmest months they dry partly or completely; in winter, because of their small depth, they often freeze down to the bottom. The surrounding trees cause accumulation of dead leaves in autumn; in spring the leaves, covered by periphyton and deposit, form a thick layer near the shore and decompose. Snails were collected from leaves in sunny and shaded places, and from macerated remains of *Typha latifolia*, from an area of 0.25 × 0.25 m, and the numbers were then converted to 1 m^2. Plant remains were dried and weighed, and the numbers of specimens were converted to 100 g dry vegetable matter. Fourteen species were found (2–9 per reservoir, mean 6). The number of species found on leaves in shaded places was 0–7 (mean 3.4), in sunny places 2–8 (mean 5.4) and on *Typha* remains 1–7 (mean 4.0). 72.1% snails were collected in sunny places, 19.3% on *Typha* and 8.6% in shady places. The mean density in shaded places was 24 individuals per 100 g dry mass of vegetation (0–76), in sunny places 157 indiv. per 100 g dry mass (3–354), and on *Typha* 85 indiv./100 g dry mass (1–296). The density was significantly, positively correlated with the number of species ($r=0.43$, $n=24$, $p< 0.05$), which indicates a lack of clear dominance of individual species whose abundance would significantly affect the total density of snails.

VALVATIDAE OF UKRAINE

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The heterogeneity of the zoogeographical composition of the valvatid fauna, its qualitative and quantitative development, are associated with a complex structure of relief, climatic differences between natural zones of the district, peculiarities of water regime and with increasing economic activities of man. However, information about the recent Valvatidae of Ukraine is rather scanty. Materials collected in the field and various museum collections (St. Petersburg,

The distribution of Valvatidae in the Ukrainian landscape horizontal zones

Species	Forest	Forest--steppe	Steppe	Carpathian region
B. naticina		+	+	
V. pulchella	+	+		+
V. cristata	+	+		+
V. depressa	+	+		
V. ambigua		+	+	
V. antiqua	+		+	
V. piscinalis	+	+	+	+
V. profunda	+			
V. trochoidea	+		+	
V. klinensis		+	+	

Moscow, Kiev, Lvov) served as a basis for the inventory. In 1964–2004, over 513 samples were taken from various water bodies of Ukraine. Over 4,000 specimens were examined. According to the recent system of European/Asian Valvatidae, the fauna of Ukraine includes 10 species, representing two genera – *Borysthenia* and *Valvata*: *B. naticina* (Menke, 1845), *V. pulchella* Studer, 1820, *V. cristata* O. F. Müller, 1774, *V. depressa* C. Pfeiffer, 1828, *V. ambigua* Westerlund, 1873, *V. antiqua* Sowerby, 1838, *V. piscinalis* (O.F. Müller, 1774), *V. profunda* Clessin, 1887, *V. trochoidea* Menke, 1857 and *V. klinensis* Milachewitch, 1881.

Usually *B. naticina* lives in large and small rivers, and *V. depressa*, *V. ambigua*, *V. piscinalis*, *V. klinensis* produce numerous populations in various kinds of water bodies, namely rivers, creeks, streams, springs, lakes (natural and artificial), ponds, marshes, pools, etc. The density of these snails reaches 100–2,500 indiv.m^{-2}. The species are euryoecious and are often found on humid soil of the shores of the water bodies. As a rule, small permanent water bodies are inhabited by *V. cristata*, and *V. pulchella* is found in temporary pools. All species of *Borysthenia* and *Valvata* are hosts to trematode larval stages (sporocyst, redia, cercaria). Adult stages of these trematodes are parasites of various freshwater fishes. In small rivers and small water bodies the extensity of invasion of the snails is high (up to 95–98%). In large rivers and lakes it is low (0.5–3%). The intensity of invasion is rarely low, more often it is moderate or high.

DISTRIBUTION AND ECOLOGY OF *PSEUDANODONTA* (MOLLUSCA, BIVALVIA, UNIONIDAE) IN UKRAINE

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A decrease in the diversity of malacocoenoses and extinction of some mollusc species have been observed in various regions of Ukraine during the last 15–20 years. Despite these dangerous tendencies, none of the freshwater bivalves is registered in the Red Book of Ukraine, though many unionids are under protection in Poland and Germany. We analysed the distribution, frequency, density and ecology of some unionid populations in Ukraine. The material was collected 1996–2004 in the basins of the rivers Prypyat, mid-Dnieper (right and left tributaries), upper and lower Dniester, Siversky Donets, S. and W. Bug. A total of 434 sites in 17 regions of Ukraine were investigated. Materials from the collection of the National Scientific Museum of Nature of NASU (Kiev) and the State Natural History Museum (Lviv) were also examined. The most endangered unionid species in Ukraine are members of the genus *Pseudanodonta* Bourguignat, 1876 – three species according to taxonomists of the former USSR, or one species – *Anodonta (Pseudanodonta) complanata* Rossmässler, 1835 – according to the European system. *Pseudanodonta* shows a mosaic distribution and low population density. During our studies, it was found only in 34 sites. The density and biomass of most populations were low, 0.1–0.6 indiv.m^{-2} and 8.7–16.4 gm^{-2}. The density amounted to 2–10 indiv.m^{-2} in some woodland rivers of the Prypyat (Zhytomyr region), Siversky Donets (Kharkiv region), and Dniester (Odessa and Lviv regions) basins. In 14 sites in the regions of Lviv, Ternopil, Rivne, Zhytomyr, Cherkasy, Zaporizhzhya, Sumy, Kharkiv, Vinnycya, Mykolayiv and Odessa, only 1–2 specimens were found. The collection of National Scientific Museum of Nature includes 14 samples of *Pseudanodonta* (mostly 1–2 specimens) collected in the Kharkiv, Volyn, Vinnytsa and Zhytomyr regions. In the State Natural History Museum the collection contains 6 samples (mostly 1–3 specimens) from the Lviv and Ternopil regions, collected and identified by J. Bąkowski as *Anodonta complanata* and *A. mutabilis* var. *anatina*. *Pseudanodonta* was found in rivers with oxygen content of 6–13.6 mgl^{-1}, carbon dioxide content 4–52 mgl^{-1}, and stream velocity 0.5–1 msec^{-1}, on sandy, sandy-gravelly, or sandy-muddy bottom. It prefers neutral-alkaline waters but sometimes lives in slightly acid waters of small rivers of bog origin in the northern region, with pH = 6.5–6.8. It lives in habitats of varied content of salts. The results suggest that *Pseudanodonta* in Ukraine is endangered, and should

be included in the new edition of the Red Book of Ukraine. In our opinion, one of the reasons for its rarity is its preference for clean water with high oxygen; such rivers are becoming increasingly fewer. Also, the absolute fertility (number of glochidia in the two outer demibranchs) of *Pseudanodonta* is within 21,600–38,100 and thus much lower than in other unionids.

THE PROJECT INVASIVE MOLLUSC SPECIES IN INLAND WATERS OF POLAND

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In 2004 the Institute of Nature Conservation, Polish Academy of Sciences, Cracow, started a three-year project "Alien invasive species in the fauna of Poland in the context of biodiversity protection". Groups of zoologists-ecologists from various scientific institutions are involved in it. The results will be published as a synthetic monograph and a series of papers by individual authors. Practical conclusions and methodological suggestions for preventive actions aimed at stopping new introductions or at decreasing the negative effects of already introduced species will be formulated. The project is a part of the package of projects on alien and invasive species, integrated with a co-project of the Botanical Institute, PAS, Cracow. The team dealing with invasive molluscs of inland waters includes: ANNA STAŃCZYKOWSKA, KRZYSZTOF LEWANDOWSKI (Podlasie Academy), MAŁGORZATA STRZELEC (Silesian University) and ANDRZEJ KOŁODZIEJCZYK (Warsaw University). The aim of our studies is an inventory of nine invasive aquatic mollusc species (*Dreissena polymorpha, Sinanodonta woodiana, Corbicula fluminea, Lithoglyphus naticoides, Potamopyrgus antipodarum, Physella acuta, Ferrissia clessiniana, Menetus dilatatus* and *Melanoides tuberculatus*) based on our own studies and literature data. We will also analyse relations between invasive and native species, and the effect of invasive species on biodiversity in aquatic ecosystems. In 2004 one paper was published within the grant (receding of *L. naticoides* in some habitats), two papers were presented at conferences and one paper was prepared to print (occurrence of *D. polymorpha* in the volume "Zebra Mussels in Europe"); materials were collected in the Mazurian Great Lakes and anthropogenic reservoirs of Upper Silesia. The project is financed by the State Committee for Scientific Research, grant no. 2P04G07626p01

ALIEN FRESHWATER SNAIL SPECIES IN INDUSTRIAL RESERVOIRS

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In strongly transformed and often degraded industrial areas of S. Poland (Upper Silesia and adjacent areas), as a result of mining, many anthropogenic reservoirs have arisen while natural water bodies are absent. Within the last thirty years three alien snail species appeared in such habitats; as a result of intense expansion they invaded considerable areas within a short time. Malacological studies which started in 1974, including area of ca. 20,000 km^2, show that *Physa acuta* (Drap.) appeared in early 1970s, *Potamopyrgus antipodarum* (Gray) in the first half of the 1980s, and *Ferrissia clessiniana* (Jickeli) in the second half of the 1980s. During the expansion *Ph. acuta* invaded over 15,000 km^2, *P. antipodarum* ca. 7,000 km^2, while there is still too little information on the range of *F. clessiniana*. In all three cases the invasion proceeded from north-west to south-east, and affected only areas below 500 m a.s.l. Among ca. 500 stagnant and running waters studied, *Ph. acuta* was found in 68, and *P. antipodarum* in 113; the former species occurred most frequently in rivers, mining reservoirs and dam lakes, the latter – in mining reservoirs and sinkhole ponds. The species differed in the rate of formation of large populations in the invaded habitats. The maximum density of *P. antipodarum* was 10,000 indiv.m^{-2}, while *Ph. acuta* never exceeded 270 indiv.m^{-2}. An interesting phenomenon is alternating dominance of these two species: the higher is the relative abundance of *P. antipodarum,* the lower the proportion of *Ph. acuta*. The latter species does not seem to contribute to disappearance of native species from malacocoenoses, which is a rule after invasion by *P. antipodarum*.

LIFE CYCLE OF *VESTIA GULO* (E.A. BIELZ, 1859) (PULMONATA: CLAUSILIIDAE) IN THE LABORATORY

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Life history of *Vestia gulo* (E.A. Bielz, 1859) has not been studied before. It is a Carpathian species, occurring also in Transylvania, and in Poland it is common in humid mountain forests in the Carpathians except the Tatra Mts. Snails for the laboratory culture were collected in the Dunajec R. valley in the Pieniny Mts. One, two, three or four adult individuals (n=140) were placed in containers, eggs (n=1,657), and then young

were counted; eggs and juvenile shell height were measured. Juveniles collected in the field (n=44) were also kept and their shells measured. *Vestia gulo* lays eggs in batches (usually 8–14 eggs, maximum 19); during one season the snail lays 1–3 batches, with a total of up to 27 eggs. The peak of egg-laying activity falls in May, first eggs appear at the end of March (when adults are kept at room temperature), the last eggs were observed in October. The eggs are oval-sphaerical (mean size 1.84 × 1.67 mm), gelatinous, with fine calcium carbonate crystals on the surface. Juveniles hatch in ca. 10 days; they grow fast in spring and summer, reaching the mean size of 7.52 mm (SD 1.43 mm) at the end of the vegetation season. In their next year the growth rate increases again and some snails within 10 months from hatching have fully formed apertural barriers and terminate growth (the shells reach 16–19 mm in height). A characteristic feature is a very rapid shell growth during formation of closing apparatus, i.e. at subadult stage (mean shell height increment ca. 7 mm per month). The results contradict the opinion that the subgenus *Vestia* s. str. is typically ovoviviparous. Its life cycle is probably significantly different from that of ovoviviparous *Vestia elata*.

VARIATION OF *VIVIPARUS DILUVIANUS* FROM ORTEL KRÓLEWSKI AND CLIMATIC CONDITIONS IN THE MASOVIAN INTERGLACIAL

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Viviparus diluvianus (Kunth) was found in lacustrine deposits in Ortel Królewski near Biała Podlaska; biometrical analysis included five samples taken every 0.5 m along the profile. A total of 1,750 shells were measured (shell height and width, body whorl height, aperture height). The shells were found to vary along the profile: toward the top of the profile they became more slender, while their body whorl height and relative aperture height decreased. The results were correlated with climatic changes based on palynological analysis. Four palynological levels were distinguished in Ortel Królewski. The sample from the depth of 2.5 m represented *Picea-Alnus* level of the Masovian interglacial, the next three (2 m, 1.5 m, 1 m) come from the *Taxus* level. The sample from the topmost (0.5 m) layer corresponds to the initial stage of the so called intra-interglacial cooling. Shells of *V. diluvianus* from the relatively cool level of *Picea-Alnus* show a smaller mean height and are less slender compared to the yew level which corresponds to increasingly oceanic character of the climate. The increase in temperature and humidity favoured the species and increase in its abundance. In better climatic conditons the relative abundance of *V. diluvianus* increases and the snails reach larger size. Larger specimens are more slender than smaller ones and have relatively lower body whorl and smaller aperture. Decrease in population abundance in the sample from 0.5 m is probably a result of disappearance of the oceanic climatic effect and continentalisation.

INVENTORY AND ZOOGEOGRAPHY OF PLANORBINE SNAILS OF THE DNIESTER BASIN

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The Dniester River (1,362 km long, basin area 72,100 km^2) begins on the NE. slopes of the Carpathians, and flows to the south-west where it falls into the Black Sea through of the Dniester liman. Water bodies in the upper section of the river valley are located in different landscapes: mountains, foothills and plain. We investigated species composition of Planorbinae in various water bodies of the upper, mid and lower sections of the Dniester basin. The material was collected in 2003–2004. The malacofauna of the Dniester includes 17 planorbine species: *Planorbis planorbis* (Linné, 1758), *Anisus vortex* (Linné, 1758), *A. vorticulus* (Troschel, 1834), *A. contortus* (Linné, 1758), *A. spirorbis* (Linné, 1758), *A. leucostoma* (Millet, 1813), *A. septemgyratus* (Rossmässler, 1835), *A. albus* (O. F. Müller, 1774), *A. acronicus* (Férussac, 1807), *A. laevis* (Alder, 1838), *Armiger crista* (Linné, 1758), *A. bielzi* (Kimakowicz, 1884), *Choanomphalus riparius* (Westerlund, 1865), *Ch. rossmaessleri* (A. Schmidt, 1851), *Segmentina nitida* (O. F. Müller, 1774), *S. clessini* (Westerlund, 1873) and *Hippeutis fontana* (Lightfoot, 1786). The most numerous species are found in the plain zone of the upper section and in the mid section of the Dniester – 17 species in each; the species are slightly fewer in the lower section of the Dniester (14) and in the foothill zone (12), the least numerous in the mountain zone (5) and in the Dniester liman (1). The most widespread species are *P. planorbis* (frequency 30%), *A. leucostoma* (17%) in the mountain zone, *P. planorbis* (54%), *A. albus* (26%), *A. septemgyratus* (22%) in the foothill zone, *P. planorbis* (35%), *A. albus* (18%), *S. nitida* (18%) in the plain zone of the upper section, *P. planorbis* (47%), *A. spirorbis* (25%), *S. nitida* (25%) in the mid section of the river, *P. planorbis* (65%), *A. spirorbis* (25%), *A. septemgyratus* (22%) in the lower Dniester. The planorbine fauna is zoogeographically heterogeneous: European and Euro-Siberian groups include six species each, Palearctic and European-W. Siberian – two each, Holarctic group is represented by one species. Species of the Euro-Siberian group constitute a majority in the mountain and foothill zones of the upper section, and in the lower section. Members of the European and Euro-Siberian groups form a ma-

jority in the plain zone of the upper section and in the Middle Dniester basin.

TREMATODE INFECTIONS IN *LYMNAEA PALUSTRIS* FROM CHANY LAKE IN WESTERN SIBERIA

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Infection of *Lymnaea palustris* with trematode larvae was studied annually in 1980–2004 (excluding 1991 and 2001) in Lake Chany, in the south of Western Siberia, Russia. 38.2% of 5,244 snails were found to be infected with trematodes. The prevalence varied between years, from 10.9 to 64.6%. The total number of species of cercariae recorded per sample of hosts varied from 1 to 7; the annual snail sample size varied from 44 to 365. The mean size of infected snails was 19.11±0.08 mm (11–36 mm). *Lymnaea palustris* was the first intermediate host for 14 trematode species of 6 families: *Echinostoma revolutum* (Fröhlich, 1802), *E. grandis* Bashkirova, 1946, *E. uralensis* Skrjabin, 1915, *Echinoparyphium aconiatum* Dietz, 1909, *E. recurvatum* (Linstow, 1873), *Moliniella anceps* (Molin, 1859), *Hypoderaeum cubanicum* (Artyuch, 1958) (Echinostomatidae Dietz, 1909); *Diplostomum* sp. (Diplostomatidae Poirier, 1886); *Cotylurus* sp. (Strigeidae Railliet, 1919); *Notocotylus* sp. (Notocotylidae Luhe, 1909); *Trichobilharzia* sp. (Schistosomatidae Looss, 1809); *Plagiorchis elegans* (Rudolphi, 1802) Braun, 1902; *Plagiorchis* sp., *Opistioglyphe ranae* (Fröhlich, 1791) (Plagiorchidae Ward, 1917). Although no special attention was paid to mixed infections, we observed such infections in 14 snails. Plagiorchid cercariae (6 snails) were found combined with *E. grandis, E. aconiatum, Cotylurus* sp. and *Diplostomum* sp. Eight snails was found to contain cercariae of *Plagiorchis* and *Opistioglyphe*. Plagiorchid cercariae were the most common in *L. palustris* (95.7% yearly samples). The prevalence varied between years, from 9.1 to 97.5%. Two species (*E. aconiatum* and *M. anceps*) were recorded in more than half of the yearly samples. The prevalence of *E. aconiatum* varied from 0.5 to 24.1%, that of *M. anceps* between 4.3 and 32.7%. Four species (*E. revolutum*, *E. recurvatum*, *Diplostomum* sp. and *Cotylurus* sp.) were recorded in less than 1/3 yearly samples (30.4, 13.0, 21.7, 34.8%, respectively). The prevalence of *E. revolutum* varied from 0.7 to 12.5%, in *E. recurvatum* from 0.7 to 3.4%, in *Diplostomum* sp. from 0.4 to 22.4%, in *Cotylurus* sp. from 0.4 to 14.3%. The remaining species (*E. uralensis*, *H. cubanicum, Notocotylus* sp. and *Trichobilharzia* sp.) were recorded sporadically (in 1, 1, 3 and 1 years respectively), with the prevalence from 0.4 to 4.3%.

SPHAERIIDS (BIVALVIA, HETERODONTA) OF THE GAĆ RIVER

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Sphaeriids – speciose and difficult to identify – of Poland are still insufficiently known. The Pilica River basin, with its fragments of natural forests and mostly pure and unregulated water courses, is among the least studied areas. Sphaeriids were collected in the Gać R., which flows through the buffer zone of the Spała Landscape Park, and joins the Pilica in Spała. The main purpose of the studies was the inventory of sphaeriids, and ascertaining their abundance, community structure and habitat preferences. The clams were collected on a 5 km section of the river from the reservoir "Szczurek" to the reservoir "Konewka". Six sites were selected, considering habitat diversity with respect to bottom deposits, shadiness, current velocity etc. Samples were taken every month during half a year. Thirteen species were recorded: *Sphaerium corneum, Pisidium amnicum, P. casertanum, P. globulare, P. henslowanum, P. hibernicum, P. milium, P. moitessierianum, P. nitidum, P. subtruncatum, P. supinum, P. tenuilineatum, P. ponderosum*. A total of 3,015 specimens were collected. The dominant was *P. supinum*, the least abundant species were *P. globulare, P. casertanum, P. ponderosum, P. moitessierianum* and *P. tenuilineatum*. The most frequent species, found in 30 quantitative samples (out of the total of 36) was *P. henslowanum*. The least frequent were *P. globulare* and *P. ponderosum*. The most numerous species were found on sandy substratum, the fewest – on muddy bottom. *P. henslowanum* and *P. subtruncatum* were frequent in the communities of the river, and clearly co-occurred. Another two species, which were rare, *P. hibernicum* and P. *milium*, also showed a clear tendency to co-occur, which indicates their similar habitat requirements.

UNIONIDS OF THE ODRA RIVER ESTUARY

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The aim of the study was to assess the species composition, abundance and population structure (metric characters of shells, age and sex ratio) of unionids in the Odra estuary. Unionids were collected in summer 2002 in shallow zone of the estuary, in 11 sites located in its various parts, which were under the effect of both sea- and freshwater, and of different depth and substratum. Shell measurements included shell length (L), shell height (H), shell ala height (HS), shell convexity (W); the following ratios were calcu-

lated: L/H, L/HS i L/W. Four species were found: *Unio tumidus, U. pictorum, Anodonta anatina* and *Pseudoanodonta complanata*. Their relative abundance varied between sites, with respect to both live individuals and dead shells. *A. anatina* showed the highest density of live (44 indiv. m^{-2}), and dead (27 shells m^{-2}) individuals; it occurred in nearly all sites. Live *U. tumidus* and *U. pictorum* were found in much fewer sites (6 and 7, respectively) and their abundance was low (maximum 16 indiv. m^{-2} and 6 indiv. m^{-2}, respectively). The number of dead shells was proportional to that of live bivalves. *P. complanata* was very rare; live individuals were found only in two sites, at a low density (max. 3 indiv. m^{-2}). Dead shells were found in three sites, also in low numbers. Biometrical analysis included only sites with sufficient numbers of live and dead specimens (for *U. pictorum* only live specimens were considered). The size ranges were the following: *A. anatina*: L 31.7–96.1 mm; H 15.7–51.3 mm; HS 18.0–56.6 mm, W 6.4–33.8 mm. The age ranged from 1 to 8 years. The highest mortality was that of individuals aged 3-5 years; females were more numerous than males. *U. tumidus*: L 16.2–91.7 mm; H 8.1–50.2 mm, HS 7.8–48.8 mm; W 3.4–35.4 mm. The bivalves were aged 0-7 years, with the highest mortality at the age of 3–5 years. Males were more numerous than females. *U. pictorum*: L 30.86–91.3 mm; H 13.34–47.18 mm; HS 12.61–43.46; W 10.64–36.01 mm. The bivalves were aged 1-6 years, with the highest mortality at 3–4 years. Males were more numerous than females. Males and females of individual species were biometrically analysed with respect to their ratios of metric characters to body length; variance analysis (ANOVA) (sites and sex) showed significant differences between sites, and the absence of significant differences between sexes.

HEAVY METAL CONTENT IN WATER, BOTTOM DEPOSITS AND SHELLS OF *DREISSENA POLYMORPHA* (PALLAS) (MOLLUSCA, BIVALVIA) OF SELECTED ANTHROPOGENIC RESERVOIRS IN POZNAŃ

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Content of copper (Cu), zinc (Zn), lead (Pb) and cadmium (Cd) was measured in shells of *Dreissena polymorpha* (Pallas) from two artificial reservoirs in Poznań: a dam lake Rusałka on the stream Bogdanka and Staw Rozlany – a clay pit in the valley of the stream Junikowski, and compared with the metals in the water and bottom deposits. The metal content was measured with atomic absorption method (AAS) after mineralisation of samples with nitric acid (HNO_3) and hydrogen peroxide (H_2O_2). The content of Cu, Zn and Pb in the water corresponded to quality class I in both reservoirs, like Cd in Staw Rozlany, while in lake Rusałka Cd content in the water exceeded that for quality class I. Bottom deposits in lake Rusałka contained 62× more Cu and 53× more Zn than the water; no Pb was detected, and Cd content was equal to that in the water. Much higher concentrations of heavy metals were found in the bottom deposits of Staw Rozlany; they contained 394× more Cu, 2,097× more Zn, 938× more Pb and 250× more Cd than the water. In shells of *D. polymorpha* from lake Rusałka Cu content was 1,437× higher than in the water, Zn – 144× higher, Pb – 82× higher, and Cd – 414× higher; shells from Staw Rozlany contained 381× more Cu than water, 338× more Zn, 994× more Pb and 660× more Cd. Shells from the second reservoir contained less Cu, and the content of the remaining metals was higher. Shells and bottom deposits from lake Rusałka contained more heavy metals. Shells from Staw Rozlany contained more Cd than bottom deposits; Cu and Pb occurred at similar concentrations in shells and deposits, and Zn concentration in shells was lower than in the deposits.

COMPARISON OF SHELL PARAMETERS OF *HELICELLA OBVIA* MENKE FROM POLAND AND RHODOS

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Snails for biometrical analysis were collected in the following sites: near nature reserve Skowronno near Pińczów (50°31'N, 20°32'E) (open, insolated site); near Osowiec, district Mońki (53°28'N, 22°40'E) (xerothermic, insolated site); W. coast of Rhodos Island, near Kremasti (36°15'N, 28°10'E) (mediterranean climate, site with stony soil and sparse vegetation). Twenty adult shells from each site were measured for the following parameters: width of embryonic shell, shell increment from hatching to collecting, shell height and width, aperture height. Kruskal-Wallis ANOVA and Mann-Whitney U test were used; the level of significance was $p<0.5$. No statistically significant differences were found in the width of embryonic shell between the Polish and the Greek sites. Shells from Rhodos were larger than those from the two Polish sites, and the height/width ratio was higher in the shells from Rhodos which reflects their more elevated shape. The results suggest that the growth conditions for *H. obvia* are more favourable on Rhodos; this is also indicated by the larger values of shell increment from the moment of hatching.

STRATIGRAPHIC CHANGES OF HOLOCENE MALACOFAUNA IN THE DEPOSITS OF BRAMA ŚWINY AND ITS BIOMETRICAL VARIATION

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The objective of the studies was to assess stratigraphic diversity of lithofacies and biofacies accumulated in the Brama Świny in various sedimentation environments during the Holocene. The area of Brama Świny is a depression between the Pleistocene moraines of the islands Uznam and Wolin. It consists of two sand bars originated as a result of fluvial, marine and eolic material accumulation. The two sand bars (Karsiborska in the west and Przytorska in the east) are separated by the Świna strait and an artificial Piastowski canal, which are the most important way of discharge of the Odra R. and the Gulf of Szczecin to the Baltic. The material for lithological and malacological studies was taken from two cores, one in the southern part of Mierzeja Karsiborska (core no. 526), another in the eastern part of the Karsibór island (core no. 529). Core no. 526, 14 m long, was slightly diversified lithologically, since the material was composed mostly of fine-grain and very fine-grain sand. The sandy deposits contained abundant subfossil shells, representing taxa of two environments: freshwater and brackish-marine. Freshwater species included only rheophilic *Teodoxus fluviatilis* and opercula of *Bithynia tentaculata*. Brackish-marine taxa were more abundant (99.9% material), and included snails: *Hydrobia ventrosa*, *H. ulvae*, *Littorina littorea* and bivalves *Cardium glaucum*, *Mytilus edulis* and *Macoma balthica*. Core no. 529, 16.5 m long, also contained abundant malacofauna which occurred in sandy deposits in places intercalated with silt. Brackish-marine species dominated (95.3%), with qualitative composition like in core no. 526, except a single specimen of *Cerastobyssum hauniense*. Freshwater molluscs, though constituting a minority, were more diverse. Out of 15 taxa, the most abundant was *B. tentaculata*, (33.68%) unionids (46.31%) and sphaeriids (8.95%). Specimens of terrestrial hygrophile snails – *Succinea* – were also found. Based on lithological material and subfossil molluscs, several series of deposits were distinguished, which originated in various sedimentation environments. In core 526/03 they were fluvial deposits (bottom); deposits of shallow and possibly periodical freshwater body; brackish-marine deposits and beach deposits. Core 529/03 contained fluvial, brackish-marine, shallow marine and estuary deposits. In order to determine palaeohaline conditions shells of *Cardium glaucum* were subject to biometrical analysis (length, width and thickness).

RESOURCES OF *DREISSENA POLYMORPHA* PALL. IN THE ODRA RIVER ESTUARY – PRESENT STATE

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The main water bodies constituting the Odra estuary were always characterised by a high biological productivity. The zebra mussel is a very important benthos component, and the main component of biofilter of the estuary. The first comprehensive studies on the zebra mussel in the Odra estuary were conducted in the 1950s, with the resources estimated at ca. 80,000 to 110,000 t. The population was theoretically capable of filtering the whole water of the Gulf in 36 days, and the filtration rate was twice higher than the mean flow of the waters in the Odra. In the 1980s information appeared on a significant decrease in the population of the zebra mussel in the Gulf of Szczecin. In the 1990s symptoms suggesting another population increase were observed, which encouraged us to undertake this study. In three years we accumulated data sufficient to estimate the resources of the zebra mussel in the Odra estuary. They will provide a basis to assess the effect of its biofiltration on the quality of the estuary waters. In the present study, the zebra mussel resources in the estuary (ca. 600 km^2) were estimated at ca. 146,000 t. In the Polish part of the main basin of the Gulf of Szczecin (Zalew Wielki – ca. 360 km^2) it is ca. 60,000 t, the mean biomass being 152 gm^{-2}. In that area the zebra mussel is the most abundant at 3.5–5 m depth (mean biomass 333 gm^{-2}, maximum 3,800 gm^{-2}). Outside the main basin of the Gulf, considerable numbers of the mussel are found in other water bodies which, because of their position, are of no great significance for the functioning of the estuary ecosystem (lake Dąbie and Roztoka Odrzańska). In lake Dąbie the zebra mussel is the most abundant at the depth of 2–3 m (mean biomass 1,130 gm^{-2}, maximum 4,500 gm^{-2}). In Roztoka Odrzańska the corresponding values are 2–4 m, 522 gm^{-2}. The total resources of the mussel in the two water bodies are 46,000 t, which provides an efficient biofiltration of the Odra waters before their joining the Gulf of Szczecin. In the Skoszewska bay (20 km^2), on the eastern shore of the Gulf of Szczecin, the resources of the zebra mussel are 22,000 t; the mussels are the most abundant at the depth of 2–4 m, the mean biomass being 1,800 gm^{-2}, the maximum 8,700 gm^{-2}. The results indicate an increase in the zebra mussel resources in the estuary; a significant effect on the estuary ecosystem and the adjcent waters of the Baltic can be expected.

SPATIAL DISTRIBUTION OF CILIATES (CILIOPHORA: CONCHOPHTHIRIDAE) IN THE MANTLE CAVITY OF UNIONIDS (BIVALVIA: UNIONIDAE)

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The distribution of ciliates of the genus *Conchophthirus* (Ciliophora: Conchophthiridae) in the mantle cavity of *Anodonta piscinalis* Nilss. (Bivalvia: Unionidae) was investigated. Smears were made from different sites of mantle cavity for detection and determination of ciliates. The area of the cavity, from which each smear was made, was 1–1.5 cm². The following sites in the mantle cavity were selected for monitoring: 1) labial palps, 2) foot, 3) outer demibranch (gill surface), 4) area of siphons. Preparations were impregnated using Klein method. The relative number of ciliates (number of ciliates on a smear/total number of ciliates on 4 smears) was used in the data analysis, since it is difficult to precisely determine the surface area of the studied monitoring sites in the mantle cavity. The similarity indicates heterogeneous distribution of *Conchophthirus* in the mantle cavity. The maximum relative number of ciliates was found on the surface of labial palps; the values for the siphons were lower, and for the outer demibranch – the lowest. The relative numbers of ciliates were found to be mutually negatively correlated: the number on the labial palps and on the foot (r=–0.71), on the labial palps and the siphons (r=–0.70), on the siphons and the outer demibranch (r=–0.60). There were differences between the sites in the mantle cavity in the species composition of ciliates: the proportion of *C. unionis* Raabe was higher on the labial palps, and of *C. curtus* (Engelmann) – in the area of the siphons. A negative correlation (r=–0.73) between the presence of ciliates of the above-mentioned species in different areas of the mantle cavity was also observed. Probably, trophic relations of ciliates determine their distribution in the mantle cavity. Ciliates of the genus *Conchophthirus* are incapable of using fragments of seston directly in nutrition, and the main food source for them are bacteria intensely developing on agglutinates. It can be hypothesised that the longer time seston particles spend in the mantle cavity, the more high-energy they become due to the activity of bacteria. This would explain the high number of ciliates on the labial palps and the foot. The negative correlation between the number of ciliates on the labial palps and the foot can be explained by the circulation of alimentary, pseudo-faecal and faecal masses in the mantle cavity. The rather low number of ciliates in the siphons area can be explained by the vigorous water circulation in this area and the risk of removal of ciliates from the cavity. This is also confirmed by the dominance of *C. curtus*, with better developed trophic apparatus in comparison with *C. unionis*, in the area of siphons.

SIGNIFICANCE OF THE EUROPEAN NETWORK NATURA FOR MOLLUSC CONSERVATION IN POLAND

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Natura 2000 is a system of areas ensuring conservation of habitats and species which are significant for European nature. The legal basis for selecting the areas is the Habitats Directive (92/43/EWG) on conservation of natural habitats, wild fauna and flora. The system includes objects which meet requirements uniform throughout the European Union, described in Annex III to the Directive. The areas are selected for habitats mentioned in Annex I of the Habitats Directive, and plant and animal species listed in Annex II. The species have been selected in such a way that their conservation would result in conservation of many other taxa associated with the same type of habitat. Among members of the Polish malacofauna there are: *Anisus vorticulus*, *Vertigo angustior*, *V. genesii*, *V. moulinsiana*, *Margaritifera margaritifera* and *Unio crassus*. All of them are under strict protection in Poland, placed on the Red List (except *V. genesii*). In areas aimed at protection of species from Annex II maintaining preservation of species "proper state of conservation" which means that their population will not decrease, nor the state of the habitat will deteriorate. The Polish government submitted to the European Commission a list of 184 areas, some of them primarily dedicated to mollusc conservation. The number of such areas is 18, and further 10, selected for other reasons, harbour populations of these species. No areas are concerned with *M. margaritifera* and *V. genesii* – since the former species is regarded as extinct in Poland, and the occurrence of the latter in its only alleged locality has not been confirmed. Out of 20 localities of *V. angustior* in Poland, three are included in the system Natura 2000 as areas aimed at protection of the habitat of the species; further three harbour the species but are not indicated as important for its conservation. The remaining localities of *V. angustior* are not included in Natura 2000. One of the localities of *V. moulinsiana* is included in the system, another two are within areas selected for other species. Among molluscs, the most numerous areas (10) were selected for *U. crassus*. The bivalve occurs also in four objects selected for other reasons. Despite this, less than 10% of the Polish population are included in the system. The proposal of the Natura 2000 network is supplemented with the so called "Shadow List" – a list of areas that meet the requirements, prepared by non-government organisa-

tions; they regard the government list for Natura 2000 as adequate except *A. vorticulus*, for which two additional areas, besides the four proposed by the government, are included. The system Natura 2000 aids the nature conservation system which is in operation in Poland. Till present, threats to many mollusc species in Poland have been recognised; 129 out of over 270 species have been placed on Red List, and 38 are legally protected. One nature reserve has been established specifically to protect terrestrial molluscs. However, the importance of Natura 2000 for protection of molluscs from the annexes of the Habitats Directive may prove considerable, since it is necessary to prepare a protection plan for each of the areas, to execute it in order to prevent population or habitat deterioration, to monitor the locality and to prepare reports for Natura 2000.

SHELL DISTORSIONS IN *LYMNAEA STAGNALIS* NATURALLY INFECTED WITH LARVAE OF DIGENETIC TREMATODES

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Individuals of *Lymnaea stagnalis* are phenotypically much variable; mainly shell shape is involved. It ranges from slender ovate with a high spire, to low-spired with a much distended body whorl. The reasons for such variation were sought in the effect of habitat factors on the phenotype. Parasites, and especially larvae of digenetic trematodes for which the snails are obligatory intermediate hosts, are among important habitat factors. Interactions between snails and parasitic larvae may last for over a year, usually till death of the host. The main aim of this study was to compare shell parameters (shell height, spire height, shell width, ratios shell height/shell width, shell height/spire height, spire height/shell width) of *L. stagnalis* from 25 water bodies in central Poland. The snails were classified according to their place of origin and species of parasitic larvae found in them. The snails were found to vary individually; also interpopulation differences were observed; trematode-infected groups varied more compared to uninfected snails. Snails infected with *Echinoparyphium aconiatum, Echinostoma revolutum*, *Diplostomum pseudospathaceum* and *Opisthioglyphe ranae* differed in their shell shape from uninfected individuals. Snails infected with *Plagiorchis elegans* had shells similar to uninfected individuals. Likewise, snails with an oligochaete *Chaetogaster limnei* did not differ in their shape from uninfected snails. The results indicate that trematode larvae contribute to phenotypic variation of *L. stagnalis*.